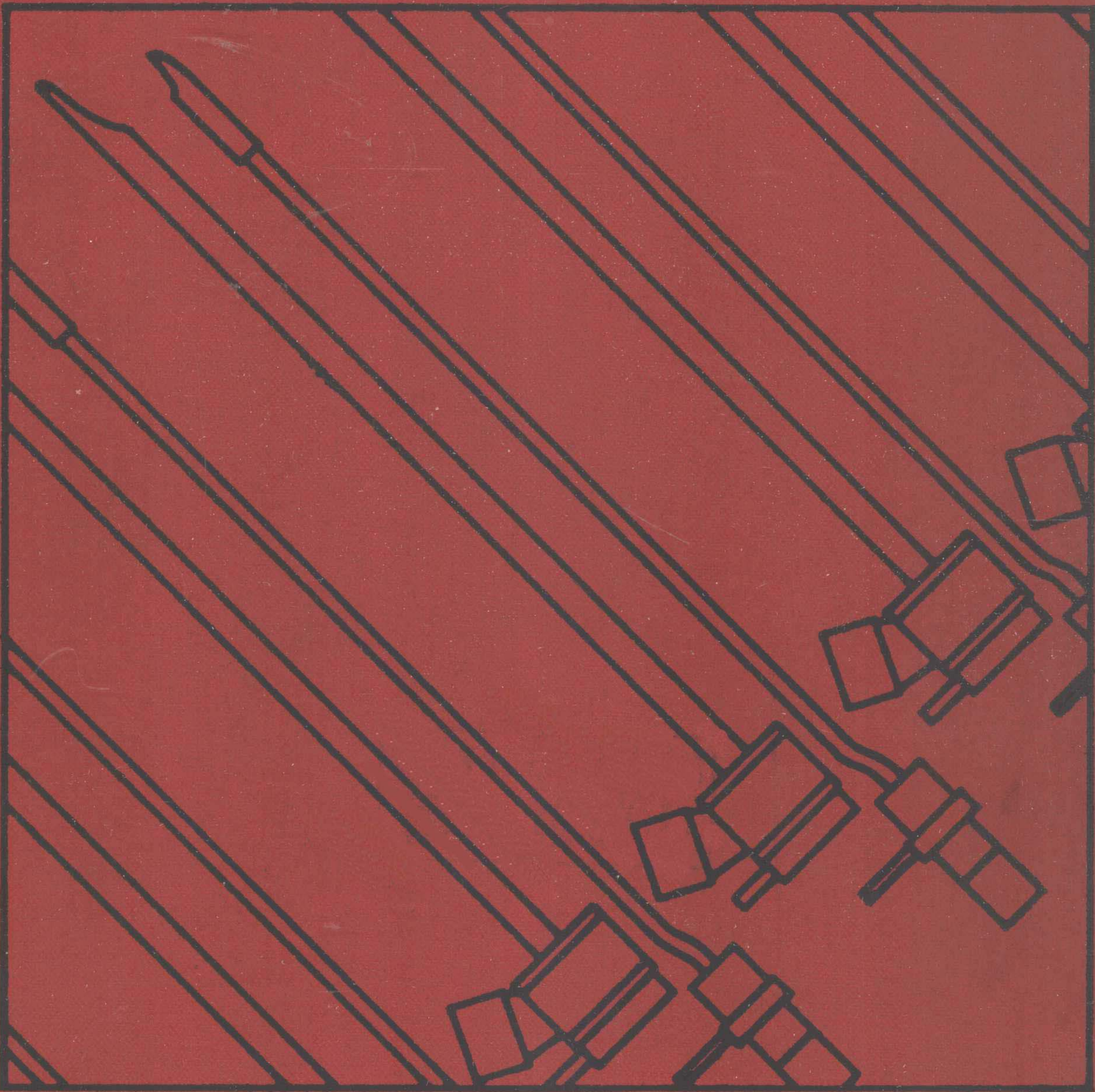
HANDBOOK OF UROLOGICAL ENDOSCOPY

J. G. GOW & H. H. HOPKINS



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Handbook of Urological Endoscopy

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Preface

Recent development in optics and in the design of optical systems and light sources have now advanced the practice of urological endoscopy to a state where it can fulfil a primary role in diagnostic urology. The success of urological practice depends on the surgeon's investigative power as well as his clinical acumen. Modern endoscopy provides this basis of clear and accurate clinical information.

This book is, therefore, addressed to young urologists who are embarking on a career in this discipline, and who will find that a high proportion of their work involves endoscopy. It is not intended as a comprehensive account of all urological conditions, but does attempt to demonstrate the common lesions most frequently encountered in urological practice as well as the importance of endoscopy in their appraisal.

The book should also be of value to general surgeons with an interest in urology, a group that is likely to continue in the United Kingdom until more specialised units are formed.

The first chapter on the history of urology has been written by Mr David Wallace, and we are most grateful to him for such an outstanding introduction. We are also grateful to Dr Gordon England for his chapter describing a new technique for the production of sterile pyrogen-free water for use in endoscopic procedures. After Mr Wallace's introduction, the next six chapters are devoted to descriptions of the technical aspects of urological endoscopy. The remainder of the book takes the form of a colour atlas of endoscopic photographs of various urological conditions with brief textual descriptions. We have kept the text to a minimum and have omitted all but the most important references.

It is to be hoped that this book will reflect in some small way the concern and enthusiasm engendered by the harmonious co-operation of the two authors engaged for nearly twenty years in furthering the development of techniques in which there has been mutual fascination and interest.

1978

J.G.G
H.H.H

Acknowledgements

The two authors have long believed that the advances made in modern optical techniques, both in their application to medicine and photography, would be of value to trainee urologists. It was this belief which inspired them to produce this volume.

In such a volume many people have been involved. First we must express appreciation to the anaesthetists, Dr Mackinnon, Dr Ryan and Dr Jarvie for long hours of patient forebearance. We are also grateful to Dr Gibson for his helpful advice on the sterilisation of endoscopic instruments and for allowing us to publish some of his data. Dr Dobbie has been most considerate in advising us of problems concerning surgical diathermy and to him we are most grateful. We are especially indebted to Dr Pugh for providing the excellent microphotographs of tumours to put alongside the cystoscopic photographs.

The excellence and precision of the photographs would not have been achieved without the help and encouragement of Mr S. Dobson, The Department of Physics, Reading University, and to him we owe a special debt of gratitude.

This manuscript could not have been prepared without the uncomplaining assistance of Mrs Barbara Worthington, who has typed and re-typed many of the chapters with cheerful enthusiasm, and who has worked hours long beyond the call of duty.

