

CATALOGUE OF
MICROSCOPES



PART 1

MICROSCOPES AND ACCESSORIES

W. WATSON & SONS, LTD.
LONDON

36th EDITION

CONTENTS

	PAGE		PAGE
Depôts and Agencies	2	Reasons for choosing a Watson Microscope	53
Conduct of Business	3	The "Myral" Microscope	54
Introduction	4	The "Kima" Microscope	56
The Compound Microscope	5	The "Service" Microscope	59
Objectives	6	Physician's Outfit	62
The Choice of Objectives	8	The "Bactil" Microscope	63
Apochromatic Objectives	11	The "Patna" Microscope	66
Holoscopic Objectives	12	Microscopes for Research	68
Parachromatic Objectives	14	Edinburgh Student's Microscope	69
Objectives for Special Purposes	16	The "Research" Microscope	72
Magnifying Powers of Objectives	17	Accessories for Edinburgh Student's and other Microscopes	74
Eyepieces or Oculars	18	Mechanical Stages	75
Holoscopic Eyepieces, Projection Eyepiece	19	The "Royal" Microscope	77
Comparator and Angle Eyepieces	20	The "Royal" Microscope, suggested General Outfit	80
Duplex Eyepiece	21	The "Van Heurck" Microscope	81
Demonstration Eyepiece	21	Ultra-Violet Light Microscope Equipment	90
Nosepieces, various types	22	The "Horizontal" Microscope	94
Condensers—Substage	23	The "Ramsden" Micrograph	95
Low-power Condensers, Expanding Stop	25	The Horizontal Reading Microscope	96
Universal Condenser	26	The "Vernier" Microscope	97
Holoscopic and Parachromatic Condensers	27	The "Museum" Microscope, patterns 1 & 2	98
Abbe Condenser and Mounts	28	The "Museum" Microscope, pattern 3	99
Holoscopic Immersion Paraboloid	29	The "Club" Portable Microscope	100
Cassegrain Dark Ground Condenser	30	The "McArthur" Portable Microscope	102
Zonal Dark Ground Condenser, Hanging Drop Slide Condenser Mounts	31	"Wenham" Binocular Body	103
Electric Light Attachment	32	The Universal Binocular Body	104
Diagram of Microscope	33	The Inclining Unit	107
The Construction of Watson Microscopes	34	The Sir Herbert Jackson Tube Length Corrector	107
Carriers for Condensers	40	"Greenough" Binocular Microscopes, pattern 3	108
Condenser Changers	43	"Greenough" Binocular Microscope, pattern 4, Inclined	109
Microscope Mirrors	44	Low-power Dissecting Binocular Microscope	113
Mechanical Stages	47	Long Arm Stand	115
Attachable Rackwork Drawtube	51	Accessory Stage	116
Guarantee of Quality	52		

IS 0.4 - WAT

36th Edition

CATALOGUE
of
WATSON MICROSCOPES
PART 1

Microscopes, Fittings and Optical Parts
for all the Biological Sciences

The Instruments described are suitable for study and research in

AGRICULTURE	CYTOLOGY	PHYSIOLOGY
BACTERIOLOGY	HISTOLOGY	PHARMACOLOGY
BIO-CHEMISTRY	HYGIENE	PHYTOPATHOLOGY
BOTANY	PATHOLOGY	ZOOLOGY

for the work of the amateur and for many technical purposes.

The complete Catalogue of Watson Microscopes is issued as follows:

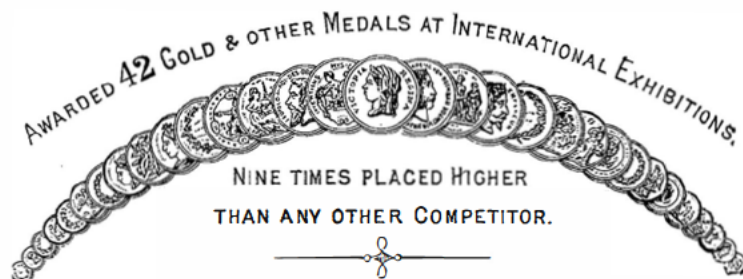
- | | |
|-------------------------|--|
| PART 1. | Microscopes, Fittings and Optical Parts. |
| PART 2. | Microscope Accessories. |
| PARTS 1 & 2. | Microscopes and Accessories. |
| PART 3. | Objects for the Microscope. |
| PART 4. | Metallurgical Microscopes and Accessories. |
| PART 5. | Photomicrographic Cameras and Accessories. |
| PART 6. | Petrological Microscopes and Accessories. |
| PART 7. | Microscopes for Industrial purposes and specialised apparatus. |

PUBLICATIONS AND LEAFLETS

Microscope Record, pubd. three times annually, gratis.
Dark Ground Illumination.
Magnifiers and Mountings.
The Book of the Watson Microscope.
Microscopes for Students and Research.

Any of the above will be sent post-free on request.

M 9975



W. WATSON & SONS, Ltd.

OPTICIANS

To H.M. Government, The Admiralty,
War Office, Royal Air Force, India Office,
Colonial and many Foreign Governments

ESTABLISHED 1837

Head Offices and Show Rooms :

313 HIGH HOLBORN, LONDON, W.C.1, ENGLAND

Two doors from Chancery Lane and one minute from the Chancery Lane Tube Station

Telephones :
Holborn 2767 and 2768

Cables and Telegrams :
" Optics, Holb., London " (2 words)

Hours of Business - 9 a.m. to 6 p.m.

Saturdays - 9 a.m. to 1 p.m.

Works : BARNET, HERTS., ENGLAND

Depôts and Agencies :

ENGLAND	BIRMINGHAM : Watson & Glover, 2 Easy Row. LANCASHIRE, CHESHIRE : J. D. Casartelli, Lyme View, Romiley. MANCHESTER : J. Woolley, Sons & Co., Ltd., Victoria Bridge. ESSEX, LINCOLNSHIRE, NORFOLK, SUFFOLK : Chas. Hawksley, Bulmer, Sudbury, Suffolk.
SCOTLAND.	GLASGOW : A. Woodger, 530 Great Western Road.
IRELAND.	BELFAST : S. E. Dickson, 9 Donegall Square West.
AUSTRALIA.	ADELAIDE : W. Watson & Sons, Ltd., 9 Graham Street. BRISBANE : W. Watson & Sons, Ltd., 105 Eagle Street. MELBOURNE : W. Watson & Sons, Ltd., 117 Collins Street. NEWCASTLE : Wm. Watson & Sons, Ltd., Carrington Chambers, Watt St. PERTH : W. Watson & Sons, Ltd., 205 St. George's Terrace. SYDNEY : W. Watson & Sons, Ltd., Watson House, Bligh St.
CANADA.	OTTAWA : Instruments Ltd., 240 Sparks Street. TORONTO : Wilson Instrument Co., 59/60 Wellington Street, West.
S. AFRICA.	DURBAN : British Instruments & Chemicals Ltd., 350 West St.
INDIA.	BOMBAY : A. H. Whelan, Commerce House, Currimbhoy Road, Ballard Estate.
NEW ZEALAND.	AUCKLAND : W. Watson & Sons, Ltd., Lister Building, Victoria Street. WELLINGTON : W. Watson & Sons, Ltd., 16 The Terrace. CHRISTCHURCH : W. Watson & Sons, Ltd., 137 Cambridge Terrace, C.1.
EGYPT.	CAIRO : A. G. Casdagli, 16, Sh. Sheikh Hamza, P.O. Box 885.
FRANCE.	PARIS : F. C. Dannatt, 198 Rue Saint-Jacques (5e).
FINLAND.	HELSINGFORS : O. Y. Chester, A. B. Kaisaniemugatan 5.
HOLLAND.	UTRECHT : F. Kooijman, Korte Smeestraat, 9-11.
JAPAN.	TOKYO : A. Buckney & Co., P.O. Box 141 Central. Thiseido Building Ginza, Nishi-nanachome Kyobashi-Ku.
LATVIA.	RIGA : Valsts Electrotechniska Fabrika.
POLAND.	WARSAW : Inz Feliks Lachman, 3 Szpitalna.

CONDUCT OF BUSINESS

TERMS.

Prices in this Catalogue are net for Cash ; there is no Discount.

Carriage, packing and insurance are not included in these prices, but are charged extra at cost.

ORDERING.

In ordering from this catalogue the edition should be stated, viz. : Thirty-sixth Edition.

Orders should be accompanied by a remittance in full or by two London trade references.

Names and addresses of customers should be written very distinctly.

ILLUSTRATIONS in this list are intended only as a general guide to the appearance and construction. Alterations and improvements are introduced from time to time and may necessitate corresponding changes in the models. In every case the instruments supplied will be of the latest and best design.

ORDERS BY CABLE.

Cable and Wireless messages may be sent at full rates by A.B.C. Code 4th and 5th editions, Bentley's Code, or by Code Words to be found against items in this catalogue. A quantity number or word should precede each code word. Where no quantity is stated it will be assumed that only one article is required. A combination of code words, if the total number of letters does not exceed ten, may be sent as one word.

Deferred cables at reduced rates are often sufficiently expeditious. Code words are not always allowed in such cables, but the catalogue numbers may be used.

PAYMENT.

A remittance to the value of the goods should accompany the order. Where delivery of the goods may not be immediate the remittance may be 25 per cent. of the value, the balance to be paid against delivery. Cheques and postal or money orders should be crossed Westminster Bank, Ltd. Postal or money orders should be payable at General Post Office, London. Customers residing abroad will find a banker's draft drawn on a London agent at sight the most advantageous method of remitting. Such a draft may be obtained at any bank. Post office orders are also a convenient form of remittance.

PACKING.

Goods are expertly packed according to destination. The cost of packing is charged to the customer.

CARRIAGE AND SHIPMENT.

Goods for the British Isles are sent by passenger train unless the purchaser desires otherwise. For export shipments that route which appears the most secure, direct and economical is selected unless other instructions are given. Charges for carriage and insurance are payable by the purchaser.

RESPONSIBILITY.

Goods in transit are at the risk of the purchaser, but every precaution in packing, selection of route and insurance is taken before despatch.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

INTRODUCTION

Founded in the year 1837 by the late William Watson, the firm of W. Watson and Sons has become famous throughout the world for Optical Instruments of various kinds including Photographic Lenses, Prism Binoculars, Astronomical Telescopes and predominantly Microscopes.

The manufacture of Microscopes was undertaken by us about fifty years ago, and gradually the Microscope Department assumed increasing proportions until it has now been for several years the most important in our business. We are the largest makers of Microscopes, Objectives, and Accessory Apparatus in the British Empire.

The success that has attended our efforts is undoubtedly due to the keen appreciation which workers show for Microscopes which enable them to express their own individuality in their work, and to Objectives and Condensers which give results and afford conveniences which are unusual and in some cases unique.

Although the Microscope is not used for recreational purposes by the amateur to the same extent as formerly, there is still an active and growing section of such workers, and certain of our Microscopes suit their requirements in a special manner. In fact we are the only manufacturers in the world who cater for their needs.

On the other hand the Microscope is now recognised as essential in nearly every branch of Industry, and the variety of subjects for research connected with science and the medical profession causes a continual demand for instruments for the purpose. The demand for our productions shows a continued annual increase.

The notable advance in microscope design which ensures unsurpassed rigidity and durability announced in the last edition, has been an unqualified success. Full details will be found in the Section on mechanical construction. New instruments and accessories will be found in the present issue.

Our Works are situated at High Barnet, Hertfordshire, and present the most favourable conditions that can be desired and modern facilities provide, for the manufacture of scientific instruments. Our main works were rebuilt in 1910, substantial additions were made in 1914 to 1918, and in 1919, while further additions have been made in 1935/6.

To make a Microscope satisfactorily requires a peculiar and special talent, which can only be acquired with apprenticeship and long training to the work. We have in our works men who have been with us all their working lives, while the succession of highly intelligent and keen young craftsmen is assured by the training received from the older men, and ensures the continuance of that outstanding quality and pride of craftsmanship for which our instruments are justly famous.

We are always pleased to receive suggestions in connection with our productions and to give such communications our most careful consideration, for we gratefully recognise that our increasing success is in no small measure due to the generous co-operation of our patrons, to whom we are indebted for many valuable suggestions and kind recommendations.

W. WATSON & SONS, LTD.

AN INVITATION

An invitation is given to all who may be interested in microscopy or scientific instruments to visit our works. A representative, by appointment at the Head Office, will accompany them.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE COMPOUND MICROSCOPE

The optical system of the Compound Microscope consists of Objective, Eyepiece and Condenser.

In the Compound Microscope a real image of the object is formed by the lens system known as the Objective. This image is formed in air in the body tube of the Microscope at a distance of from 6 to 10 in. from the Objective and is then rendered visible and further enlarged by the Eyepiece. The essential optical elements of a Compound Microscope then are, the Objective and the Eyepiece.

The effective working of the Objective depends on the proper illumination of the Object which is under examination. For this purpose optical systems, known as Condensers, are employed for concentrating the light.

The Microscope Stand carries the optical system. The effective working and the facility with which objects can be viewed and measured depends on the accuracy of construction and the mechanical conveniences with which the stand is equipped, hence the variety of different models that are offered and described.

In this catalogue will be found a range of Objectives, Eyepieces, Condensers, and Microscope Stands, progressing in completeness of construction from the plain types which are suitable for the work of the student, to the advanced models that are necessary for the more ambitious worker and those who are engaged in original research, whose purpose cannot be served by anything but the best.

There are branches of investigation which necessitate special arrangements in the design of the Microscope stand, and models are made for such. Thus the special facilities that are offered in the Microscopes that are made for the Metallurgist and Petrologist are redundant to the Biologist. Separate catalogues of these are published as mentioned on page 1.

This microscope catalogue, as notified on page 1, is published in seven sections.

The descriptions of the optical components precede the Microscope stands, as these are necessary for use with all types of Microscope.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

OBJECTIVES

However perfectly a Microscope stand may be constructed, the quality of the image seen depends upon the lenses that are used. The selection, therefore, of suitable Objectives for the class of work to be done is of the utmost importance. Consideration must be given to questions of numerical aperture, tube length, working distance, ability to stand high eyepieces, etc. In the following paragraphs we have endeavoured to give some guidance on these important points.

The large number and variety of the types of optical glass offer a wide choice in the computations of formulæ, and the successful efforts of **British** optical glass manufacturers to meet the needs of opticians have resulted in the supply of glass which is unsurpassed for the purpose.

Great care has been taken by us to eliminate all glasses that are likely to oxidise or decompose. We use hard and durable types of glass, and should any of our Microscope Objectives made subsequent to 1920 exhibit traces of decomposition at any time, we undertake to correct this free of charge, provided that no other damage has been done to the Objective, and it has not been subjected to misuse or injury, and is in the hands of the original purchaser.

By constant refinement in methods of manufacture and unremitting severity of inspection the uniform excellence of the Objectives is always maintained at the high standard that is set for them. Only those who are conversant with the modern possibilities of optical work are aware of the wonderful accuracy and perfection of workmanship that is called for and obtained. The computations provide for constituent lenses of a certain thickness and curvature. These are scrupulously adhered to, the surfaces being tested by means of "proof" plates, which enable differences of less than one hundred thousandth of an inch to be perceived, and finally when the components have been cemented together, they are mounted in the Objective mount with the surfaces at prescribed distances from, and accurately centred to, each other. So faithfully is this work carried out, that the number of Objectives that exhibit defects of manufacture or adjustment when subjected to the regular examination and testing, is very small.

Tube Length. It cannot be too strongly emphasised that if the Objective is to give its best result it must be used with the proper thickness of cover glass on the object, and with the precise tube length for which it has been adjusted. The expert eye can detect an error in tube length of a few millimetres by the lessened defining power that results.

Our standard Objectives, especially those for students' use, are corrected for a tube length of 160 mm., and the thickness of cover glass for which all our Objectives are corrected is .007 in. (.18 mm.). It must always be remembered that the depth to which the object is embedded in the mountant is equivalent to an increase in cover glass thickness.