Contents

1. History of cystoscopy

Professor D. M. Wallace, O.B.E., B.Sc., M.S., F.R.C.S.

Even before the days of the Romans, man's natural curiosity concerning the functions of the human body, led him to produce a variety of instruments, some of which resemble the diagnostic equipment of today. It is assumed that these, rather crude, instruments were designed for the inspection of the vagina or rectum.

It is however, only in the last century that technical advances have allowed the development of more complex diagnostic methods. It is not generally realised that up to the beginning of the last century, sunlight, animal fat or vegetable oils, were the only sources of light available. The stimulus to endoscopy came with the development of better light sources, at first, mineral oil with additions to make the flame brighter, then the electric filament lamp, especially the Mignon version, and even more recently, the fibre optic non-coherent light cables.

Some of these technical developments were adopted into clinical practice with extreme speed, others took longer.

Bozzini's lichtleiter

It was not until 1806 that any attempt was made to visualise body cavities. In this year Bozzini demonstrated his new invention to the Academy of Medicine in Vienna, in the Hosephinian Library of the then Academy (now the Institut für die Geschichte der Medizin der Universität, Wien), but received scant encouragement. His original instrument, which is now preserved in the American College of Surgeons, Chicago, was clumsy and ineffective, but it did represent the first serious attempt to inspect body cavities (Fig. 1.1). It was an instrument designed for a multitude of functions; it could be fitted with a speculum, with an angled mirror at the end, which was probably designed for inspection of the nasopharynx. Another instrument, with several attachments, few of them bladed and one with a urethral speculum, was made for examination of the anal canal, the rectum and the vagina.

The urethral speculum, made of silver, was an open-ended tube and must have been used with air insufflation. It could, only under extreme difficulty, have been used in an air-filled bladder. The area of the urethral or bladder wall available for inspection, could have been only a few millimetres in diameter.

The main instrument is made of silver, covered in shark skin to prevent burns. Within the instrument a beeswax candle, spring loaded, provided a light, the flame of which was in a constant position. To one side of the light, and shielded from the light by a mirror, was the observation eyepiece in line with the axis of the examining speculum.

The whole instrument had to be kept vertical and presumably the patient was positioned around the instrument.

The two major causes of the lichtleiter's failure to be adopted as an endoscopic method, were the absence of optical magnification and a poor and uncontrollable light source.

The mid 19th century

Several attempts at endoscopy were made by a variety of clinicians, but it was not until Désormeaux of Paris produced his endoscope, that endoscopy became a

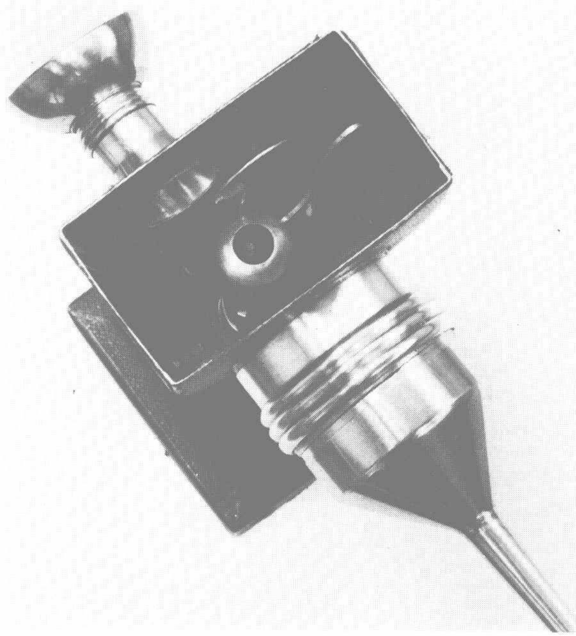
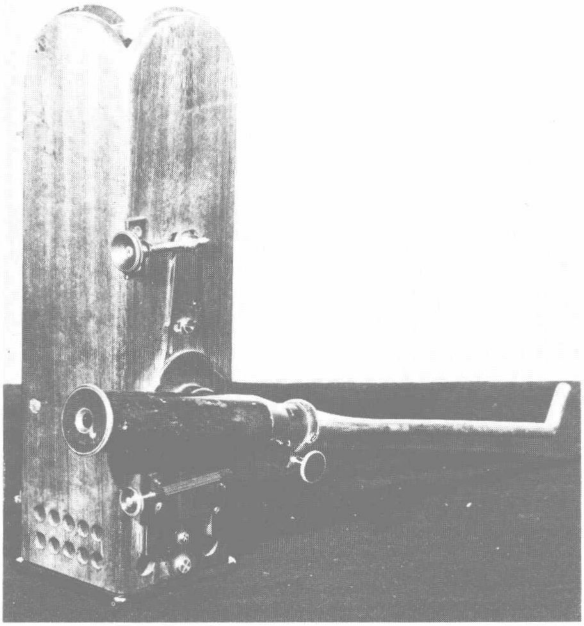
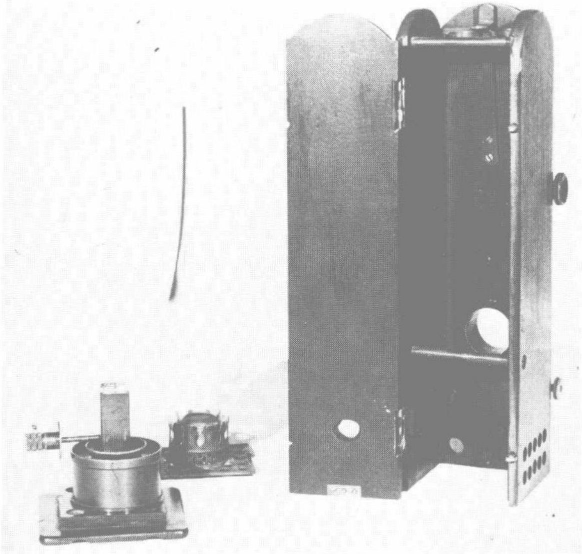


Fig. 1.1 Bozzini's lichtleiter 1806.
View from above to show mirror inspection eyepiece and spring loaded candle.





Figs. 1.2 and 1.3 Cruise instrument (2 views).

practical, though difficult method of investigation. Désormeaux, the father of endoscopy, designed his instrument around a paraffin flame, which was made to burn more brightly by the addition of turpentine. The metal lamp-housing tended to become very hot and there is at least one comment in the contemporary reports about burns to the surgeon's face. Attached to the lamp-housing was the endoscope proper. The light was reflected down the endoscope by means of an angled mirror, perforated to allow inspection along the endoscope axis. A variety of fittings were available including an optical method of magnification attached at the external end.

Cruise of Dublin was a friend and a close collaborator of Désormeaux. Cruise's instrument (Figs. 1.2. & 1.3) preserved in the Royal College of Surgeons in Dublin, is similar to that of Désormeaux, but because of the risk of burns this instrument is housed in a wooden box. Cruise used the flame edge on to the reflecting mirror, and increased its brilliance by adding camphor. The fittings however, are even more interesting, especially the urethral cannula. This cannula, one of which is open-ended, would have been used in an air-filled bladder, but Fenwick describes a cannula devised by Cruise which was fitted with a lateral window, and an angled proximal mirror. Fenwick reports that, when the lateral window was set in the axis of the tube, light was reflected back, which made observation of the lateral wall of the bladder difficult, but this could be prevented by setting the window at a slight angle. There is no doubt, that these men, through a bladder cavity filled with boracic solution, were able to inspect the greater part of the bladder mucosa.

The technique and the physical contortions on the part of both patient and surgeon resulted in this method failing to be generally adopted. However, at this time, electricity was being developed as an alternative source of light.

The late 19th century

Brueck, a dentist of Breslau, was experimenting with a platinum filament lamp heated to a white heat as a source of light. His earliest effort, a dental mirror, was cooled by a stream of water circulating behind the filament. Subsequently, he developed his interests to include the bladder. Here he inserted one of his glass tubes with a cooling jacket (Figs 1.4 & 1.5) into the rectum, and by passing a straight speculum into the bladder was able to see a small portion of the bladder wall by the light transmitted from the lamp in the rectum. This instrument is also preserved in Wien.

A colleague of Brueck, a gynaecologist called Schramm, of Dresden, attempted the same procedure and claimed that with Brueck's lamp in the vagina he could 'in a thin woman in a darkened room' make out the shape of the uterus and ovaries.

Neither of these techniques were of any significance, but the knowledge of their efforts spread to Berlin, where a young urologist decided to re-open the whole question of endoscopy. Max Nitze had two fundamental ideas: firstly to use lenses in the form of a miniature telescope to magnify the image down the endoscope, and secondly to illuminate the interior of the bladder by a water-cooled electric platinum filament lamp. His first efforts to

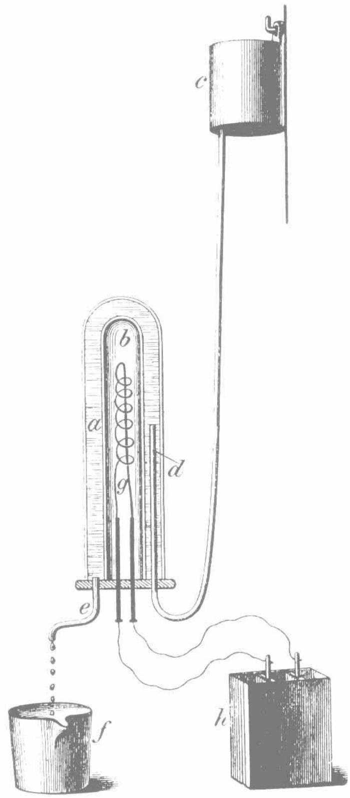


Fig. 1.4 Diagram of Brueck's irrigating system.

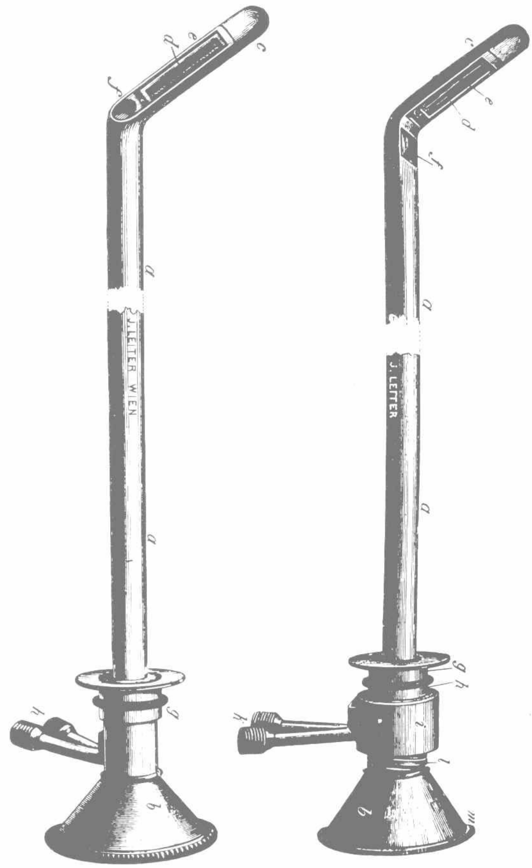


Fig. 1.6 Platinum filament lamp, goose quill cover and irrigating system 1878.

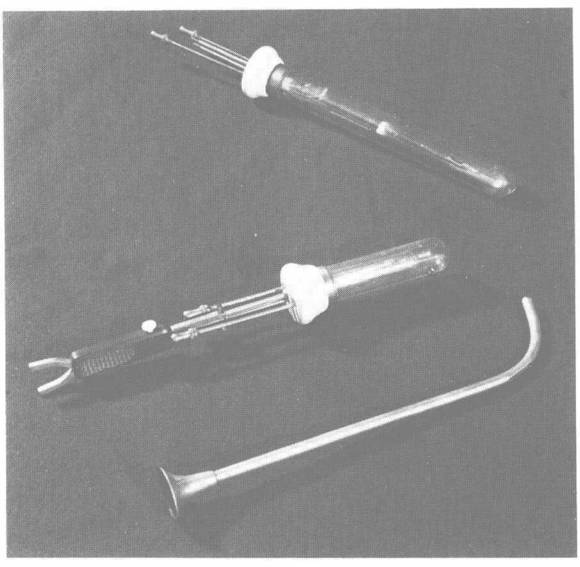


Fig. 1.5 Lamps for vaginal and rectal insertion with a direct vision non-optical cannula for inspection of the posterior bladder wall.