We are always prepared to supply any of our Objectives, corrected for any length of tube, or to work on uncovered specimens or any specified thickness of cover glass, without extra charge, if notice is given at time of ordering.

We usually have in stock in addition to the lenses having standard correction, a number of Objectives that are corrected for metallurgy for use without cover glass and others to work on tube lengths of 200 and 250 mm.

Those who wish to wrest the best results from their equipment should from the commencement familiarise themselves with this most important factor in obtaining resolution. We are always glad to give instruction to those interested if they will visit us.

We realise that the more the recognition of quality in Objectives and manipulation of the microscope is understood the more the unique advantages of the Watson Microscopes will be appreciated.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

In order that the special and unique features which are incorporated in our Objectives may be more fully appreciated, we would submit the following remarks :

Apochromatic Objectives. These are described on page 11. We recommend them because both visually and photographically they are truly apochromatic, their spherical corrections are such that the whole of their numerical apertures can be effectively used, they will stand deep eyepieces, they give brilliant crisp images. We believe them to be the best Objectives of their type available.

Holoscopic Series. The lenses of this series are referred to on pages 12 and 13.

These offer wide range of Objectives from 3 in. to 2 mm., computed with exceptionally wide effective apertures combining crisp definition and ability to stand deep eyepiecing. A feature of this series is that in common with our Apochromatic Series the back lens is a triple combination. These form a series of truly semi apochromatic lenses and by the use of light screens which pass light of one range of colour only, are rendered equal in performance to Apochromatic Objectives.

Parachromatic Objectives. For general work, which represents probably 90 per cent. of microscopical observation. the lenses of this series are supreme.

These are the lenses universally employed in teaching institutions, laboratories, routine work, and by all not engaged on research or similar work necessitating the best optical systems available.

Certain conditions have to be satisfied, and performance that is irreproachable is maintained by rigid inspection. In this series we offer Objectives which are recognised throughout the world as yielding unsurpassed results. Their long working distances offer unique convenience in use. The outstanding feature of the Parachromatic series, apart from the general excellence of performance, is the adaptation of the colour correction to coloured objects on which they are almost invariably used.

A reference is made to these important features on page 14, but we would here emphasise the immense advantage that is conferred on the average student by the working distance of 1 mm. in the $\frac{1}{8}$ in. Objective of this series. It enables him to work on bacteriological specimens, counting chambers, etc., with a freedom not associated with lenses having less working distance.

The $\frac{1}{12}$ in. Oil Immersion Objective ("Versalic") has the same quality in a lesser degree. The maximum working distance is given that will allow of immersion contact being maintained between the cover glass and the front lens of the Objective.

Coloured Objects. It has been found in practice that an Objective that may give excellent definition on an uncoloured object does not necessarily perform so well on a stained specimen.

This matter has been the subject of long consideration, discussion and experiment ; our Objectives are now corrected to yield fine definition on coloured objects, and it will be found that they are no less good on unstained specimens.

Flatness of Field. Flatness of field is so often asked for that we think it desirable to mention that this can never be obtained in other than Objectives of low power or low aperture, and this fact applies to Objectives by all makers.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

Theoretically and practically, all microscope lenses have a curved field, and with high power Objectives the greater the excellence of the lens, the more particularly does this become apparent. It is possible, by altering the focus, to view separately every zone of the field, but when a specimen is focussed in the *centre* of the field, this part is absolutely sharp. Flatness of field can only be obtained by sacrificing the maximum sharpness at the focal point, and this produces inferior definition. The necessities of many classes of work render as great a degree of flatness of field as can be discreetly given desirable, and the judicious combination of that effect with the best possible definition in the circumstances is provided.

With low powers—1 in., $\frac{1}{2}$ in., $\frac{2}{3}$ in., etc., and those of less magnification, flatness of field can be secured over nearly the entire field, but under no circumstances can flatness of field be produced in a high power lens of large aperture and **fine quality**—it is an optical impossibility.

THE CHOICE OF OBJECTIVES

The Objectives that are to be chosen will depend on the class of work that is to be undertaken.

The ability of a lens to define fine structure is associated with its numerical aperture, the greater the numerical aperture the larger the number of lines per inch that can be divided. If the unknown is to be investigated, and the limits of resolving power are to be available, Objectives with the largest numerical aperture that can be obtained are essential.

The greater part of the work that is done, however, does not call for the use of such lenses. Generally the aim is to see with the utmost clearness, structure which is known and probably described, and for such, lenses of sufficient though comparatively low aperture are satisfactory. Our Parachromatic series meets these requirements in the best possible manner.

In choosing Objectives it must be borne in mind that wide numerical aperture necessitates reduction of working distance and increased curvature of field. As a general recommendation we should say that our Parachromatic series will be found to cover the wants of all those who are engaged in work of a general educational and recreational character, but for those who desire the best obtainable, or are doing research work, lenses of the Holographic or Apochromatic series must be chosen.

An indication of the resolving power yielded by the different apertures will be realised from the following table :

<i>N.A.</i>	<i>Resolving power in lines per inch. White light.</i>	<i>Green light.</i>
1.37	132,082	143,170
1.30	125,333	135,854
0.95	91,590	99,278
0.85	81,949	88,828
0.70	67,487	73,152
0.65	62,667	67,927
0.45	43,385	47,026
0.30	28,923	31,351
0.28	26,995	29,261

The attainment of this resolving power is dependent upon the use of fully achromatised and aplanatised condensers, of aperture fully corrected and equal to that of the Objective.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

Where two or more Objectives are used for some particular kind of study, one of them is usually employed for the purpose of finding the object or detail, and this Objective should have qualities which make it useful for searching and for a general view of the object. The nature of the objects to be examined and the conditions under which they are viewed are therefore the factors which affect the choice of a set of Objectives for any particular work. In view of the special features associated with every kind of study it is impossible to give general rules which may be applied to the selection of Objectives. It seems better to state what Objectives are actually found most useful in different branches of Microscopy and the following list is offered as the result of considerable experience of expert workers and in accordance with the demands most frequently received.

Botany, Zoology and General Biology [2 in., $\frac{2}{3}$ in. and $\frac{1}{2}$ in. (0.70 n.a.) Parachromatic. The 2 in. is not always included in sets, but it is a very desirable addition.

Animal and Human Histology, $\frac{2}{3}$ in. and $\frac{1}{2}$ in. (0.70 n.a.) Parachromatic.

Bacteriology, Serology, Haematology and Pathology, $\frac{2}{3}$ in., $\frac{1}{2}$ in. (0.70 n.a.) and $\frac{1}{4}$ in. Parachromatic.

The eyepieces which would accompany these objectives would be No. 2 ($\times 6$) and No. 4 ($\times 10$) or if one only were taken No. 3 ($\times 8$).

In certain branches of these studies it may be advisable to depart from the above recommendations. For the study of the Foraminifera, for instance, a 2-in. and a 1-in. Objective would be more useful than those specified for general zoology. Again, in the study of certain organisms, such as the Rotifera, the inclusion of the 2 in. or an even lower power may be advisable.

In Petrography the usual Objectives are 1 in. and $\frac{1}{2}$ in. Occasional use may be made of an immersion Objective. These may be of the Parachromatic series, but if the interference figures from very thin sections are to be examined the extra numerical aperture of the Holoscopic 2 mm. Objective will be useful.

In Metallurgy the $\frac{2}{3}$ in. and $\frac{1}{2}$ in. Parachromatic will be found generally satisfactory. To ensure the finest photomicrographs it is, however, better to adopt the Apochromatic 16 mm. and 4 mm. For the very finest detail the 2 mm. Apochromatic may be added. Metallographic Objectives are made in the same three series as the others, but differ from other Objectives in being corrected for use on an uncovered object. They are also mounted differently. We recommend that for this work a tube length of 200 mm. be used.

For original research in any branch of study in which the discovery of delicate or very minute detail may be possible, the best Objectives which it is possible to obtain should be used. These are of the Apochromatic series. Visibility of very delicate structure may only be possible through perfect corrections in the Objective as well as to its numerical aperture, so that Apochromatic Objectives of low and medium power which approach perfection so closely are of the greatest value in the study of delicate and elusive details and particularly in Photomicrography where accurate colour rendering is essential.

THE AMATEUR MICROSCOPIST, who wishes to be able to examine polyzoa one day and the finest structure on the diatomaceæ the next, must necessarily be supplied with a wide range of Objectives. Usually, however, the amateur takes advantage of the lower prices of those Objectives which are most in demand, such as the $\frac{2}{3}$ in. and $\frac{1}{2}$ in. Parachromatic, and adds a lower or higher power as the need arises.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

For technical uses the Objectives which are to be used will depend upon the nature of material to be examined. For the examination of building and paving materials a 2 in. Objective (Parachromatic) is very suitable. For textiles and paper-making a 2-in. and $\frac{3}{4}$ -in. would be adequate, with the additions of a $\frac{1}{8}$ -in. if more than routine work is intended. The same outfit would suit the agriculturalist, but if dairy work is in view a complete bacteriological set should be obtained.

If the purchaser is in doubt as to what Objectives should be included with a microscope for any special purpose, Watson's will be pleased to give the benefit of their experience in meeting similar needs and, if desired, to demonstrate by means of specimens and Objectives what result may reasonably be expected. Such demonstrations may serve to reveal the great possibilities of microscopical methods for certain purposes and also occasionally save disappointment where too much is expected.

DARK GROUND ILLUMINATION.

High aperture oil immersion Objectives are now available with iris diaphragms incorporated for a small extra charge, obviating the use of the funnel stop.

THE PROPER USE OF OBJECTIVES.

Watson Objectives have been computed to perform at their best under given conditions. Except the Metallurgical Objectives they are arranged to give optimum results on objects covered with a glass 0.18 mm. in thickness, and require under such conditions that the draw-tube should be set at 160 mm. unless ordered otherwise. If the cover-glass actually used has less thickness than this, then, in the case of Objectives of 0.65 n.a. and more, it may be necessary to increase the tube length in order to obtain good definition. If the cover glass is thicker than 0.18 mm. the tube should be shortened for best results. The adjustment is made by inspection of the image and not by measurement.

The immersion Oil used with Watson Objectives should not be purchased elsewhere. A supply of oil is sent with every oil immersion Objective, and fresh supplies can be sent at a reasonable price. Several oils are sold for use with immersion lenses, and they differ greatly in refractive index and dispersive power from the standard article. They may be good oils if Objectives are computed for use with them, but they are not necessarily suited to Watson Objectives. Some immersion oils have a solvent effect on the cement which is used to hold in place the front lenses of Objectives of great numerical aperture. The oil supplied for Watson Objectives is free from this defect.

ON APPROVAL.

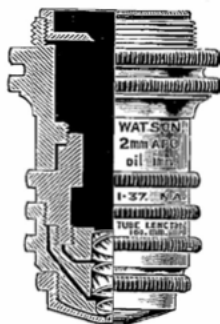
In order to ensure satisfactory selection of Objectives, a purchaser may have Objectives for examination for four days by sending a deposit to cover the value as per list. Those who have an account with Watson's are not asked for a deposit.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

APOCHROMATIC OBJECTIVES



In Objectives constructed entirely with optical glass, even in those of the finest quality such as the Holooscopic series, there remains one outstanding defect which is inherent in the material used, namely, the so-called secondary Spectrum. This arises from the fact that the distribution of colour in the Spectrum produced by the various optical glasses varies with their density, the red end being relatively too long in glasses of low dispersion, and the blue end too long in glasses of high dispersion, the result being that when such glasses are combined to obtain the best achromatism for the brightest part of the visual Spectrum, both the ends of the Spectrum, namely, the red and violet, are refracted too little or, in other words, come to a focus at a greater distance than the middle of the Spectrum; the chief inconvenience arising from the presence of this secondary Spectrum is that the Objectives cannot be used for photographing in white light on ordinary plates, but will only give satisfactory results if Orthochromatic plates and effective colour screens are used. Occasionally the secondary Spectrum also interferes with delicate visual observations because the faint halo of purple light due to it falsifies the true colour of small detail.

In Apochromatic Microscope Objectives the removal of the secondary Spectrum depends upon the use of fluorite. We are in possession of optically perfect fluorite and produce Objectives of outstanding merit.

In photomicrography of stained or unstained specimens the colour freedom of Apochromatic Objectives ensures outstandingly pure results. Objectives that are truly Apochromatic can be used with a variety of colour filters without need for refocussing.

The 16 mm. Apochromatic is not exceptional in aperture. The images given by Objectives of this power in the Parachromatic and Holooscopic series are so sharply defined and so free from colour defects that only the very finest performance can justify an apochromatic 16 mm. The Watson objective does not fall short of this justification, and no images have ever been produced finer than those given by this lens.

The 8 mm. Objective offers unique convenience to the busy worker. Its numerical aperture, 0.65, is equivalent to that of many achromatic $\frac{1}{8}$ " Objectives. With a range of Eyepieces it is therefore possible to use the Objective for surveying a relatively wide area and then by increasing the power of the Eyepiece to concentrate upon any given spot, examining minutely. The perfection of correction both spherically and chromatically will be realised when tests with X50 Eyepieces are carried out. It will be found that no deterioration in the image takes place. This lens is as nearly perfect as possible.

With a view to making the 4 mm. Objective most generally useful its numerical aperture has been reduced to 0.85, although it has been customary to make such an Objective to 0.95 n.a. Professor Conrady has shown that the effective aperture of a dry 4 mm. Objective is limited by considerations of critical angle, relation between R.I. of object and mountant. In addition errors increase rapidly as the n.a. approaches 0.95, the depth of focus becomes nil, and the tube length adjustment becomes an operation requiring extreme skill.

With the slightly lower n.a. these difficulties are reduced so as to be almost negligible and in the 4 mm. Apochromatic microscopists are offered a lens not only of superb performance, but easy to use.

2 mm. Objective n.a. 1.37. This aperture has been deliberately selected as being the one which permits a relatively firm mounting for the front lens, a working distance such that an object beneath a No. 3 cover glass may be focussed, and ability to stand high eyepieces without breaking down. Finally the whole of the numerical aperture of the Objective can be employed. In every way this Objective is unsurpassed.

Code Word.	No.	Equivalent Inches.	Image distance		Numerical Aperture.	Price.		
			Focal length. mm.	Initial Power. 10 inches.		£	s.	d.
Match.	11101	$\frac{1}{2}$	16	15	0.30	5	0	0
Matoa.	11102	$\frac{1}{4}$	8	30	0.65	7	0	0
Mater.	11103	$\frac{1}{8}$	4	60	0.85	9	0	0
Mathe.	11104	$\frac{1}{4}$	2	120	1.37 Oil Immersion	17	10	0
Matho.*	11105	$\frac{1}{2}$	2	120	1.37 do.	18	10	0

* With iris diaphragm for dark ground illumination incorporated

The above may be supplied corrected for any tube length to order.

For particulars of mechanical correction for cover glass thickness see page 10.

It is essential that compensating or Holooscopic Eyepieces be used with the above Objectives, see page 19.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

OBJECTIVES—THE HOLOSCOPIC SERIES (SEMI-APOCHROMATIC)

A reference to the illustration will show that the construction of this series of Objectives is not of the usual type, the correction in all Objectives other than those of lower power than 24 mm. depending largely on a cemented triple back combination.

The special factors which have made these Objectives famous will be best appreciated from the following considerations.

When dealing with the wide-angled pencils and consequent great angles of incidence which occur in microscope Objectives, the usual methods for correcting chromatic and spherical aberration prove inadequate; their shortcomings lead to the presence in Objectives, produced by their use, of heavy residuals of aberration, known to microscopists as spherical zones, and as spherical difference of chromatic aberration. The former of these defects leads to the formation of untrustworthy images, because the required phase-relation of the light forming the image is falsified, whilst the chromatic residual prevents the taking of presentable photographs of objects; for it amounts to this, that the Objective although tolerably free from spherical aberration for the visually strongest rays, is affected with heavy spherical aberration for other colours, such as those acting most strongly on a photographic plate.