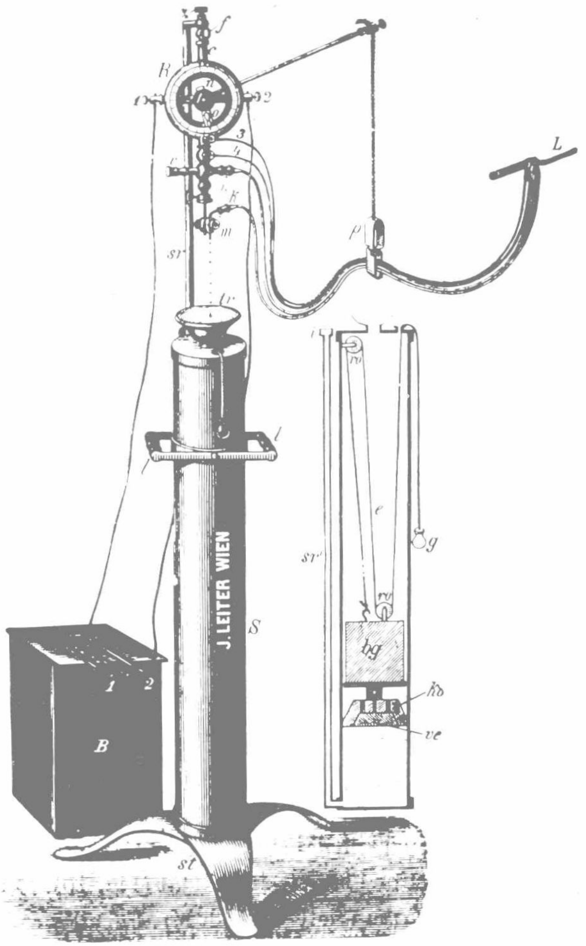


Fig. 1.7 Irrigating system to keep lamp cool.

produce a satisfactory instrument in Berlin were incomplete, so he moved to the clinic of Von Dittel in Vienna. Here, he was allowed every opportunity to develop his technique, and at the same time he collaborated with a senior surgical instrument maker, Leiter, and a lamp maker, Heyman.

Their first instrument was cumbersome (Fig. 1.6). The filament was a platinum spiral inside a goose quill; it was kept cool by a complicated irrigation system (Fig. 1.7) and the telescope design was far from perfect. The urologist of those days required a porter to carry his cumbersome and somewhat temperamental equipment (Fig. 1.8). Sir Henry Thompson of St. Peter's Hospital, wrote scathingly of this instrument and saw no future in it. Unfortunately, even though Sir Henry possessed a replica of this instrument, it has since been lost.

The Mignon lamp

Heat from the white hot platinum filament was the limiting factor in cystoscopy, but in England and America almost simultaneously, a major technical advance occurred. Swan, in 1878, demonstrated in Newcastle, that a lamp could be produced which, in vacuum, was neither too hot nor liable to burn out. Edison, a few months later, using a carbon filament in a vacuum, produced a similar lamp. This event, the discovery of a vacuum lamp, rapidly resulted in the production of the Mignon lamp, a small vacuum lamp which could be inserted at the end of a cystoscope into a water-filled bladder. This lamp was reliable and unlikely to damage, by heat, the patient's bladder wall (Fig. 1.9).

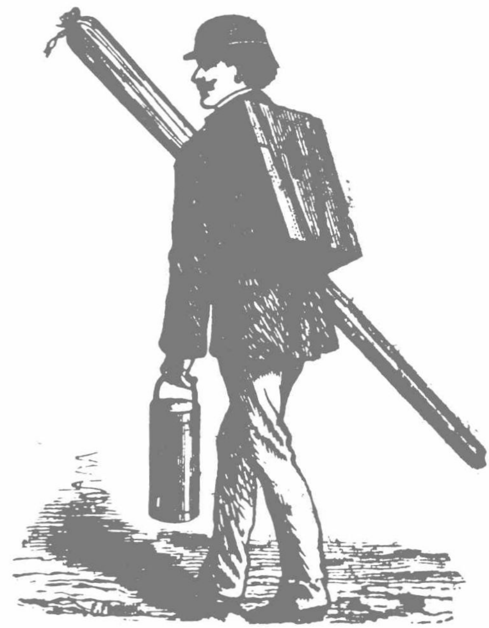


Fig. 1.8 Well equipped urologist proceeding to a cystoscopy.

The three main Nitze-type cystoscopes are (Fig. 1.10)

1. The urethroscope, developed in Berlin with the goose quill lamp and irrigating system (1876)
2. The urethroscope/cystoscope, improved optically by Leiter but still with a complicated irrigating system (1878)
3. The Nitze-Leiter cystoscope of 1880, fitted with the improved telescope and the Mignon vacuum lamp without an irrigating system.

The next few years are interesting because Von Dittel gave Nitze all the credit for the development of this instrument. Leiter and Nitze were to write a book on the technical and clinical aspects of urology, but the Vienna of those days, to a handsome young man, must have offered considerable distractions. The co-authorship book failed to materialise, the collaboration broke up and Nitze returned to Berlin, where he and

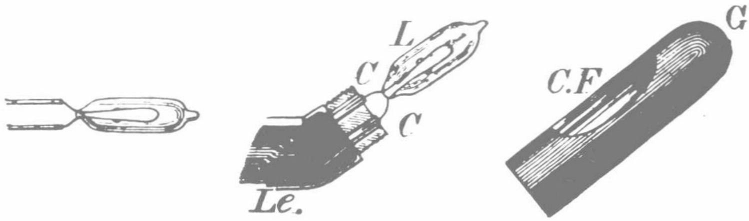
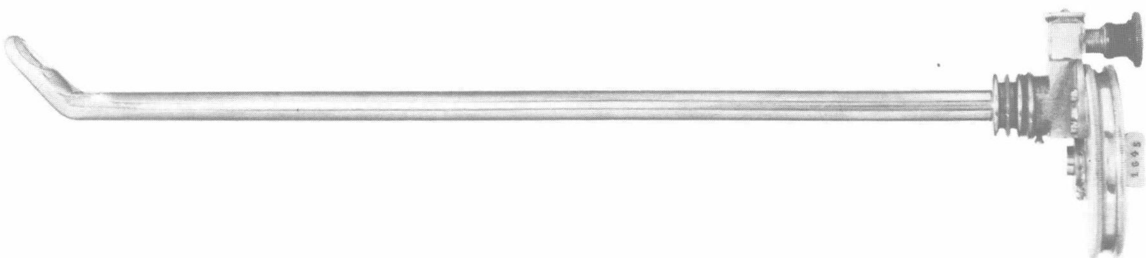


Fig. 1.9 Mignon lamp 1880.

Fig. 1.10 One of the earliest Nitze Leiter cystoscopes fitted with the Mignon lamp.



Figs. 1.11 and 1.12 Nitze photographic cystoscope (2 views).

B

his University department continued to produce, and modify, improvements in cystoscopes.