In the Holooscopic Objectives both these defects are minimised; the spherical correction is carried to high perfection by so determining the data that the rays which are geometrically united in the focus arrive there in exactly equal phase and are thus in the relation theoretically demanded, but not hitherto realised in practice. The exceptionally perfect spherical correction attained in this manner has often been noticed by expert workers and renders the Holooscopic Objectives extremely valuable for all delicate observations, for it reduces the possibility of spurious images to a minimum.

Similar perfection has been aimed at in the correction of chromatic aberration, thus rendering the Holooscopic Objective capable of yielding very excellent photographs of microscopical objects, and in order to secure this it was found necessary to adopt ENTIRELY NEW TYPES of Objectives to realise the perfection aimed at, and to produce Objectives equal to the best Apochromatics, except in freedom from secondary colour.

These Objectives have been highly praised by expert workers who have purchased them for their excellent performance with deep-power Eyepieces, large solid illuminating Cones, annular and dark-field illumination, and the yielding of exquisite photographic effects.

They meet the needs of the original investigator, and all who would possess the best optical means, in the fullest possible manner.

The numerical aperture stated is the GUARANTEED MINIMUM for each Objective. The Lenses may be trusted to have the magnifying power (within a SMALL percentage) corresponding to the equivalent focus given in the list.

All Lenses in this series with the exception of the low-power lenses, as noted below, are under-corrected for chromatic differences of magnification; they should therefore be used in conjunction with our Holo-scopie Eyepieces (page 19).

The 2 mm. which has a guaranteed minimum aperture of 1.37 n.a., is a superb lens and is only equalled by the Apochromatic Immersion Objective. Microscopists requiring the maximum resolving power will find their wishes satisfied with this lens.

Special Note re Low Powers. The three Objectives of lower power than 24 mm. are not under-corrected in the manner that the other Holo-scopie Objectives are. They should, therefore, be used either with Huygenian Eyepieces or Holo-scopie Eyepieces with the adjusting tube pushed home.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

The Holoscopic Objectives were designed to provide a series of Objectives of high numerical aperture whose performance would be equal to that of the most outstanding Apochromatic Objectives, except in freedom from secondary colour.

We cannot stress too highly the perfection of the spherical corrections of these Objectives. High-power Eyepieces can be used without any deterioration of the resultant image.

The apertures are such that in conjunction with low-power Eyepieces a comparatively wide field can be surveyed and any local structure more carefully examined by deep Eyepiecing.

The Objectives can be corrected for any desired tube length between 140-250 mm.

These Objectives must be used in conjunction with the Holoscopic series of Eyepieces.

When used in conjunction with colour screens, no difference between these and Apochromatic Objectives will be observed.



Special Features.

Watson Holoscopic Objectives were designed to meet a demand by expert microscopists for Objectives which would have a greater ratio of numerical aperture to magnifying power than is to be found in any other Objectives.

The advantages of this feature of Holoscopic Objectives are:

1. A greater range of useful magnifying power.
2. A greater working distance for any given numerical aperture.
3. Ability to compensate for the effect of different thicknesses of cover-glass by small changes of tube-length.

Code Word.	No.	Equivalent Focal Length.		Initial power Diameters calculated for an image distance of 10 inches.	Numerical Aperture.	Tube Length.	Price.
		Mm.	In.				
Matin.	11301	75	3	4	0.11	200	£ 3 0 0
Matri.	11302	50	2	5	0.17	200	2 10 0
Matol.	11303	35	1½	8	0.19	200	2 10 0

Medium and High Powers. From stock for 6 inch (160 mm.) and 8 inch (200 mm.) tube length.

Matyl.	11304	25	1	10	0.30	200	£ 4 10 0
Matte.	11305	16	1	15	0.45	200 & 160	4 10 0
Matoc.	11306	12	1	20	0.65	200 & 160	5 5 0
Matry.	11307	8	1	30	0.65	200 & 160	5 5 0
Matro.	11308	6	1	45	0.95	200	6 5 0
Matur.	11309	4	1	60	0.95	200 & 160	6 5 0
Maude.	113010	2	Oil Immersion do.	120	1.37	200 & 160	10 0 0
Maud.*	113011	2		120	1.37	200 & 160	11 0 0*

* With iris diaphragm incorporated for use in dark ground illumination.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

OBJECTIVES—THE PARACHROMATIC SERIES

Universities, Schools and many workers find all their requirements satisfied by Objectives of medium aperture provided that the whole of the available aperture is effective and the performance irreproachable. The Objectives listed in the Parachromatic series are in all respects unsurpassed, while they also incorporate features which make them unequalled for general work.

Advances in design and performance of microscope Objectives are dependent not only upon the skill of the mathematician, but also upon the types and quality of the optical glass available.

It is now common knowledge that optical glass produced at the present time by the English glass makers is equal in quality and in many instances superior to that made elsewhere.

Full advantage of these improvements has been taken by Watsons' technical department.

There is no finality in optical construction. Unceasing research in optical design is carried on and wherever possible advances are indicated the Objective is recomputed. Thus the computations and formulae to which many of these Objectives are made show a distinct advance since the last catalogue was issued.

GENERAL NOTE.

The following features are common to all the Objectives in this series :

The spherical and chromatic corrections are such that they can be used in conjunction with high-power eyepieces without breaking down.

The whole of the numerical aperture of each Objective can be utilised providing always that there is a sufficient contrast between the refractive index of the mountant and the refractive index of the specimen.

LOW POWERS—(4 in. to $\frac{1}{2}$ in.).

Low-power Objectives are not distinctly sensitive to correction for tube length, and may generally be used between 160 and 250 mm. without material depreciation in definition. A wide range of magnifying power can therefore be obtained with such Objectives. Further, flatness of field which cannot be imparted in Objectives of high power is an outstanding feature of these low powers.

MEDIUM POWERS—($\frac{1}{2}$ in. to $\frac{1}{4}$ in.).

These Objectives are exceptionally fine in performance, and all of them have the special and unique quality of a long working distance between the front lens of the Objective and the object under examination.

The $\frac{1}{2}$ in. is the Objective of medium power with which Laboratory work generally is done, and the competition to produce a lens of outstanding merit of this power is so keen that excepting it be to the universally demanded high standard of excellence it would be impossible to sell it at all.

This $\frac{1}{2}$ in. Objective of the Parachromatic series has found universal favour. Not only has it on numerous occasions been ordered to replace similar lenses of other makes, but its many advantages have led to its standardisation in teaching institutions. It is, in fact, the ideal type of Objective for all classes of medium-power work. It has corrections similar to those of the Achromatic, and is classed as semi-Achromatic. The same lens is made with two different numerical apertures, viz., .70 and .80. The great feature of it is that the former has unusually long working distance of 1 mm. The field is relatively flat. It will, in fact, be found flatter than many other Objectives of equal aperture.

An ample working distance in a lens of this power has long been a desideratum, but it has hitherto been so short that difficulty has been experienced in focussing through the cover-glass of a Haemacytometer, or any other than a No. 2 (.008 in.) cover-glass.

The examination of objects with thick covering glasses with our $\frac{1}{2}$ in. has proved an immense boon to workers. This does not cause the sacrifice of other important qualities in fact its perfection of correction, both for spherical and chromatic aberration, renders it exceptionally fine in performance. This, allied with its great working distance, makes it superior to any other lens produced at the present time for all who use their instruments on other than specially mounted specimens, and it particularly appeals to Students, Laboratory workers, and those who are interested in pond life.

$\frac{1}{4}$ " OBJECTIVE FOR UNCOVERED OBJECTS.

Modern staining technique and rapid examination of blood films necessitate the viewing of uncovered specimens. The usual design of $\frac{1}{4}$ in. Objective provides for a cover glass and, consequently, when an object is examined without this, definition must deteriorate. To meet a very general demand Watsons have designed a $\frac{1}{4}$ in. Objective for the use of the metallurgist and technician which is corrected for use on uncovered specimens.

OIL IMMERSIONS.

These are made in three magnifications and four types. The $\frac{1}{4}$ in. Oil Immersion is intended for those who do a certain amount of bacteriological work and wish to combine in one Objective the qualities of the $\frac{1}{2}$ in. and the $\frac{1}{4}$ in. The numerical aperture 0.94 is kept low so that the use of a funnel stop for the examination of living spirochaetae, etc. is unnecessary. It can, in fact, be used with ordinary Dark Ground Illumination as it stands. Workers who are unaccustomed to the use of medium-power Oil Immersion Objectives will be astonished at the brilliant definition that is obtained with this lens. The working distance of the lens of 0.5 mm. is such that it can be used advantageously in conjunction with the thick cover-glass of a Thoma Haemacytometer.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

$\frac{1}{2}$ " OIL IMMERSION.

The same lens is made in two types the "Versalic" with a numerical aperture of 1.28 and the "Utility" with a numerical aperture of 1.25.

In conformity with the usual rule these are called $\frac{1}{2}$ in., but the magnifying power and focus is actually that of a $\frac{1}{2}$ in. in each instance.

Both these lenses have a flatter field than other first-class Objectives of similar type. They also have a long working distance. In the case of the "Versalic" it is .43 mm. Although this is so very considerable, the maintenance of oil contact is perfect.

An important feature of the "Versalic" Objective is that the front lens is held in position by a metal bezel and is not dependent on cement, as usually prevails in other Oil Immersion Objectives.

The probability of the front lens being displaced by pressure or other circumstances does not arise in this instance.

The front lens is fixed in a manner which renders it practically immovable.

All the Objectives of the Parachromatic series are specially computed for work on stained objects, but the amateur will find that he is at no disadvantage on colourless objects in consequence. They are the best lenses for Students, Laboratory, and general work that are produced.

 $\frac{1}{6}$ " OIL IMMERSION.

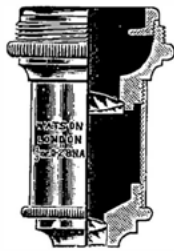
For the Cytologist, high magnification is sometimes even more important than high resolving power. The $\frac{1}{6}$ in. Oil Immersion Objective has been introduced to meet this need. The numerical aperture is 1.30, and it can be used in conjunction with the deepest eyepieces, giving a range of magnification up to 2000 diameters.

 $\frac{1}{2}$ " WATER IMMERSION.

This is specially designed for the Ecologist and all wishing to examine specimens without previous preparation. It can also be used for specimens in alcohol, but the setting of the front lens cannot be guaranteed for a long period.

 $\frac{1}{2}$ " WATER IMMERSION.

The demand in recent years for a lens of this type has led to the introduction of this Objective. It will be found very useful to the Biologist, Zoologist, and other workers.



Low-power Objective.
 $\frac{2}{3}$ in. to $\frac{1}{2}$ in.



Medium-power Objective.
 $\frac{1}{2}$ in. to $\frac{1}{3}$ in.



Oil Immersion Objective.
 $\frac{1}{2}$ in.

Code Word.	No.	Focal Length.		Initial Power at 10 in.	Numerical Aperture.	Price £ s. d.
		in.	mm.			
Maund	11501	4	100	3	0.08	2 0 0
Mauso	11502	3	75	4	0.09	2 0 0
Mavis	11503	2	50	6	0.15	2 0 0
Mawle	11504	$1\frac{1}{2}$	35	8	0.17	2 0 0
Mawke	11505	1	25	12	0.21	1 12 6
Maxil	11506	$\frac{3}{4}$	16	15	0.28	1 12 6
Mayon	11507	$\frac{1}{2}$	12	20	0.34	2 0 0
Maypo	11508	$\frac{1}{3}$	6	42	0.68	3 5 0
Maxon	11509	$\frac{1}{4}$	4	65	0.70	3 5 0
Maxbu	115010	$\frac{1}{5}$	4	65	0.70	3 5 0
Mazar	115011	$\frac{1}{6}$	4	65	0.80	3 15 0
Meado	115012	$\frac{1}{8}$	3	83	0.88	3 15 0
Mcage	115013	$\frac{1}{2}$	Oil Immersion §			
Mealt	115014	$\frac{1}{2}$ Utility	3.4	77	0.94	5 10 0
Meala	115015	$\frac{1}{2}$ Versalic	1.8	140	1.25	5 0 0
Mexte	115016	$\frac{1}{2}$	1.8	140	1.28	6 10 0†
		$\frac{1}{2}$	1.5	160	1.30	10 0 0†
			Water Immersion			
Mewat	115017	$\frac{1}{2}$	3.4	77	0.84	5 10 0
Mxwat	115018	$\frac{1}{2}$	1.8	140	1.15	6 10 0

* This Objective is for use on uncovered specimens, such as blood-films.

† 115019 Extra for iris diaphragm incorporated in mount obviating use of funnel stop in dark ground illumination, 17/6

§ The price includes an oil bottle and supply of oil.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

OBJECTIVES FOR SPECIAL PURPOSES

TANK OBJECTIVES

For the examination of objects immersed in water a series of three Objectives has been developed. They will be found of great use for the study of living organisms which are anchored to aquatic plants or to such as will creep about the bottom of a small beaker or tank. In use, the front lens must be submerged below the surface of the water.

Vertical illumination can be used with marked success with these Objectives and details elucidated which would otherwise be unnoticed.

Code Word.	No.	Focal Length.		Price. £ s. d.
		in.	mm.	
Mauge	11601	1	25	2 2 0
Maule	11602	$\frac{2}{3}$	16	2 2 0
Maumo	11603	$\frac{1}{2}$	12	2 2 0

VARIABLE POWER OBJECTIVES

For elementary schools and for work where relatively low magnifications are required a variable power Objective has been designed. The initial power of the Objective is varied by altering the separation of the combinations. A rotating collar is fitted for this purpose.

Code Word.	No.	Focal Length.	Initial Power.	Price. £ s. d.
Mealk	11604	$1\frac{1}{2}$ in. to $\frac{3}{8}$ in.	8 to 15	2 10 0

PHOTO-MICROGRAPHIC OBJECTIVES

HOLOSTIGMAT SERIES

These Objectives are mounted with the R.M.S. Objective thread, will fit any standard microscope, and have an iris diaphragm and scale. They are for use without eyepieces, and for penetration and colour correction they are unsurpassed, the definition being needle sharp to the edge of the plate.

	No.									£ s. d.
Biarl	11605	1 in. focal length f/3	...	...	...	...	...	...	...	7 10 0
Biant	11606	2 in. focal length f/6	...	...	...	...	...	...	...	6 0 0
Biblo	11607	3 in. focal length f/6	...	...	...	...	...	...	...	6 0 0

"ARGUS" OBJECTIVES

To meet the demand for inexpensive Objectives of low power the "Argus" series has been designed.

Each Objective of the series consists of an Achromatic doublet and gives the most brilliant and best defined image obtainable from such a combination.

Code Word.	No.	Focal Length.		Initial Power.	Numerical Aperture.	Price. £ s. d.
		in.	mm.			
Myale	11608	3	75	3	0.07	1 2 6
Mayne	11609	2	50	5	0.11	1 2 6
Maygi	116010	$1\frac{1}{2}$	35	8	0.13	1 2 6
Mayed	116011	1	25	10	0.15	1 2 6
Maygx	116012	$\frac{3}{4}$ *	16	15	0.17	1 2 6

* Contrary to usual practice this Objective consists of two Achromatised doublets.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

FIGURES IN ITALICS>=FIELD OF VIEW

PARA- CHROMATIC OBJECTIVES.	Primary Magnifi- cation at 160 mm. tube length.	Micro- metric value.	Combined magnifications at 160 mm. tube length with Huygenian eyepieces, and field of view.						PARA- CHROMATIC OBJECTIVES.	Primary Magnifi- cation at 160 mm. tube length.	Micro- metric value.	Combined magnifications at 160 mm. tube length with Holoscopic eyepieces and field of view.			
			× 5	× 6	× 8	× 10	× 12	× 15				× 7	× 10	× 14	× 20
			Inch.												
4	0.6	250μ	28.0	32.0	28.0	23.0	22.0	17.5	4	0.6	250μ	26.0	21.0	14.7	9.8
3	1.25	200μ	3	4	5	6	7	9	3	1.25	200μ	4	6	8	12
2	2.5	58μ	14.5	16.5	14.0	11.7	11.6	9.5	3	1.25	200μ	13.3	11.0	7.5	5.2
1½	3.5	41μ	6	7	10	12	15	19	2	2.5	58μ	9	12	17	25
1	6	25μ	7.8	8.5	7.6	6.0	6.2	5.0	2	2.5	58μ	7.1	5.8	4.0	2.8
¾	9	16.0μ	12	15	20	25	30	37	1½	3.5	41μ	17	25	35	50
½	13	11.3μ	5.5	6.0	5.5	4.4	4.3	3.5	1	6	25μ	5.0	4.0	2.8	2.0
¼	26	5.5μ	17	21	28	35	42	52	¾	9	16.0μ	24	35	49	70
⅙	42	3.5μ	3.3	3.75	3.3	2.73	2.6	2.1	½	13	11.3μ	3.0	2.4	1.72	1.22
⅓(o.i.)	42	3.5μ	30	36	48	60	72	90	1	6	25μ	42	60	84	120
⅛	51	2.1μ	2.13	2.25	2.06	1.7	1.69	1.35	¾	9	16.0μ	1.95	1.59	1.09	0.78
⅓	60	2.1μ	45	54	72	90	108	135	½	13	11.3μ	63	90	126	180
⅓(o.i.)	96	1.5μ	1.47	1.59	1.45	1.19	1.18	0.94	¼	26	5.5μ	1.35	1.11	0.76	0.55
⅙(o.i.)	106	1.3μ	65	78	104	130	156	195	⅙	42	3.5μ	91	130	182	260
			0.73	0.77	0.71	0.58	0.58	0.46	⅓	42	3.5μ	0.66	0.54	0.37	0.26
			130	156	208	260	312	390	½	13	11.3μ	182	260	364	520
			0.45	0.48	0.45	0.37	0.36	0.29	⅓	42	3.5μ	0.41	0.34	0.23	0.17
			210	252	336	420	504	630	⅙	42	3.5μ	294	420	588	840
			0.44	0.47	0.44	0.36	0.36	0.28	⅓(o.i.)	42	3.5μ	0.40	0.33	0.23	0.16
			210	252	336	420	504	630	⅛	51	2.1μ	294	420	588	840
			0.27	0.28	0.26	0.22	0.22	0.17	⅓	60	2.1μ	0.25	0.20	0.14	0.10
			255	306	408	510	612	765	⅙	42	3.5μ	490	700	980	1400
			0.27	0.28	0.26	0.22	0.22	0.17	⅓	60	2.1μ	0.25	0.20	0.14	0.10
			300	360	480	600	720	900	⅙	42	3.5μ	490	700	980	1400
			0.20	0.21	0.20	0.16	0.16	0.13	⅓(o.i.)	96	1.5μ	0.18	0.15	0.10	0.07
			480	576	768	960	1152	1440	⅙(o.i.)	106	1.3μ	672	960	1344	1920
			0.17	0.18	0.17	0.14	0.14	0.11	⅙(o.i.)	106	1.3μ	0.16	0.13	0.09	0.06
			530	636	848	1060	1272	1590	⅙(o.i.)	106	1.3μ	742	1060	1484	2120

HOLOSCOPIC OBJECTIVES.	Primary Magnifi- cation at 160 mm. tube length.	Micro- metric value.	Combined magnifications at 160 mm. tube length with Holoscopic eyepieces, and field of view.				HOLOSCOPIC OBJECTIVES.	Primary Magnifi- cation at 200 mm. tube length.	Micro- metric value.	Combined magnifications at 200 mm. tube length with Holoscopic eyepieces, and field of view.			
			× 7	× 10	× 14	× 20				× 7	× 10	× 14	× 20
			mm.										
25	6	24.8μ	3.0	2.4	1.68	1.20	25	8	19.3μ	2.3	1.9	1.31	0.94
16	8	18.0μ	42	60	84	120	16	10	14.2μ	56	80	112	160
12	13	11.6μ	2.15	1.76	1.21	0.87	12	16	9.2μ	1.67	1.39	0.94	0.68
8	19	7.3μ	56	80	112	160	8	24	5.8μ	70	100	140	200
6	23	6.2μ	1.38	1.12	0.77	0.56	6	30	4.9μ	1.08	0.89	0.62	0.44
4	37	3.9μ	91	130	182	260	4	46	3.2μ	112	160	224	320
2(o.i.)	84	1.7μ	0.88	0.72	0.50	0.36	2(o.i.)	104	1.4μ	0.7	0.58	0.40	0.29
			133	190	266	380				168	240	336	480
			0.73	0.60	0.41	0.29				0.59	0.48	0.33	0.24
			161	230	322	460				210	300	420	600
			0.46	0.38	0.26	0.19				0.38	0.31	0.21	0.15
			259	370	518	740				322	460	644	920
			0.21	0.17	0.11	0.08				0.17	0.14	0.09	0.07
			588	840	1174	1680				728	1040	1456	2080

APO- CHROMATIC OBJECTIVES.	Primary Magnifi- cation at 160 mm. tube length.	Micro- metric value.	Combined magnifications at 160 mm. tube length with Holoscopic eyepieces, and field of view.				APO- CHROMATIC OBJECTIVES.	Primary Magnifi- cation at 200 mm. tube length.	Micro- metric value.	Combined magnifications at 200 mm. tube length with Holoscopic eyepieces, and field of view.			
			× 7	× 10	× 14	× 20				× 7	× 10	× 14	× 20
			mm.										
16	8	18.0μ	2.15	1.76	1.21	0.87	16	10	14.2μ	1.67	1.39	0.94	0.68
8	19	7.6μ	56	80	112	160	8	24	6.1μ	70	100	140	200
4	37	3.9μ	0.89	0.73	0.49	0.36	4	46	3.2μ	0.71	0.59	0.40	0.29
2(o.i.)	84	1.7μ	133	190	266	380	2(o.i.)	104	1.4μ	168	240	336	480
			0.46	0.38	0.26	0.19				0.38	0.31	0.21	0.15
			259	370	518	740				322	460	644	920
			0.21	0.17	0.12	0.08				0.17	0.14	0.10	0.07
			588	840	1174	1680				728	1040	1456	2080



Student's Eyepiece.

glass, worked to ascertained curves gives results that are superior to those ordinarily obtainable.

We strongly recommend microscopists to try our Huygenian Eyepieces, and make comparisons between those of our current make and any others they may have hitherto used.

Huygenian Eyepieces 1-4 Student's size are all parfocal so that on interchanging the different powers the object remains in focus.

The advantage of this in Laboratory practice is obvious.

The magnifying power of each Eyepiece is engraved on the eyecap. This figure represents the number of times the Eyepiece will magnify the image produced by the Objective of the microscope.

The Eyepieces also bear an ordinal number 1 to 6, which corresponds with the old notation of A, B, C, etc.

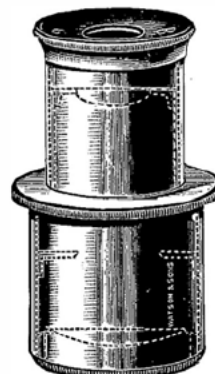
EYEPIECES OR OCULARS

Watson's Eyepieces are made in two patterns—the Universal small, or Student's size, 23.3 mm. (.9173 in.) dia., and the large size of the Royal Microscopical Society, with caps, to ensure correct position of the eye, 32.26 mm. (1.27 in.) dia.

Eyepieces of small diameter may be used in draw tubes of large diameter by the use of an adapter costing 7/6.

HUYGENIAN EYEPIECES

This series of Eyepieces has been the subject of considerable experiment and re-computation. It has been found in consequence, that the use of selected optical glasses, instead of the usual ordinary crown



Best Capped Eyepiece.

Code Word.	No.	Number ...	1	2	3	4	5	6
		Power ...	× 5	× 6	× 8	× 10	× 12	× 15
Measl.	11801	Price for Universal Size.	£ s. d. 0 10 0	£ s. d. 0 10 0	£ s. d. 0 10 0	£ s. d. 0 10 0	£ s. d. 0 15 6	£ s. d. 0 15 6
Meand.	11802	Price for Large Capped Size.	1 5 0	1 5 0	1 5 0	1 10 0	1 10 0	1 10 0

LARGE SIZE CAPPED EYEPIECES

These actually produce a more brilliant and slightly larger field. They have definite advantages both in Photomicrography and dark ground illumination. The longer eyepoint allows ample space for the use of spectacles.

DAYLIGHT EYEPIECES

The daylight filter supplied for use in the condenser is often lost. Watsons have secured a supply of daylight filter glass of the correct constants and it is used for the field lenses. For many purposes these Eyepieces have been found most useful. They are made in two magnifications No. 2 X6, No. 4 X10 at 15/- each.

11806 11807

EYEPIECES FOR MICROMETER, CROSS WEB, etc.

X6 Eyepieces are recommended for this purpose. The field is sufficiently flat. In eyepieces of higher magnification curvature of the field vitiates all save the central measurements. There are occasions when these higher magnifications are essential and such eyepieces are therefore listed.

Meaot	11803	X6 HUYGENIAN EYEPIECE with focussing eyelens	...	...	...	£ s. d. 0 15 0
Meaop	11804	X8	"	"	"	0 15 0
Mepot	11805	X10	"	"	"	0 15 0
POINTER TO EYEPIECES—If fitted at time of ordering, add to price of eyepiece						0 5 0

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

“HOLOSCOPIC” EYEPIECES

These Eyepieces are designed to work with all types of objectives, making it unnecessary to have two series of Eyepieces if Parachromatic and Apochromatic or Holoscopic Objectives are used.

In Achromatic Objectives corrections are carried out in the Objective itself and the Eyepiece serves to a large extent as a magnifier.

Apochromatic systems, however, are based upon a different conception of design. The Objective besides being corrected spherically is corrected chromatically for two colours only, the remaining correction being carried out by the Eyepiece.



Thus the owner of Objectives Achromatic and Apochromatic should to obtain the best results have a set of Eyepieces for each. Further as the total correction necessary varies from computer to computer there should be a complete series of compensating Eyepieces provided for each different make of Apochromatic Objectives.

To overcome this very serious difficulty Prof. Conrady designed the Holoscopic Eyepieces. A variable separation between two corrected combinations is provided. For Achromatic Objectives the lenses are brought as nearly as possible together, for the Holoscopic series the lenses are separated to about the third division, for Apochromats to the fifth to eighth division dependant upon the amount of correction required.

The magnifying powers are engraved on the caps of the Eyepieces and are calculated for the Eyepiece when the adjusting tube is closed.

Holoscopic Eyepieces offer the further advantage that they give a flatter and more uniformly defined field than the ordinary Huygenian Eyepieces. They can be used advantageously with any make of Apochromatic Objectives.

Code Word.	No.	Power.	× 5	× 7	× 10	× 14	× 20
Mecha.	11901	Price for Universal Size.	Not made	£ s. d. 2 0 0	£ s. d. 2 0 0	£ s. d. 2 0 0	£ s. d. 2 0 0
Medle.	11902	Price for Large Capped Size.	£ s. d. 2 15 0	£ s. d. 2 15 0	£ s. d. 2 15 0	£ s. d. 2 15 0	£ s. d. 2 15 0

Holoscopic Eyepieces are made in two patterns the ordinary Student's universal size, and the large capped pattern. The large capped pattern gives a bigger and more brilliant field. Either kind can be used with any tube length.



THE PROJECTION EYEPIECE for Photo-Micrography and Micro-Projection.

These Eyepieces may be used advantageously with Objectives of either the Apochromatic or ordinary series, for photographic purposes, projecting an exquisitely sharp image on the plate. A divided circle is provided, the figures of which record the adjustment for camera extension. For visual focussing the pointer should be set to the division marked 0. When photographing, the Eyepiece is correctly set when the focussed image of the diaphragm forms a sharp edge to the photographic picture. Made in the Student's (·9173 in.) size.

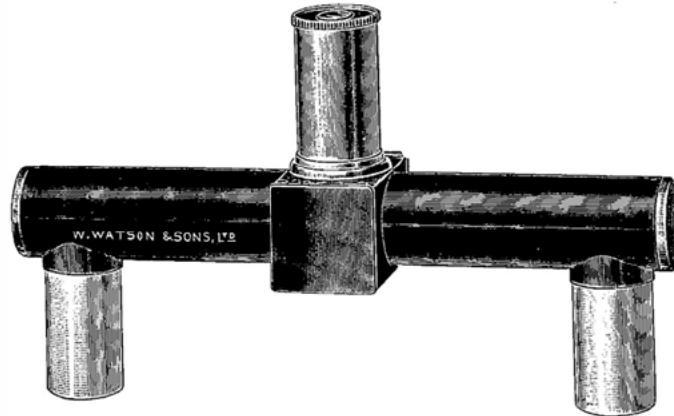
Code Word.	No.		£ s. d.
Medif	11903	Initial magnifying power, × 6	2 10 0
Medeg	11904	Adapters between Student's Eyepieces and any larger size	0 7 6

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

COMPARATOR EYEPiece

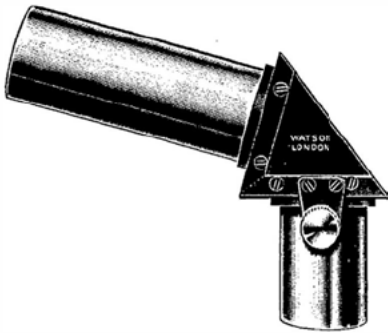


To enable two microscopic objects to be accurately compared they must be seen with the same eye in the same field of view.

Watson's Comparator Eyepiece is constructed to connect two microscopes and by a series of reflecting prisms to present the images formed by the two microscopes in the field of view of a single Eyepiece. By its means the similarity or dissimilarity between two objects may be instantly detected. The appliance is particularly valuable in every branch of research, industrial and forensic investigations.

Code Word.	No.		£	s.	d.
Mefas	12001	Comparator Eyepiece complete with Ramsden Eyepiece, to attach to two microscopes	12	10	0

ANGLE EYEPiece



When observing living organisms, loose material or unmounted objects in fluid by means of the microscope it is necessary to keep the stage of the instrument in a horizontal position, in which case the optical axis of the objective must be vertical. In such circumstances it has usually been necessary to direct the eye vertically downwards, a condition which is not only uncomfortable for the muscles of the neck, but also renders vision less distinct. Really delicate observations cannot be made in this manner.

Watson's Angle Eyepiece enables the observer to obtain all the advantages of an inclined microscope tube while maintaining the stage in a horizontal position. The image is presented to the observer in the same position as a book or other object placed for comfortable vision.

Watson's Angle Eyepiece is an attachment the lower end of which slides into the draw tube and the upper end receives any ordinary eyepiece. The middle portion contains an accurately ground and polished prism which receives the rays from the objective and reflects them completely so that the optical axis of the instrument is deflected 75 degrees. A clamping screw attaches the fitting to the draw-tube of the microscope so as to prevent rotation. The slight increase of tube length may be overcome by the use of slightly thinner covers if desired.

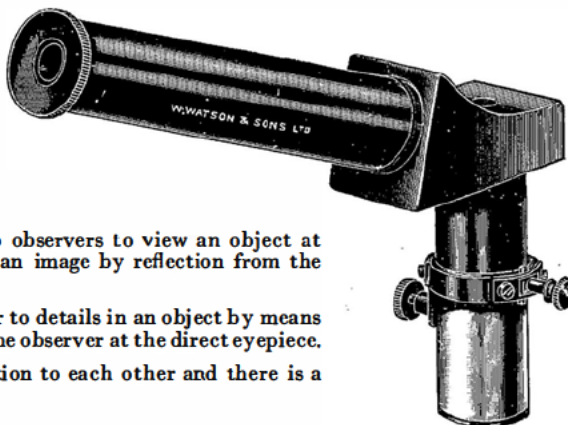
Code Word.	No.		£	s.	d.
Mefol	12002	Angle Eyepiece, as described, to fit standard draw tube	2	10	0

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

DUPLEX EYEPIECE



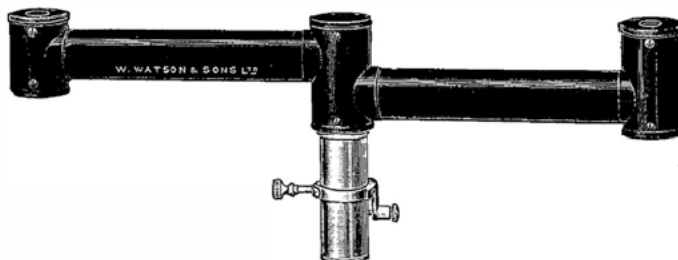
The Duplex Eyepiece enables two observers to view an object at the same time, the side tube receiving an image by reflection from the direct eyepiece.