The number of cystoscopes which evolved over the next twenty years is incredible, but one modification is worthy of a more detailed description. The Amici prism marks a different era. The original cystoscope had either a direct forward-looking visual axis or the axis was altered through 90° by means of a terminal right-angled prism. This prism had one defect, in that it produced an inverted image, a mirror image. The Amici prism (a roofprism) was developed for use in cystoscopes in 1906. In brief, an extra prism was cut in the first prism on the hypotenuse face so that the image underwent a double reflection and thus became optically corrected. This prism is an essential component of all European instruments, but the American instruments of those days were corrected by the insertion of an additional prism in the shaft of the cystoscope.

The various modifications to the classical Nitze instrument mainly stemmed from Nitze's close collaboration with Herschman and Hartweg, instrument makers of Berlin. A photographic cystoscope allowed Kutner to take photographs inside the bladder in 1890 (Figs. 1.11 & 1.12). A diathermy cystoscope, credited to

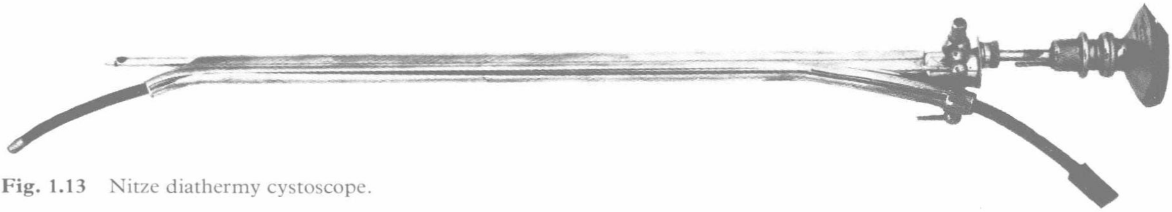


Fig. 1.13 Nitze diathermy cystoscope.

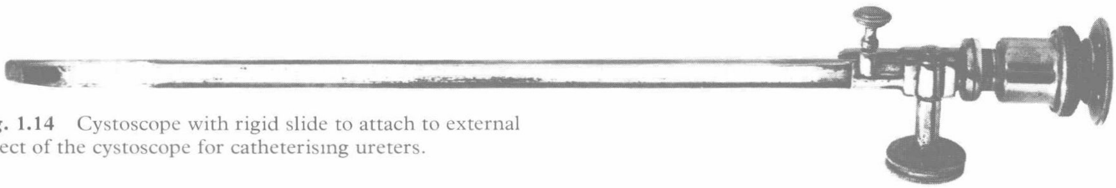


Fig. 1.14 Cystoscope with rigid slide to attach to external aspect of the cystoscope for catheterising ureters.

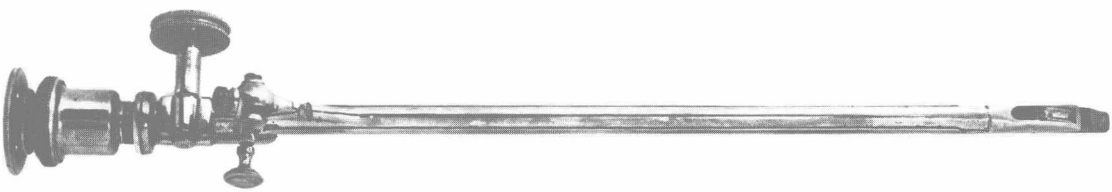


Fig. 1.15 Slide attached to outside of sheath with movable lever.

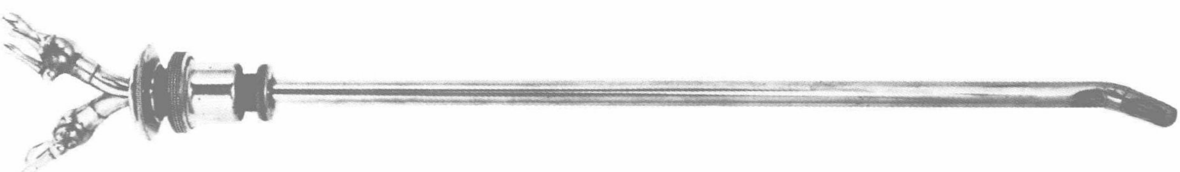


Fig. 1.16 Guterback's irrigating system for use prior to inserting telescope.

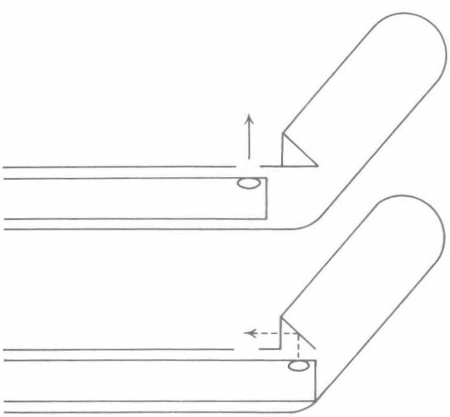


Fig. 1.17 Method of increasing the optical range by the use of prisms.

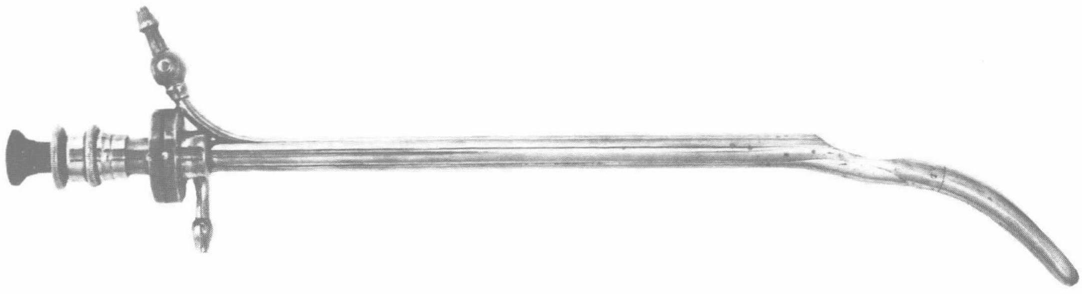


Fig. 1.18 Woddislo instrument with unique curve to scope and with the lamp built into the spine of the sheath.

Nitze, where a large electrode could be passed was the forerunner of the Kidds diathermy instrument (Fig. 1.13). Several cystoscopes were produced with an interchangeable external slide to allow catheterisation (Figs. 1.14 & 1.15).

Albarran in 1896, produced a cystoscope with an internal lever working inside the sheath to facilitate ureteric catheterisation. Brenner produced an instrument with a direct vision telescope and a fixed internal catheterising channel. Guterback used a double luman cannula for irrigation of the bladder prior to inspection (Fig. 1.16), but none of these represented a major optical advance.

Two attempts were made to increase the optical range by the addition of prisms. In the first, a prism fixed below the lamp (Fig. 1.17) could be brought into use by advancing the telescope, while a second model allowed a prism to be rotated over the end of the telescope. In both of these models the image, because of the double mirror effect, was both reversed and inverted.

Wossidlo, a urologist from Saxony spent part of his professional life in South Africa before returning to Berlin. He evolved a cystoscope with a completely different shape and with the lamp inserted in the spire of the sheath, a device which was later copied by some of the prostatic punch manufacturers (Fig. 1.18).

The British experience

In Britain the endoscope had failed to make any significant impact, although Newman of Glasgow had invented an instrument and he was certainly the first to catheterise the female ureters (1886) in Britain (Fig. 1.19). Unfortunately this instrument has also been lost, but was a forerunner of both Luys and the Kelly open tube type of cystoscope.

This Scottish invention passed unnoticed by the urologists south of the border, who began to rely on cystoscopes made in Berlin.

It was not until 1916 that the source of cystoscopes and means of repairing cystoscopes became a national problem. In this year, the Government commissioned Weiss, an old established instrument maker with a long-standing interest in urology (Weiss collection of lithotrites in Institute of Urology, London), to develop a British cystoscope. A small unit of three men began to develop a copy of what was then the popular cystoscope designed by Ringleb, but shortly afterwards, the development unit left Weiss to become the Genitourinary Manufacturing Company. From this simple wartime necessity, numerous offshoots of other companies have developed. British urology however, is a very personal speciality, so that a host of modifications, different types, different fittings and complete lack of standardisation became the pattern in the interwar years.

The advent of 1939–45 and the large numbers of Brown-Buerger cystoscopes left in Europe at the end of hostilities finally convinced British urologists that some form of standardisation was essential, not only for urology in Britain, but also in the interests of world trade.

The most recent, and perhaps, the most significant contribution to urology from Britain came with the closer collaboration between urology and physics, as practised by Professor Hopkins.

Although fibre-optics had been described as a method of conducting light around corners by Professor Hopkins in 1954, it took several years before this form of illumination was adopted by the cystoscope manufacturers and even longer before his second contribution, solid rod lenses, was also incorporated as a standard form of cystoscopic observation.

The American experience

The observation of the bladder in America was made popular by gynaecologists, such as Kelly who, using short open-ended tubes with the patient in the knee-chest position or reversed Trendelenburg, were able to conduct a limited inspection of the bladder wall. This tradition has been handed down to the American urologists in the form of the Braasch cystoscope, and the many modifications of the punch resectoscope.

It was Otis who, following a visit to Berlin, first introduced the Nitze-type instrument to America.

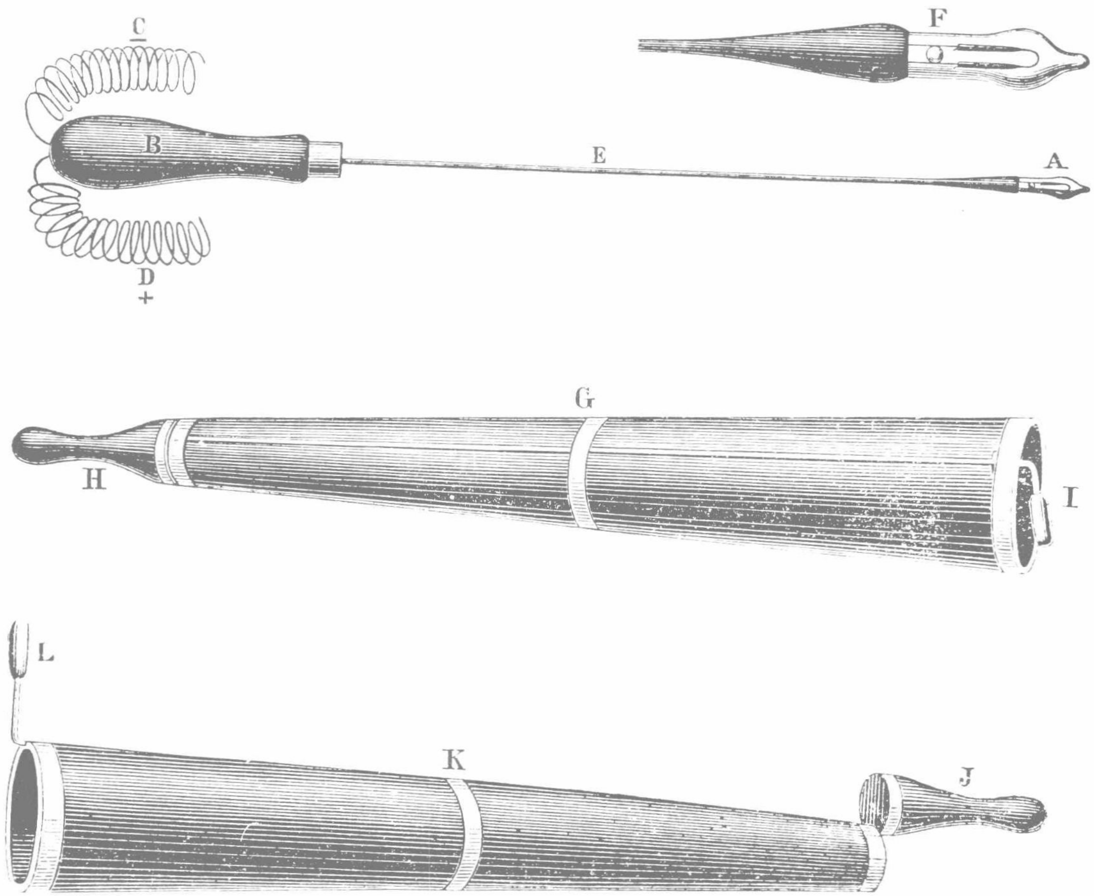


Fig. 1.19 Newman's electric endoscope for ureteric catheterisation in the female.

Tilden Brown and Leo Buerger were able to persuade Wappler, the founder of the most famous firm of cytoscope makers, to develop an American cystoscope, which for the last seventy years, has remained virtually unchanged as the pre-eminent cystoscope. It is now recognised and used worldwide. For any instrument to have been in regular use for so long speaks highly for its design and the principle of interchangeability and standardisation of components. The advent of new technology will allow the dearly loved classical Brown-Buerger cystoscope to retire with both dignity and honour.

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Royal College of Surgeons, Dublin.
American College of Surgeons, Chicago.
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École de Médicin, Paris.
Institute of Urology, University of London.
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Institute for History of Medicine, Berlin.