By its use a demonstrator can refer to details in an object by means of a movable pointer for the benefit of the observer at the direct eyepiece.

The images are orientated in relation to each other and there is a slight difference of magnification.

Code Word.	No.		£	s.	d.
Medij	12101	Duplex Eyepiece, Universal size ...	5	15	0
Medoc	12102	Tinted glass to render images equal in intensity ...	0	10	0

DEMONSTRATION EYEPIECE



By means of a special system of reflecting prisms similar to that of a high power binocular eyepiece the image of the object formed by the objective is seen simultaneously at the same magnification and orientation in each eyepiece. Both observers look in a downward direction. A movable pointer is controlled by the teacher and can be directed to any structure in the field.

This Demonstration Eyepiece is the best that has been devised and will be found invaluable for the explanation of complex structures.

Code Word.	No.		£	s.	d.
Mefem	12103	Demonstration Eyepiece complete with indicator ...	10	10	0

OTHER SPECIAL EYEPIECES MADE:

Binocular pattern.	Petrological pattern.
Drawing pattern.	Photographic Camera.
Ehrlich pattern for blood counting.	Pinhole Eyepiece for centring.
Micrometer pattern, various,	Spectroscopic pattern.
Konimeter pattern.	Watching Eyepiece.

For particulars, see Part 2 of this catalogue.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

NOSEPIECES OR OBJECTIVE CHANGERS

Watson Double and Triple Nosepieces are made with carefully fitted plates which exclude dust. To ensure accurate centration each Objective fitting is provided with tangential adjustment, and Objects found with the low power Objectives will be found in the same position of the field with each succeeding power when rotated on the nosepiece.

These Nosepieces should be rotated in one direction only (clockwise) an arrow being engraved to show this direction. This arrangement ensures continued accuracy. Their internal and external screws will fit all standard Objectives and microscopes.



NOTE. When Nosepieces are fitted to Microscopes, the Nosepieces should be fixed so that they project outwards, otherwise they are liable to catch against the Microscope itself. If preferred nosepieces can be supplied to rotate in either direction.

Code Word.	No.								£	s.	d.
Mated	12201	Double Nosepiece, for two Objectives	...	...	...	...	...	...	1	5	0
Maste	12202	Triple Nosepiece, for three Objectives	...	...	...	...	...	...	1	10	0
Masto	12203	Quadruple Nosepiece for four Objectives	...	...	...	...	...	...	1	18	0

CENTRING NOSEPIECE



To ensure that the axis of an Objective shall coincide with the axis of a rotating stage or of another Objective or Condenser a centring Nosepiece is made.

Centration is effected by means of two radial screws.

Code Word.	No.								£	s.	d.
Masty	12204	...	...	...	...	...	...	...	1	10	0

NOSEPIECE IRIS DIAPHRAGM OR DAVIS SHUTTER



B 3462

Iris Diaphragm fitted in an adapter to interpose between Objective and Nosepiece for the purpose of controlling the aperture of the Objective. It is of value in dark ground illumination and for increasing penetration.

It can be set with the handle in any direction.

Code Word.	No.									£	s.	d.
Peace	12205	...	...	...	...	...	...	...	...	1	2	6
Peaky	12206	Ditto, with substage adapter to enable Objectives to be used as Condensers	...	...	...	...	...	...	...	1	7	6

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

CONDENSERS—SUBSTAGE

The exacting demands of modern teaching and research work have emphasized the importance of the condenser in the microscopist's equipment, and a range of condensers both for transmitted light and dark ground illumination, for photomicrography and projection is offered. The following notes will serve as a guide to those who wish to select condensers for any particular purpose:

Direct Light without a Condenser. For objectives up to and including $\frac{1}{2}$ in. sufficient illumination for ordinary class work is available from the concave mirror, the curve of which is such as to cause a pencil of rays from the illuminant to be brought to an approximate focus in the plane of the stage.

The Abbe Illuminator. For routine school and teaching purposes the Abbe Illuminator will be found sufficient. This condenser is neither achromatised nor aplanatised and was introduced by Professor Abbe for the universal use of Students and Laboratories because of its insensibility to centring, and its capability of illuminating. It is popular where concentration of light on the specimen is desired but where ultimate resolution is not essential. It is specially effective for dark ground illumination.

CORRECTED CONDENSERS

It has been shown that the total resolving power of any microscope system is not only dependent upon the numerical aperture of the Objective but is equivalent to the mean of the aplanatic aperture of the condenser and of the Objective. Thus, the conventional equipment of oil immersion Objective and Abbe condenser cannot in any circumstances give the full resolving power of the Objective. This will be seen from the equation.

$$\text{Aplanatised aperture of Abbe Condenser} + \text{Numerical aperture of oil immersion Objective} = \frac{0.65 + 1.28}{2} = \frac{1.93}{2}.$$

In research work, therefore, or in any work where unknown structure is to be investigated and the full resolving power of the Objective is to be employed a Condenser of aplanatic aperture equal to that of the Objective should be used. There arise certain objections to this: for instance, the Botanist or the Zoologist uses the immersion Objective but seldom. The purchase, therefore, of a condenser with an aperture when immersed equivalent to that of an oil immersion Objective would be an unnecessary expense and the Universal or the Parachromatic Condensers will be found ideal. Conversely, if the Bacteriologist, Pathologist or Cytologist wish to wrest the utmost from their equipment they should select as their work is predominantly carried out with immersion oil Objectives the Holooscopic oil immersion condenser. This condenser is so designed that it may be used dry at an aperture of 0.95.

The general routine worker will find a distinct gain in the use of these condensers in his daily practice. With the exception of the Abbe Condenser, all condensers offered are not only aplanatised but also achromatised. It is not sufficient to purchase an Objective such as the Holooscopic, Apochromatic, or even modern Parachromatic in which colour corrections have been carried to a high degree of perfection and expect that the chromatic beam yielded by the Abbe Condenser will assist these to give optimum results. Objectives are not capable of eliminating colour when this is in the beam of light transmitted through them, their corrections are necessarily based upon the assumption of a corrected beam of light. Under these circumstances a combination of the Parachromatic Objectives with the Universal or Holooscopic Condensers will give superior results to a combination of these Objectives with an Abbe Condenser, while the results will be superior to the use of Apochromatic Objectives with an Abbe Condenser.

Recent developments of substage design have led to the introduction of Condenser changers of similar design to Objective changers. The objection to the use of several condensers when it was necessary to shift the whole substage apparatus is now overcome, and in addition to the centring screws to the substage Watson's research condenser changers to-day incorporate separate centring arrangements on the condenser slides themselves. It is thus possible to have a series of condensers all interchangeable on the same substage of the microscope and all co-axial, immediate exchange can be made without the necessity for recentring on each occasion. To the busy worker, especially those using dark ground illumination, this adjunct will be found advantageous.

Three forms of dark ground condenser are offered. The Holooscopic Immersion Paraboloid which has found such favour among all workers, which is standardised by the Indian Government for all medical services, by H.M. Admiralty for use throughout the Fleet, and by many teaching Institutions, is retained. This Condenser will be found the most satisfactory for general diagnostic practice; it should be used with Objectives whose aperture is less than 1.0. An oil immersion Objective may be employed provided a funnel stop or iris diaphragm for reducing aperture is inserted. Alternatively, we recommend the semi-apochromatic $\frac{1}{2}$ in. oil immersion Objective 0.94 N.A. for this purpose.

The Cassegrain Dark Ground Condenser is made for use with all Objectives up to 1.40 N.A., dependent upon the refractive index of the medium employed. Thus specimens mounted in water or serum the refractive index of which is 1.33 should be examined with Objectives having an aperture not greater than 1.28.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

The New Long Working Distance Zonal Dark Ground Illuminator has been introduced for use by those whose research requires dark ground illumination in conjunction with high powers and deep cells. These condensers are made in two types, one for use with Objectives having a numerical aperture not greater than 1.15 and with a working distance up to 2.5 mm.; this condenser is fitted with the standard R.M.S. thread. The alternative condenser having a larger front lens 25 mm. diameter is supplied with the Watson Universal and Abbe size condenser thread and can be made with a working distance of 4 mm. It is also designed for use with Objectives whose numerical aperture does not exceed 1.15.

Please specify the working distance required at the time of ordering.

GENERAL INDICATIONS FOR USE OF THE VARIOUS CONDENSERS

Macro Condenser. This is intended for use in conjunction with photographic and other Objectives of 2 in. and longer focal lengths. In use the Condenser should be racked up until almost in contact with the under surface of the specimen. The beam is then brought to a focus inside or beyond the Objective, by this means an evenly illuminated field is provided and the whole of the specimen can be photographed without difficulty. For projection with low powers or for projection drawing, this condenser, which is fully achromatised, will be found ideal.

Low Power Condenser. For Objectives whose aperture does not exceed .45 this condenser is indicated, having a relatively long focus a large area is illuminated with a resultant equality of intensity of illumination over the whole field. If critical illumination be employed and the light source focussed in the plane of the object it will be found that the image is sufficient to fill the field of these Objectives.

Universal Condenser. This condenser is designed for those whose work is primarily with low and medium powers. Having a focal length of $\frac{1}{6}$ in. the light source, assuming that the Pointolite, oil lamp or similar radiant is employed, will be found to fill the field effectively with a $\frac{1}{8}$ in. Objective.

If low powers such as the $\frac{3}{8}$ in. Objective are to be used and full aperture is required combined with a large image of the light source, the top lens of the condenser may be unscrewed and a fully achromatised combination is left.

Parachromatic Condenser. This is suitable for workers with medium and high powers who desire to be able to use the oil immersion Objective with critical illumination. The focal length of this condenser is $\frac{2}{5}$ in., and consequently a smaller image of the radiant is projected into the field of view and this will be found sufficient for oil immersion Objectives, while the concentration of light into the smaller area is of great advantage.

For low powers such as the $\frac{3}{8}$ in. the top lens may be unscrewed when a fully achromatised and aplanatised combination at N.A. 0.40 remains.

Holoscopic Oil Immersion Condenser. This serves the purpose of those requiring maximum resolving power from their Objectives. It can be made with apertures from N.A. 1.30 1.37 and for any thickness of slip from 0.9 mm. 1.4 mm. Its corrections are as perfect as those of an achromatic oil immersion Objective, and for critical high power visual or photomicrographic work this condenser has no equal, the performance of Objectives and the detail seen is immeasurably increased especially if critical illumination be employed.

The condenser will be found to perform in every way satisfactorily if used dry with dry Objectives, while with the front lens removed an aperture of 0.55 is available.

In fact one of the best known microscopists of the day remarked when using this condenser "It is like another eye."

In our series of substage condensers, we provide for all classes of work, with every power of Objective, as follows :—

Condenser.	Full Aperture.	Aplanatic Apertures.		Equivalent Focus.		Page.	Diameter of Back Lens.
		Complete.	Top Lens Removed.	Complete.	Top Lens Removed.		
Macro Illuminator... ..		—	—	In. 2.0	In. —	25	1.25
Aplanatic Low-power ... ..	.50	.48	—	.66	—	25	.60
The Universal	1.0	.95	.40	.40	1.0	26	.77
The Parachromatic	1.0	.90	.40	.29	.40	27	.62
Oil Immersion (Holoscopic series)	1.30 to 1.37	Full	.55	.22	.55	27	.60

And our well-known Abbe Illuminator, page 28.

The freedom of the lens-system from spherical aberration shows the degree of aplanatism attained. In the above table the aplanatic aperture is very large in relation to the full aperture : a sufficient indication of high efficiency.

As already explained achromatism is as important as aplanatism for really good results ; particularly with highly corrected Objective systems. All the above condensers are achromatised.

Special attention is drawn to the new Condenser Changers described on pages 42 and 43.

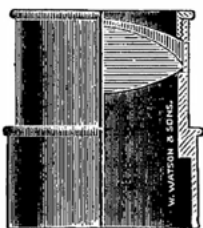
LOW-POWER APLANATIC SUBSTAGE CONDENSER



12501

This Condenser will provide a solid cone of rays of nearly 0.50 N.A. and will give dark illumination for Objectives of 0.30 N.A.

Code Word.	No.		£	s.	d.
Medio	12501	Optical part only with Universal screw ...	3	10	0
Medit	12502	Completely mounted, similar to Parachromatic Condenser, page 27, with iris diaphragm and set of stops ...	5	0	0



12503

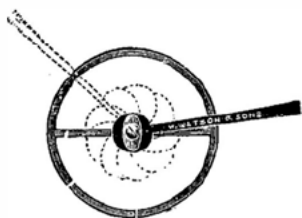
THE MACRO ILLUMINATOR

The problem of the even illumination of a large field is solved by the use of this illuminator. It is a valuable means of illuminating large objects (up to 1½ in. dia.) for low power Photomicrography.

Code Word.	No.		£	s.	d.
Medla	12503	Mounted for Substage ...	3	10	0

SPOT-LENS FOR LOW-POWER DARK-GROUND ILLUMINATION

Code Word.	No.		£	s.	d.
Pecas	12504	Spot-Lens for dark-ground illumination ...	0	15	0
Pedal	12505	Ditto, in Sliding Mount ...	0	18	6



12506

EXPANDING STOP FOR DARK-GROUND ILLUMINATION

This is a substitute for a large series of Stops. It is made to fit the Stop-ring of our Universal Condenser and Abbe Illuminator. The proper diameter of stop for use with any given Objective is accurately obtained by the movement of the lever which operates on the same principle as an iris diaphragm. The central disc can be varied in diameter from 0.4 to 0.75 in.

Code Word.	No.		£	s.	d.
Medin	12506	Expanding Stop as described, for Stop ring 1.375 in. dia. ...	1	0	0
Medix	12507	Do. do. do. .875 in. dia. ...	1	0	0
Medir	12508	Alteration of Stop-ring to take Expanding Stop where necessary ...	0	5	0

NOTE.—These Stops are somewhat fragile, and no responsibility can be accepted for them after leaving our hands

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

CONDENSERS—SUBSTAGE

HOLOSCOPIC SYSTEM

THE UNIVERSAL CONDENSER



12601

For rapid work, a condenser having large lenses is an immense advantage, and in the Universal Condenser a diameter of back lens is given, which in practice affords all the convenience of the larger sizes. With it work can be done as rapidly, and more accurately, than with any other Condenser, while the beautiful achro-aplanatic corrections render it the finest all-round Condenser procurable.

It is constructed on our Holographic System, a triple back lens producing the correcting effect. It is this system which has enabled us to produce in our Holographic Objectives and Oil Immersion Condensers, corrections for spherical aberration, which have made them famous as the best examples of optical skill and perfection in aplanatism.

We would emphasise the enormous aplanatic aperture it yields. Its **total** aperture is aplanatic, if the exact thickness of slip (1 mm.) be used for which it is corrected. It will work through any reasonably thick slip, but is slightly under-corrected for thin ones. This can, however, be corrected by partly unscrewing the front lens so as to cause it to touch the slip when in focus.

The Mounting is the same as used for the Abbe Illuminator, with which the Universal Condenser will interchange. It has iris diaphragm and cell for stops.