Dates

Bozzino (Philip) 1773–1809
Leopold von Dittel 1815–1898
Joseph Leiter 1830–1892
Max Nitze 1848–1904
Désormeaux, A. J. 1815–1882
Francis Cruise
Leopold Casper
Alex Brenner

Two books

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2. The endoscope

The evolution of the cystoscope has been fully discussed in Chapter 1. Gone are the days when the endoscopist depended on an instrument illuminated at its tip by a small lamp of inadequate power and doubtful reliability. Now a more sophisticated system based on an external high intensity light source fed to the instrument through a fibre cable and transmitted through the telescope by a fibre light bundle, so arranged, to illuminate the area subtended by the objective lens, is standard practice. It is essential that the modern endoscopist should consider cystourethroscopy not as an isolated investigation, but part of a more sophisticated system embracing most situations associated with this examination. It should, therefore, be possible to undertake ureteric catheterisation, biopsy of suspected areas, resection of tumour or prostate and removal of small foreign bodies without removing the sheath used for the initial examination. For such a system to be successful, continuous irrigation must be available, as no satisfactory cystourethroscopy can be carried out without such facilities. The one exception is cystoscopic litholapaxy, as the sheath is an integral part of the mechanism and cannot be separated.

The examining sheath

The examining instrument consists of a hollow tube, constructed from stainless steel, with a small angle at the tip. Prior to the introduction of the instrument, an obturator is inserted to prevent trauma, especially to the external meatus. Figure 2.1 shows three instruments of different dimensions, size 17.5, 22 and 24 charriére. These are colour-coded to help identification. Occasionally urethral lesions require diathermy treatment and this is best carried out through a panendoscope sheath which is similar to the examining sheath but which does not have a terminal beak. Figure 2.2 shows 3 sheaths, size 18, 22 and 24, with the same colour-coding as the examining sheaths.

The instruments shown are fitted with British Standard irrigation connections but these are being

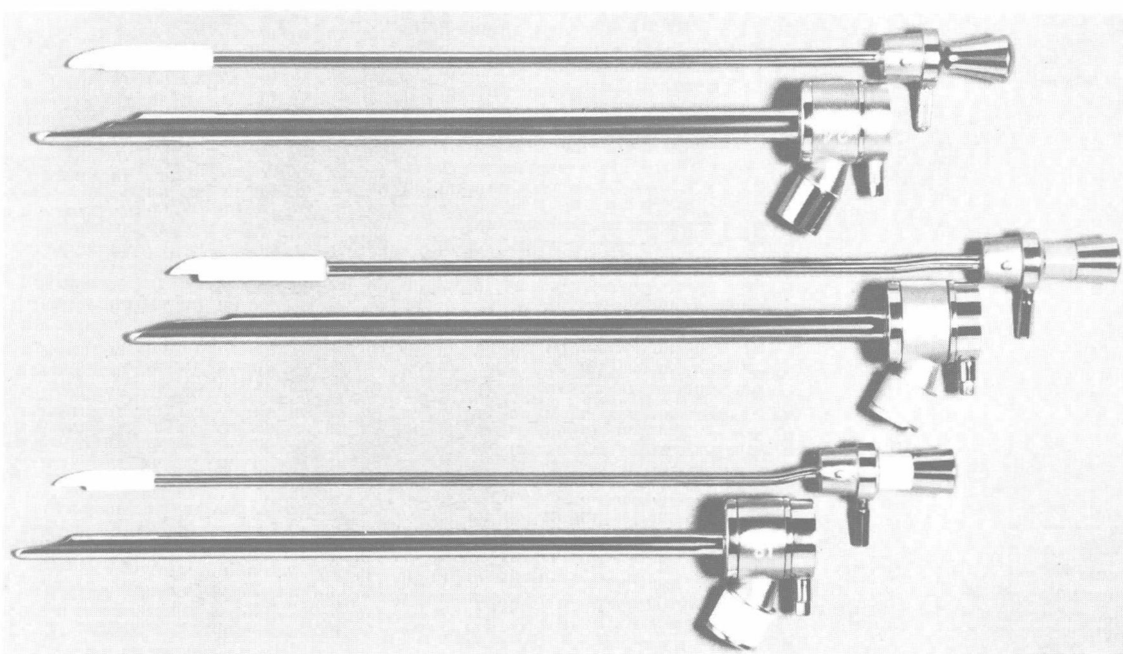


Fig. 2.2 Colour coded panendoscope sheaths 18, 22, 24.

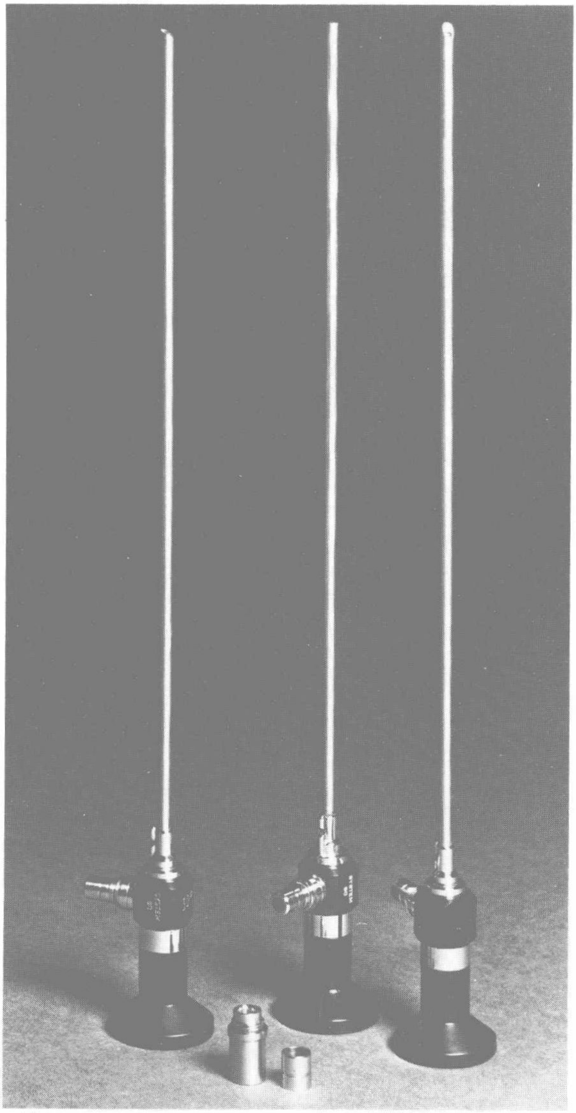
replaced by Luer fittings to conform with the agreed standard for the European Community. These sheaths cannot be used for diathermy resection and are being employed less and less in view of the concept of a rationalised integrated system.

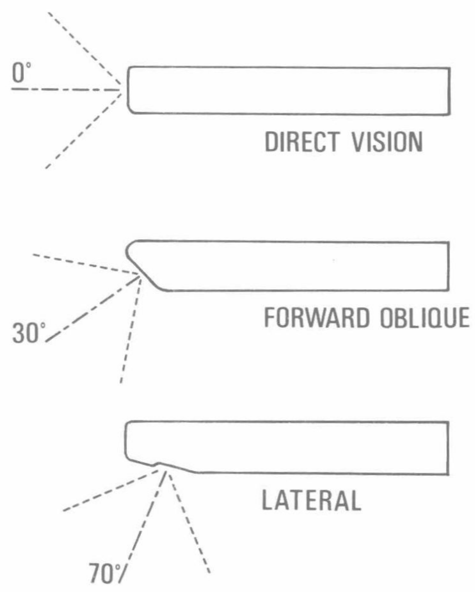
The resectoscope sheath

The resectoscope sheath is an insulated tube constructed from woven glass fibre bonded with an epoxy resin, which is wound round a mandrel, until the desired thickness is obtained. This one has become the sheath of choice. The dark colour is obtained by introducing the pigment during the winding process. Such tubes have been tested and failure only occurred, when it was exposed to a load far in excess of that likely to be experienced in normal use. Figure 2.3 shows three sheaths of different dimensions, size 24, 26 and 28 charriére, again colour-coded to facilitate recognition. As these sheaths have a straight beak at the end, which can be either short or long, it is advisable, to avoid posterior urethral trauma, to use a spring loaded articulated obturator (Fig. 2.4), which forms an angle at the tip when it is pressed fully home into the sheath. Some continental manufacturers construct the main shaft of the sheath in metal, bonding an insulated material on the tip. This has the advantage of a greater strength as fracture of the shaft of the bonded glass fibre material has been reported. But its disadvantage is a weakness at the tip where the insulated material is attached to the metal. Operators have experienced a fracture at this point. This can be an embarrassment, as it can be difficult to remove through the urethra. These sheaths are made in sizes 24, 26 and 28 charriére. The size 26 is the normal size for routine use, but the ultimate criteria is the size of the patient's urethra and size 28 should only be used on rare occasions when the urethra is wide, as in these cases, there is additional risk of urethral or meatal stricture. The irrigation system is attached to the side of the sheath and the types of fluid are discussed in a later chapter.

The telescope

A typical modern telescope is the System 80, which is, at present, available in three angles, 0°, 30° and 70° (Fig. 2.5). The 0° is direct vision, 30° forward oblique, 70° lateral (Fig. 2.6). All have a field of view, under





Figs. 2.5 and 2.6 Three telescopes 0°, 30° and 70° with adaptors for different fibre light cables.

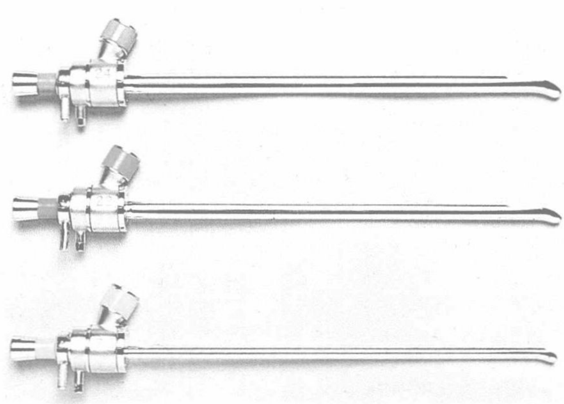
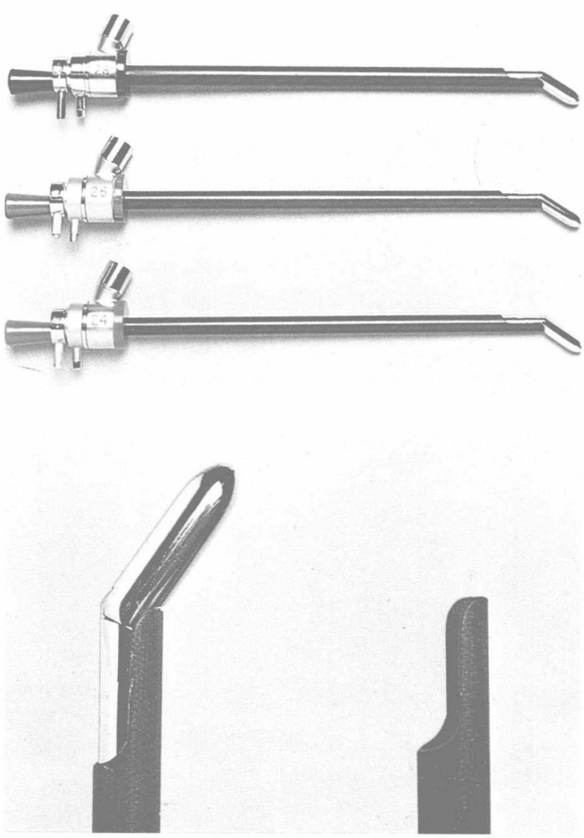


Fig. 2.1
Colour coded examining sheaths 17·5, 22, 24.



Figs. 2.3 and 2.4
Colour coded Resectoscope sheaths with articulated beak 24, 26, 28.

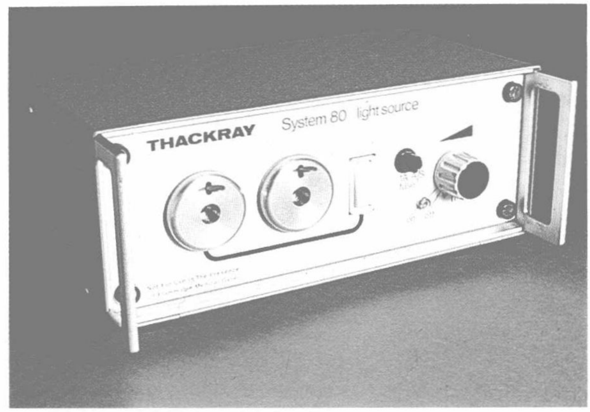


Fig. 2.7
High intensity external light source.

Fig. 2.8
Fibre light cable.

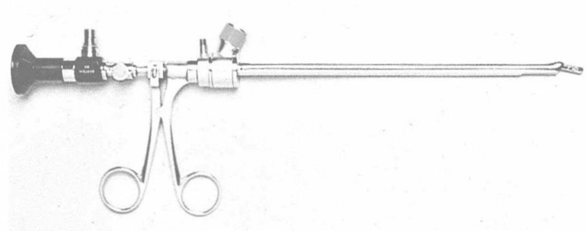


Fig. 2.10
Biopsy forceps (black and white).