Power.		Total Aperture.	Aplanatic Aperture.		Diam. of Back Lens.
Complete.	Front lens removed.		Complete.	Front lens removed.	
·4 in.	1·0 in.	1·0	·95	·40	·77

Code Word.	No.					£	s.	d.
Meeko	12601	Optical part only	...	...	...	5	10	0
Merem	12602	Completely-mounted with iris diaphragm.	For Understage			6	10	0
Megim	12603	Do. do. do.	For Substage	...		7	0	0
Meine	12604	Set of stops for dark-ground illumination, etc.	...	...		0	10	0
Melan	12605	Coloured glasses blue, yellow, signal green, ground, etc., Dr. Spitta's "pot green."	...	...	each	0	1	6

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

SUBSTAGE CONDENSERS

THE HOLOSCOPIC OIL IMMERSION CONDENSER

**12701**

The Holoscopic Oil Immersion Condenser is designed for the Expert Research Worker and Connoisseur to exhaust the possibilities of all Oil Immersion Objectives.

It is constructed on the same plan as our Holoscopic Objectives in which all corrections for chromatic and spherical aberration are effected by a triple cemented combination. Its total numerical aperture is 1.30; it can be used with glass slides up to 1.4 mm. in thickness and it will give an aplanatic cone of rays to the limit of its aperture. This is equal to the utmost requirements of modern Objectives of the greatest aperture.

If desired this Condenser can be made (specially to order) with a numerical aperture of 1.37; but its use would be limited to slides not exceeding 1.3 mm. in thickness.

The Holoscopic Oil Immersion Condenser may be used dry (without immersion oil). Under such conditions its numerical aperture is 1.0 and the aplanatic cone of rays is 0.92 N.A.

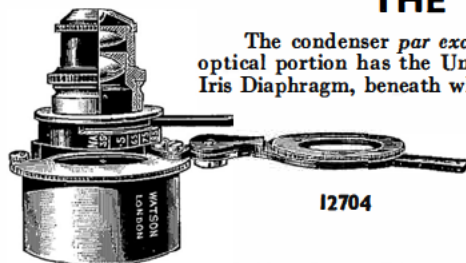
When Objectives of low or moderate power are occasionally resorted to and a change of Condenser would be inconvenient it will be found that the removal of the top lens of the Holoscopic Oil Immersion Condenser converts the latter into an efficient Condenser very suitable for such Objectives.

N.B.—It is not fully realised what an excellent condenser this is for dark ground illumination with Objectives of high numerical aperture.

	Oil immersed complete.	Dry complete.	Dry top lens removed.
Focal Length ... ..	.22 in.	.22 in.	.55 in.
Full aperture	1.30 1.37 N.A.	1.0 N.A.	60 N.A.
Aplanatic aperture	do.	.92 N.A.	.55 N.A.

Code Word.	No.	Clear diameter of Back Lens, .6 in.	£	s.	d.
Melio	12701	Optical part only, having standard R.M.S. thread ...	8	0	0
Melif	12702	Completely mounted with iris diaphragm, similarly to Parachromatic Condenser shown below, with divisions to indicate aperture employed. With set of stops complete ...	9	10	0
		For coloured glasses, see 12705.			

THE PARACHROMATIC

**12704**

The condenser *par excellence* for medium and high power workers. The optical portion has the Universal Objective Thread and is mounted over an Iris Diaphragm, beneath which is a revolving carrier for Stops for dark ground and oblique illumination. The Iris Diaphragm is divided so as to indicate the N.A. at which the Condenser is being employed. The diameter of the back lens is specially large for such a Condenser. This Condenser is eminently suited for critical and photographic work, and we confidently recommend it.

Power.		Aperture.	Aplanatic Aperture.	Diameter of Back Lens.
Complete.	With top lens removed.			
.29 in.	.4	1.0	.90	.62 in.

Code Word.	No.		£	s.	d.
Mallo	12703	Optical part only, having standard R.M.S. thread ...	5	10	0
Melod	12704	Completely mounted as figured, with set of stops ...	7	0	0
Melte	12705	Disc of blue, yellow, signal green, ground-glass or Dr. Spitta's "pot green" for either of the above Condensers ... each	0	1	6

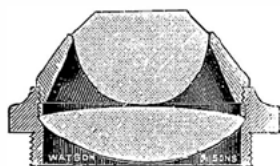
W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

CONDENSERS—SUBSTAGE

WATSON'S NEW ABBE CONDENSER.



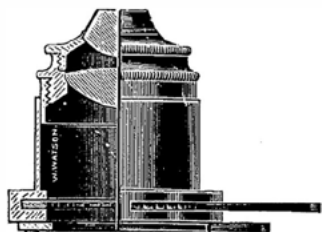
Optical part of Abbe Illuminator.
1.20 N.A. 12801.



Mounted for Substage.
12802.

The continued popularity of this Condenser is due to the ease and rapidity with which it can be employed and for its brilliancy of image.

Although its numerical aperture is great, being 1.20, its Aplanatic Cone is comparatively small, but the ease with which it can be used has caused it to be universal for both high and low power routine work; for the latter purpose the top lens is removed. A beautiful dark ground effect may be obtained with it with Objectives up to 0.45 N.A.



Mounted for Understage. 12803.

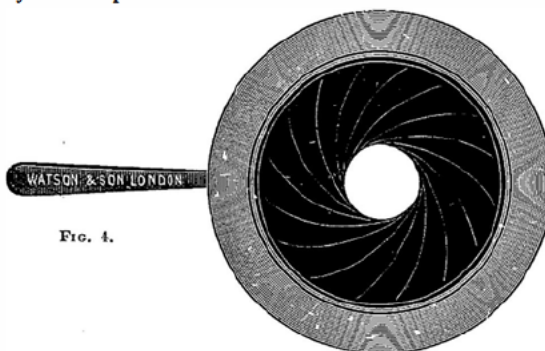


FIG. 4.

We have designed a very perfect Iris Diaphragm for the fittings of these Condensers (as Fig. 4), which permits of the most precise gradation of illumination being immediately obtained.

ABBE CONDENSER

Code Word.	No.		£	s.	d.
Membe.	12801	Optical part only, N.A. 1.20	1	5	0
Memen.	12802	Completely mounted for substage , with iris diaphragm and cell for stops, N.A. 1.20	3	0	0
Memor.	12803	Completely mounted for understage with iris diaphragm and carrier for stops, N.A. 1.20	2	5	0
Memab.	12804	Set of stops for dark-ground, etc., illumination in brass box	0	10	0
Memyo.	12805	Discs of glass, tinted, blue signal green, yellow, ground glass, Dr. Spitta's "Pot Green," etc. ... each	0	1	6

SIMPLIFIED ABBE CONDENSER WITH IRIS DIAPHRAGM

Memed.	12806	The Iris diaphragm can be used independently if the Condenser is removed	1	10	0
Memex	12807	Sleeve pattern iris diaphragm only with thread to receive simplified Abbe condenser if required	0	15	0

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

W. WATSON & SONS' HOLOS IMMERSION PARABOLOID

(Adopted by H.M. Admiralty)



The purpose of this Illuminator is to display minute organisms and ultra-microscopic particles, brilliantly illuminated upon an intensely black field.

It will be found very suitable for the detection of many living pathogenic organisms in blood and watery media and for the differentiation of structural details in tissues which are not amenable to staining processes.

For the convenience of those who use the English type of Microscope, the optical portion of the Holo Immersion Paraboloïd is so mounted that it can be interchanged with the ordinary optical part of the Abbe Illuminator and similar Condensers supplied by ourselves and other English houses, and therefore used in conjunction with the Iris diaphragm mounting which carries the Abbe Illuminator optical part, Nos. 12802 and 12803.

It can usually be supplied to fit any other make of Microscope that may be specified.

Essentials of Successful Working.

1. The Holo Immersion Paraboloïd must in every case have oil between it and the object slip, and the contact must be maintained, and all air bubbles avoided.
2. The Paraboloïd must be accurately centred.
3. The object slip must be within 20 per cent. of the thickness engraved on each of the Paraboloïd mountings. A supply of suitable slips is included with each Paraboloïd.
4. The specimen should be in as thin a layer of fluid as possible.
5. The source of light must be a very brilliant one, and a lamp condenser should be used.

The annular illumination provided by the Paraboloïd extends from about N.A. 1.0 to N.A. 1.45, and it is noteworthy that the use of the Iris diaphragm cuts out the rays of low numerical aperture first, so that the illumination becomes more and more oblique. This is a very favourable circumstance, as it secures the greatest resolving power attainable under the circumstances of dark ground illumination for all Objectives exceeding .48 numerical aperture.

The smaller the source of light the more care is required in making the adjustments, and in using slips of the proper thickness. The latter is, therefore, engraved on the mount of each instrument.

Oil immersion Objectives can only be used with the Paraboloïd if a special stop is used which reduces their numerical aperture below 1.0.

Annular Illumination.

This Paraboloïd is also excellent for the resolution of striated objects such as Diatomaceæ. The Objective is then used at its fullest aperture, the illumination from the Paraboloïd being annular and oblique in all azimuths.

Code Word.	No.		£	s.	d.
Merca	12901	Optical part only, mounted to fit Abbe Illuminator Carrier such as is supplied with English Microscopes, with immersion oil and supply of suitable slips	2	15	0
Mercf	12902	Complete Paraboloïd with mounting for Substage	4	10	0
Merce	12903	Ditto, with mounting for understage	3	15	0
		Immersion oil and supply of slips is included with above. ...			
Merch	12904	Funnel Stop	0	5	0
Mercz	12905	Iris diaphragm for reducing N.A. mounted behind back lens of oil immersion Objective. The Objective must be sent for the fitting to be made from	0	17	6
Mercu	12906	This Paraboloïd must be accurately centred, and if the Microscope has no centring screws to the Substage, a Centring Nosepiece should be used, which is supplied with the complete Paraboloïd at a special extra charge	1	10	0

For illuminating attachment for above see page 32.

A leaflet on dark ground illumination technique is published separately. Copies gratis on application. See also articles in Watson's Microscope Record.

For particulars of the new Eisenberg Hanging Drop Slide see page 31.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

CASSEGRAIN DARK GROUND ILLUMINATOR

Designed by Mr. E. M. Nelson.



The "Cassegrain" Illuminator is so named because its curved reflecting surfaces are disposed somewhat similarly to the mirrors of the reflecting telescope invented by Cassegrain. Mr. Nelson discovered that this arrangement, applied to the construction of an oil immersion dark ground illuminator, favoured an intense concentration of rays of greater obliquity than had been utilised before.

Objects mounted in media of high refractive index such as Canada balsam, styrax, or realgar, may be so illuminated by this Condenser as to be seen brilliantly upon a dark ground with Objectives having numerical apertures up to 1.37. This implies a resolving power of 40 per cent. in excess of that obtained with dark ground illuminators which require the aperture of the Objective to be reduced to 1.0 N.A. or less.

Objects such as living bacteria and spirochaetes in aqueous media may be illuminated upon a dark ground by the "Cassegrain" Illuminator by reducing the aperture of the Objective to 1.25 N.A. by means of a funnel stop or iris diaphragm. Water, having a refractive index of 1.33, will not receive the most oblique rays given by this illuminator, but nevertheless the increase in resolving power over other types is 20 per cent.

The apparatus represents a great advance in dark ground illuminators and, as it can be employed with Objectives of the highest apertures now made, without the use of a funnel stop, it attains the limit of possibilities of dark ground with visible light.

A very intense source of light is not necessary with this illuminator. An oil lamp may be used, but for laboratory work a gas filled pearl-frosted electric lamp is recommended. The illuminator will focus through glass slides having a thickness of from 1.0 to 1.2 mm. For centring purposes a fine circle is engraved upon the upper surfaces of the illuminator. Two glass discs bearing central patch stops are supplied with the illuminator for use with different Objectives.

The Illuminator may be screwed into any mount supplied for Watson Abbe Illuminators or Universal Condensers, and is thus interchangeable with these accessories.

A "Cassegrain" Illuminator made of quartz is supplied for use with ultra-violet light.

PRICES

Code Word.	No.		£	s.	d.
Mytol	13001	"Cassegrain" Dark Ground Illuminator, optical part only, with screw to fit mounts for Abbe and Universal Condensers	3	17	6
Mytin	13002	Mount to carry optical part and to fit standard Understage or Substage, provided with centring screws for use with Microscopes which have no centring Substage	1	15	0
Myxom	13003	"Cassegrain" Dark Ground Illuminator, optical part only, made in quartz for use with ultra-violet light	6	5	0
Masty	13004	Centring Nosepiece for use with Microscopes having no Centring Substage	1	10	0

For Substage Electric Lamp for use with this Illuminator, see page 32.

For particulars of the new Eisenberg Hanging Drop Slide see page 31.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

ZONAL DARK GROUND CONDENSER

Will give perfect dark ground illumination with Objective up to NA 1.15.

**13101**

The No. 2 pattern with top mounting 25 mm. diameter necessitating a larger aperture in stage can be made with working distances up to 4 mm.

With both these condensers an intense black background is obtained; their value for work on tissue culture, etc., need not be stressed by us. Although the light concentration with these condensers is intense it will be found that resolution is markedly satisfactory and not spoiled by halation.

**13102**

Code Word	No.	PRICES	£	s.	d.
Maaba	13101	Zonal dark ground condenser, pattern No. 1, with R.M.S. Objective thread made with any working distance up to 2.5 mm. ...	5	0	0
Maabe	13102	Zonal dark ground condenser, pattern No. 2, with Universal, Holographic and Abbe Condenser threads, made in any working distance required up to 4 mm. ...	7	10	0

Please specify the working distance required when ordering.

The use of an iris diaphragm in the Objective in place of a funnel is recommended.

EISENBERG HANGING DROP SLIDE

A 3×1 slide optically polished 1 mm. thick with central cavity hemispherical 2 mm diameter, polished for sterilisation. Overcomes air space usually found with cavity slides.

Designed by Dr. Eisenberg, Middlesex Hospital ... 0 8 6

NEW SUBSTAGE CONDENSER MOUNT

In all Watson's previous Microscopes, when fitted with centring substage, provision has been made for hinging the whole substage with condenser out of the optic axis. This movement is most helpful for low-power work, but the new design of rigid form of centring substage has necessitated the redesigning of this movement.

In general work the Condenser is not removed, but there are occasions when it is preferable to do without a condenser, and a new design of condenser mount has therefore been evolved. In this the optical part of the Condenser swings out of the optic axis, but the Iris diaphragm remains in the substage; it is thus possible to control the intensity of illumination. The swing-out has been designed on new lines; a trigger is now fitted to the part of the mount carrying the condenser optical part and this trigger is of case hardened steel, and instead of the sharp angled catch commonly used on optical instruments a blunt-ended piece is employed which engages in a correspondingly wide slot on the lower section of the mount; this slot is also of case-hardened steel.

Code Word.	No.	PRICES	£	s.	d.
Maabi	13103	Substage condenser mount with swing-out to optical part ...	2	5	0
Maabo	13104	This can be substituted for the condenser mount on the "Service," "Patna" and "Bactil" Microscopes at an extra charge of ...	1	5	0
Maabu	13105	or on the "H" Edinburgh Student's and "Research" models at an extra charge of ...	0	10	0

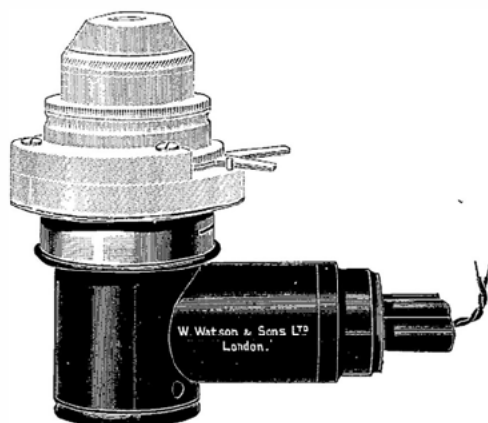
W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

ELECTRIC LIGHT ATTACHMENT

FOR USE WITH THE WATSON HOLOS IMMERSION PARABOLOID
AND OTHER ILLUMINATORS.



Many clinical workers experience difficulty in the rapid setting up of apparatus for diagnosis by dark ground illumination, inexactitude in centring the light or wrong placing of the lamp condenser being fruitful causes of trouble.

By means of the Electric Light Attachment dark ground illumination may be effected rapidly and with certainty. The small enclosed electric lamp gives brilliant illumination and is held in its correct position relatively to the illuminator. A condensing lens is interposed between the lamp and the illuminator.

The appliance is attached to the fitting of the Watson Holos Oil Immersion Paraboloid and, as this fitting is similar to that of the Watson "Universal" Condenser, Abbe Illuminator and Nelson Dark Ground Illuminator, it may be used with these illuminators also for direct illumination, photo-micrography, etc.

The lamp may be supplied with current from a dry battery or accumulator or from the ordinary house supply through a suitable resistance which serves also to control the intensity of illumination.

PRICES

Code Word.	No.		£	s.	d.
Merdo	13201	Electric light, complete with fitting to attach to Holos Immersion Paraboloid, with Condensing Lens, lamp, 3 ft. of flexible wire, no battery	2	10	0
Merel	13202	Four-volt battery in box with switch	1	12	6
Merfo	13203	Extra four-volt battery, dry cells	0	10	6
Merfy	13204	Extra lamps, four-volt or twelve-volt each	0	1	8
Merka	13205	Extra lamps, for use with ordinary house electric supply through a resistance (see below) frosted bulbs, twelve volt, each	0	1	8
Merge	13206	Resistance for 100-125 volts	1	7	6
Mergil	13207	" " 200-250 "	1	17	6

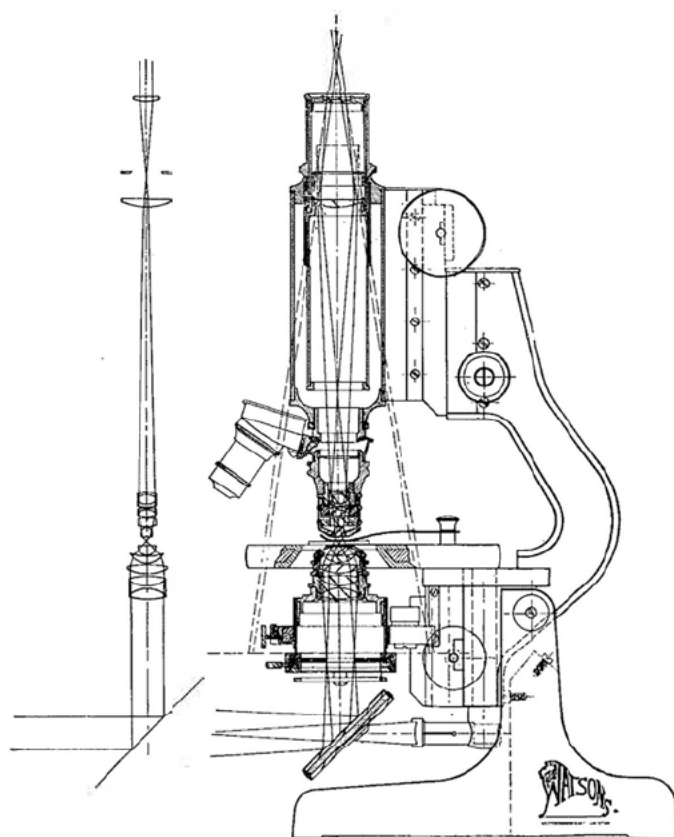
When current from a main supply is to be used with a resistance a 12-volt lamp is supplied. If dry cells or a storage battery are employed a 4-volt lamp is usually taken.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

DIAGRAM OF MICROSCOPE



Enlarged views of the above, size 28 x 40 inches, mounted on cloth, are offered to Schools, Laboratories and others, to hang on Walls, etc.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

PRINCIPLES OF CONSTRUCTION

In the intervening period between the issue of one edition of a catalogue and the next it generally happens that some changes have taken place or some modifications made in the design or the construction of most of our Microscopes. This has taken place because some better way has been found of manufacture and which at the same time gives definite advantage to the user of the instrument. All readers of this catalogue may not be familiar with the salient features of our Microscopes, so we propose to state them as concisely as possible, indicating the most recent developments.

General

The success that has been achieved by the Watson Microscope has been largely due to appreciation of the working conveniences and permanent working qualities which they afford; one aim in their construction has been to minimise the number of parts. So successful has this been that the risk of anything becoming unscrewed or loose is practically non-existent. Thus rigidity and freedom from tremor is assured by the solidity of the various parts and proper balancing.

The fitting of adjusting screws to all working parts is another important factor in the long life of Watson instruments. It is not merely wear and tear that has to be contended with in the fittings of a microscope; other considerations such as dust, extremes of temperature, thoughtless handling, all play havoc with the delicate fittings and adjustments which are associated with a good microscope. Watson's adjustable fittings enable any part to be taken to pieces by a mechanic or a careful worker so that it may be cleaned, oiled and, when replaced, screwed exactly to that degree of fitting which gives the movement that is not too tight but is just tight enough. Workers in the tropics and remote places have in numerous instances testified to the unique benefits that they derive from this valuable provision.

This method of control has been an outstanding feature of the Watson Microscopes for more than forty years: it is not an experiment, it is a happy experience by which every user benefits. It will be more fully explained as the various parts of the Microscopes are described.

It is in consequence of the foregoing and the fittings which will be described hereafter that Watson's are able to give a guarantee of five years and to assure the user of a lifetime of working efficiency.

The Limb.

The limb of the Watson Microscope is something more than is usually called by that name and exhibits the way in which multiple parts held together by screws have been superseded by a solid casting. The limb, as shown in the illustration on page 38, carries the body at one end, the substage at the other; between are the supporting bracket pieces for the stage, and at its extremity is the mirror fitting.

Further advantages are offered; the dovetailed fittings which carry the body and those which carry the substage are machined in one continuous operation ensuring basic alignment throughout. Simultaneously the stage brackets are machined to ensure that they are truly at right angles to the body and substage. A degree of accuracy never before imparted is thus assured and the substage once centred to the body always carries the condenser in the axis of the Objective.

To this limb which was originated in our works we give the title of the Optical Bench Limb.

Incidentally we may say that in recent months the limb has been lengthened at the eyepiece end and thickened.

Compare this with the many parts, all likely to become loose, of which older Microscopes were constructed.

The Body Tube.

The Microscope body has hitherto consisted of the outer tube with a fitting which screwed into the lower end of the body tube and was threaded to receive the Objective. This body tube was fixed to the bar on which the dovetails were machined, to form the coarse adjustment, the fixing of the body tube and bar being done either by screws alone or by screws and solder.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

Watson's are offering something which is definitely in advance of this; the body tube, the Objective fitting and the bar are now machined out of one solid piece of metal and the risk of the parting of either portion is abolished for ever. Enduring parallelism between the optical and mechanical axes is ensured. The reader's kindly reflection on what this important development means and its beneficial effects will disclose that definite progress has been made. The body tube is 40 mm. diameter.

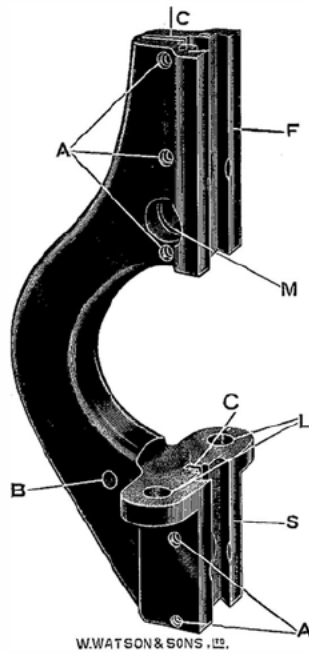


FIG. 1.

- A Screw holes for adjusting the slides.
- B Hole for axis bolt.
- C Saw cut which permits the adjustment of the slides.
- F—Fine adjustment slide.
- L Holes in the extension for attaching the stage.
- M Hole into which the fine adjustment micrometer screw and nut are assembled.
- S—Substage slide.

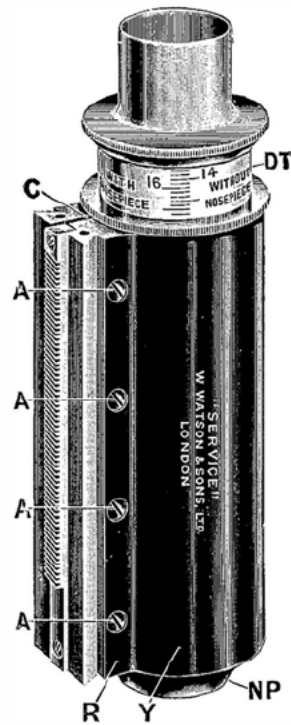


FIG. 2.

The one-piece body nosepiece and coarse adjustment fittings of the "Service" Microscope.

The portions marked R, Y and NP are from solid metal without joints. A are adjusting screws for expanding or contracting the Slot C in the Coarse Adjustment dovetailed fitting. DT is the drawtube.

The Drawtube.

With the narrow drawtube corresponding to the diameter of the standard Student's size eyepieces hitherto supplied in microscopes, a certain amount of internal reflection almost inevitably occurs, and instruments fitted with these drawtubes cannot be advantageously used with low-power photomicrographic Objectives, particularly without eyepieces.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

On all Watson microscopes excepting the "Kima," the drawtube now fitted is 34 mm. diameter. It is provided with the Royal Microscopical Society's thread at one end and a fitting for an eyepiece at the other end. This is so arranged that the eyepiece fitting is slightly smaller than the internal diameter of the drawtube and the eyepiece may be regarded as virtually suspended. This overcomes internal reflection and glare. In addition, the eyepiece fitting is so arranged that it may be unscrewed.

The diameter of the body is of sufficient size when the eyepiece fitting is removed, to permit of the use of low-power photomicrographic Objectives without any cutting off of the field.

The drawtube is divided to show the tube length with and without the nosepiece. It is finished in chromium plating.

Adjustments for Focussing.

Watson microscopes have always borne the highest reputation for the permanent and accurate working of their mechanical movements, and they have long been acknowledged as the best and the most enduring made.

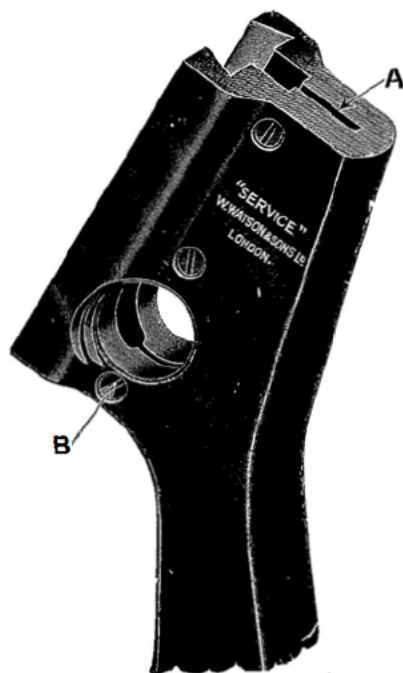


FIG. 3.

The arrangement of Rack and Pinion, and Fine Adjustment dovetailed fitting with Adjusting Screws A.

Coarse Adjustment.

Fitted with Watson's patented compensated bearings, the rack is of phosphor bronze, the pinion of steel. Made throughout in our High Barnet Factory, these two essential portions are interchangeable, and even if the rack be disengaged from the pinion it will mesh accurately with any tooth.

The smoothness of the slides is such that a $\frac{1}{8}$ -in. Objective may be focussed with ease, and even the oil immersion Objective roughly focussed.

Fine Adjustment.

The fine adjustment is made in two forms, both dependent upon a lever for their movement.

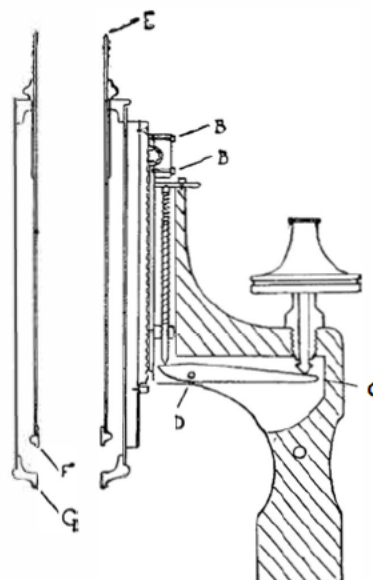


FIG. 4. Section of Limb of Edinburgh Student's Microscope, showing construction of Watson's Standard Fine Adjustment, etc.

B—Screws holding pinion plate in contact with rack of Coarse Adjustment. C—Lever. D—Fulcrum of Lever of Fine Adjustment. E—Eyepiece fitting at top of drawtube. F—Universal objective thread at lower end of drawtube. G—Objective thread at nose-piece end of body.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

The horizontal lever fine adjustment was adopted by Watson's fifty years ago, and the accumulated experience of years has shown this principle to be the most enduring, satisfactory and the most sensitive available. Every possible way of achieving slow motion on the Objective has at different times been tried in the experimental department, but none has been found to excel this in effectiveness.

Vertical Lever Fine Adjustment.

The demand for fine adjustments operated from the side of the limb has of late years become insistent among students and workers in laboratories. Watson's experience with the lever pattern led them to experiment on these lines and the type introduced by them in 1919 on their "Service" model microscope has been used ever since, and it may be claimed without exaggeration that it has proved itself to be the most effective side limb fine adjustment available.

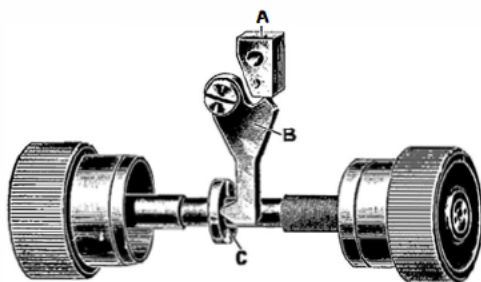


FIG. 5.

The action of the Fine Adjustment. B—The Lever. A—The Block which is attached to the Fine Adjustment Slide. C—The Travelling Wheel that imparts the movement, actuated by the screw on the right, which is revolved by the milled heads. The reverse movement is assisted by a spring.

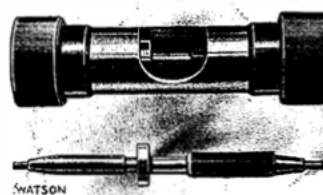


FIG. 6.

The assembled Fine Adjustment unit.
The Steel Rod and Screw.

Reference to the two illustrations shows the method in which this adjustment is carried out.

FIG. 4. Horizontal Lever Fine Adjustment. The whole body of the instrument is supported on the shorter end of the lever "C," boxed in the limb of the stand. The long end rests against the point of a micrometer screw which is actuated by a milled head. Double spiral springs exerting their force along the plane of movement keep the body pressed closely against the lever.

It will be observed that the fulcrum "D" is as close as possible to the body, thus minimising the actual weight to be raised. In the "Edinburgh Student's" microscope the arm on one side is 3.25 times longer than that on the other. The weight of the body to be lifted with its drawtube and coarse adjustment fitting is 2 lbs. The screw has 70 threads to the inch.

The movement covered by one complete turn of the milled head is $\frac{1}{70}$ in., and this is actually sensitive to $\frac{1}{100}$ th of a rotation of the milled head.

Both the lever itself and the bearing points are of polished hardened steel, and a long dove-tailed bearing is provided despite the fact that movement only takes place over a distance of $\frac{1}{8}$ in.

Fine Adjustment of the Vertical Type.

In this the lever is so placed and shaped that its pressure against its opposing point is always perfectly vertical. Hitherto this type of fine adjustment has been fitted in conjunction with a compression spring. In Watson microscopes a new recoil spring of tempered cast steel is used, thus introducing a further permanency and instantaneous response where the instrument to be used is in the horizontal position.

The micrometer screw which moves the lever with the milled head, is operated on both sides of the limb, and is contained in one unit and fixed as a unit into the instrument, as will be seen in the illustration Fig. 6.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

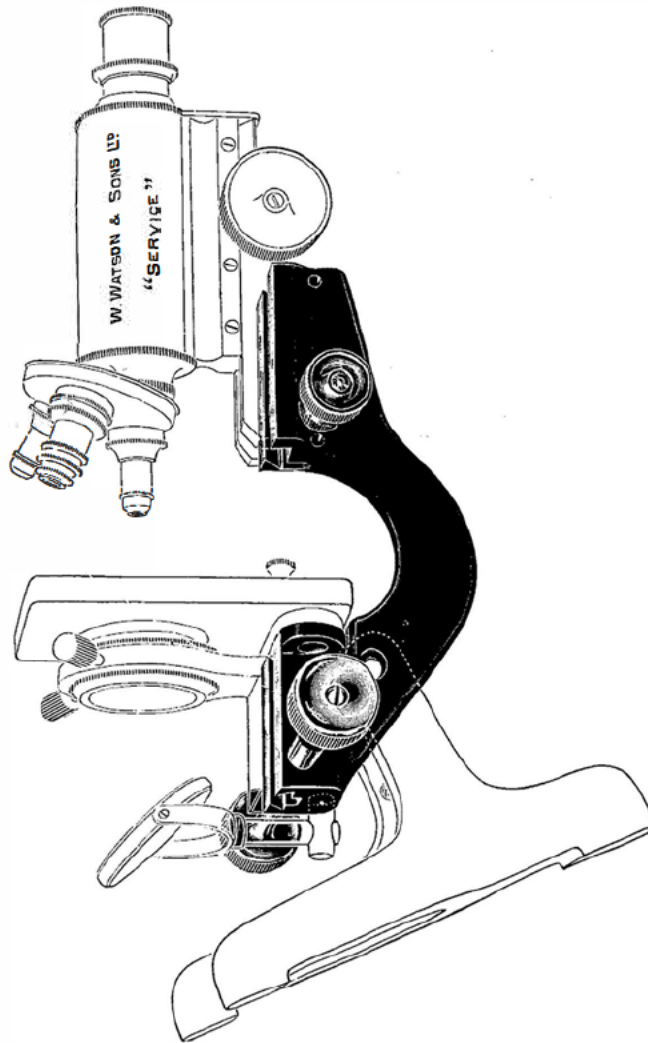


FIG. 7.

THE OPTICAL BENCH

system of construction of the Watson Microscopes. The dark portion is the Limb, the lighter lines represent the attached parts, as explained on page 34.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

To show the method of attaching Carriers for Condensers to the extension of the limb below the stage.

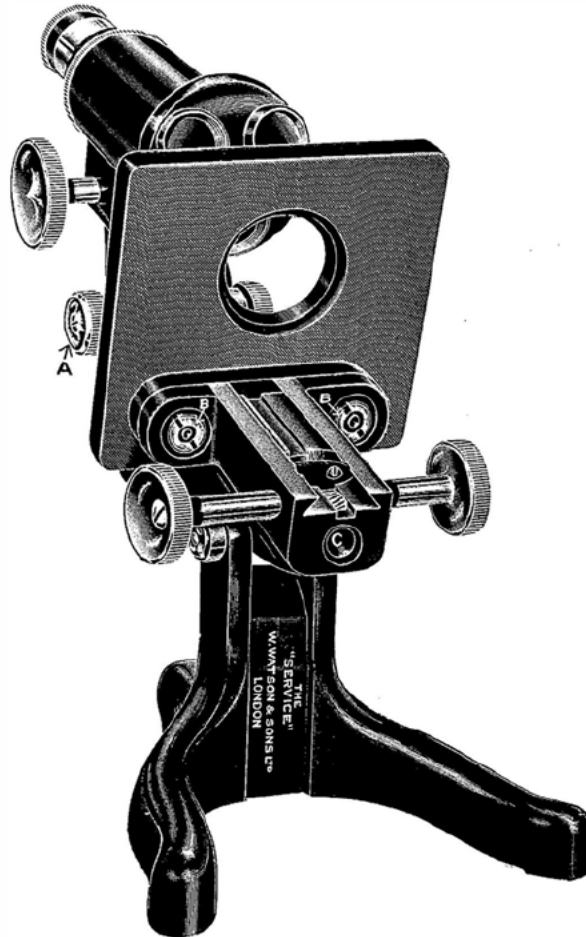


FIG. 8.

The above is the "Service" Microscope; the same method is used in the "Edinburgh Student" and other Microscopes.

- A Fine adjustment, milled head.
- B Stage supports cast in one piece with the limb; note width of support.
- C Mirror-stem fitting.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

CARRIERS FOR CONDENSERS

Various forms of Condenser Carriers will be found listed to meet all requirements. With the exception of the "Kima" model Microscope the spiral screw focussing underfitting has been discontinued. The new design of optical bench limb has resulted in the introduction of a substage ring cast solidly with the metal head carrying the rack, thus securing a further advance in rigidity.

The types of condenser carrier now available on Watson's Microscopes are :

The plain ring underfitting to carry a condenser or iris diaphragm, in which focussing is by sliding.

The spiral focussing screw underfitting supplied on the "Kima" Microscope only, see illustration, page 57.

The plain rackwork focussing substage for "Service" models.

Substage rackwork focussing with centring screws.

Substage rackwork focussing with Research pattern Condenser Changers.

These last three focus by milled heads on both sides of the limb in a manner similar to that of the coarse adjustment.

The exacting requirements of modern research have shown the importance of accurate centring arrangements of the substage condenser. In dark ground illumination the centring nose-piece cannot take the place of a centring substage: it can be but a makeshift at best.

With the centring substage, eyepiece, objective and condenser may be made to conform to a common optic axis. Wherever a microscope is purchased other than for class work, particularly in the case of those who intend carrying out serious microscopy either as amateurs or research workers, we cannot emphasise too strongly the importance of this fitting.

The Carriers for illuminating apparatus below the stage may be of either of three types.

1. A plain tubular fitting in which the condenser slides up and down to focus.
2. The Simple Substage (as illustrated, Fig. 9, page 41). This consists of a solid casting with tube to carry the condenser in sleeve pattern mount with iris diaphragm. A certain amount of latitude is given to the sleeve fitting so that at any subsequent date, if after rough handling in the laboratory it is found that the condenser is no longer central, necessary centring can be carried out by releasing the screws AS. This substage is provided with rackwork focussing. The adjusting screws to the dovetailed fitting are shown at A.
3. Centring Substage (as illustrated, Fig. 10, page 41). For this, in addition to the plain casting mounted on the rackwork slide, centring screws CS are provided so that any form of condenser can be axially aligned to the optical system; a new form of substage condenser mount (page 31) is supplied in which the optical part of the condenser hinges aside laterally. It is secured by a steel catch and released by a trigger.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

SIMPLE SUBSTAGE. (*As described, page 40.*)

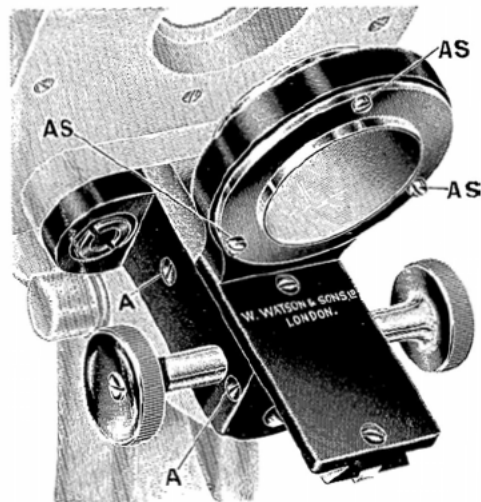


FIG. 9.

COMPOUND SUBSTAGE. (*As described, page 40.*)

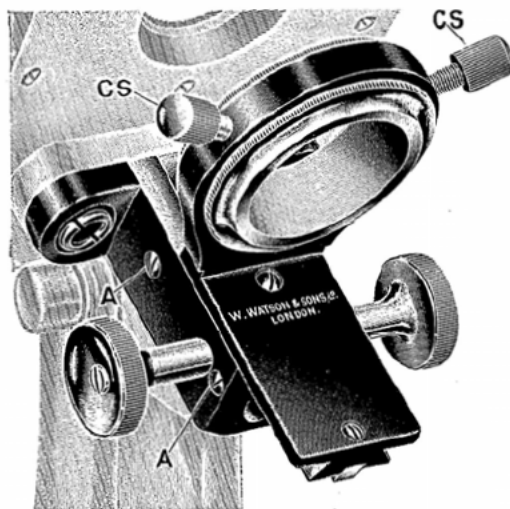


FIG. 10.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

Research Substage.

This substage is based upon the centring substage, but incorporates certain unique features. In addition to centring screws to the bracket, an iris diaphragm is mounted in the substage ring. Above the substage ring, cast solidly with it, are dovetailed slides. These carry the condenser changers so that it is possible to use a series of condensers in the course of a day's observations to exchange from one to the other in exactly the same manner as with Objectives.

Watson Condenser Changer Slides are all fitted with **independent centring adjustments** which in turn have clamps. Each condenser can therefore be centred to the optic axis of the microscope and then exchanged from one to the other without recentring.

The method of setting up is as follows :

With a low power Objective on the body of the microscope, focus the iris diaphragm mounted in the substage, and centre this to the axis of the microscope. Thereafter the centring screws of the substage should not be touched. The condenser on its slide should now be introduced. This condenser, being an optical system, forms an aerial image of the substage iris diaphragm. This aerial image should be focussed by means of the Objective and then the condenser optical part brought into alignment with the eyepiece, Objective and substage iris by means of the independent centring adjustments provided. It is then clamped to that position and is ready for use.

PRICES

Code Word.	No.		£	s.	d.
Maaby	14201	Plain tubular understage ring condenser carrier, as fitted to the "Kima" Microscope, supplied to any other instrument, price including fitting	0	7	6
Mabba	14202	Spiral focussing screw underfitting, with provision for hinging out of the optic axis when at the end of its travel	0	17	6
NOTE. This is only fitted to Watson's "Kima" Microscope.					
NOTE.—Can usually be fitted to any make of microscope at a small charge for fitting.					
Mabbe	14203	Compound centring substage with solid casting, slide and substage ring, if fitted to "Service" Microscope in place of plain rack focussing substage	3	15	0
Mabbi	14204	Compound centring rack focussing substage with milled head on one side, male and female slides complete for attachment to "Service" microscopes supplied prior to July 1931	4	5	0
Mabbo	14205	Compound centring rackwork focussing and screw centring substage for attachment to microscopes other than Watson's manufacture, where this can be carried out (Extra charge will be made for the cost of fitting.)	4	5	0
Mabby	14206	Research Substage, as described, with solid casting slide, and bracket, iris diaphragm, built into the substage bracket, with centring screws and with two Research Condenser Changers, each with centring screws	8	0	0
Macha	14207	Extra substage slides for above, with centring adjustments and clamps each	1	7	6
Macbi	14209	Extra for dovetail to lower side of substage bracket for carrying substage lamp or polariser. This will then receive substage slides of the standard pattern	1	5	0

N.B. All Substage focussing arrangements on Watson Microscopes with the exception of the "Kima" model are fitted with focussing milled heads on both sides of the limb in a manner similar to that of coarse adjustment milled heads.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

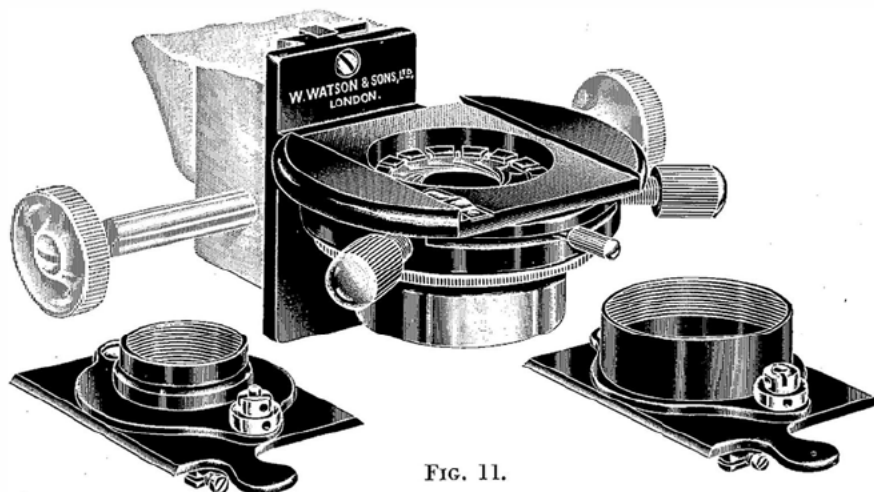


FIG. 11.

The technique for setting up of this substage appears on the foregoing page. It offers unique advantages in every form of microscopy.

PHOTOMICROGRAPHY

Where the microscope is mounted as part of the complete apparatus, and where a wide variety of magnifications, ranging from perhaps $\times 10$ diameters with a photomicrographic type lens, medium magnifications with $\frac{2}{3}$ in. and similar objectives, high magnifications with $\frac{1}{8}$ in. and $\frac{1}{12}$ in. objectives are used, condenser changers will be found indispensable. By this method also the change over from ordinary transmitted light to dark ground illumination is carried out quite easily. Each condenser is mounted on a separate slide, with its own centring arrangements, thus rendering it interchangeable and co-axial with the other condensers in the outfit. A series of photomicrographs at different magnifications can be taken without the necessity of dismounting and fitting a different type of condenser and re-aligning the optical train. In other words, as objectives are rotated on the nosepiece, or substituted by means of the objective changer, the same procedure is followed with condensers.

In the Laboratory, particularly in Research or Pathological Laboratories of small hospitals, immediate exchange between transmitted light and dark ground illumination is frequently essential. The difficulty of carrying out this exchange daunts many microscope users owing to the loss of time and the difficulty connected with illumination when using a dark ground condenser. The substage slides overcome this difficulty.

For General Microscopy, for the amateur and the isolated worker, for the Works Laboratory, the series of combination available when an additional slide is supplied to the lower surface of the substage will be readily appreciated. It is then possible to use the substage lamp, with a polarising prism, or any other desired combination.

The importance of substage technique is increasingly recognised. Watsons are always prepared wherever possible to reconstruct the fitting below the stage on other makes of microscopes, substituting for non-centring substages their own specialised designs.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

MICROSCOPE MIRRORS

Three sizes of mirrors are used on Watson microscopes.

The "Kima" microscope is provided with mirrors, plane and concave, 40 mm. diameter, the "Service" and other microscopes, with the exception of the "Van Heurck" series, with mirrors 50 mm. diameter. The "Van Heurck" series are fitted with mirrors 65 mm. diameter.

All microscope mirrors on Watson microscopes are mounted separately to the substage in extensions on the limb provided for this purpose, and can be manipulated and fixed independently of the substage.

Sufficient space is provided for their free rotation when the condenser is focussed and the microscope in a vertical position.

Alternatives.

Code Word	No.				
Macbo	14401	An optically plane mirror can be fitted in place of the silvered glass mirror, so as to yield one reflection of the source of light only, on Watson microscopes, at an extra price of	£	s.	d.
			...	...	0 12 6
Macbu	14402	Stainless steel plane surface mirror, 50 mm. diameter	...	...	0 15 0
Macby	14403	The cost of such a prism depends upon its size and the accuracy in working the angles. A prism 40 mm. clear aperture, 45° type, with special mounting, to fit in place of the mirror, can be supplied for the sum of	...	...	3 10 0

All mirror stems carrying the mirror brackets are provided with flats upon which a leaf spring bears so that the user may always be aware when the mirror is in the optic axis.

MICROSCOPE FEET

Two designs of foot are available—the English or tripod foot, and the horseshoe or Continental foot.—In consequence of its wide spread the tripod foot is of necessity more rigid than the horseshoe foot and will be found preferable by those who purchase microscopes for their own use, and by photomicrographers. The wide spread of the two front toes removes all restriction upon the apparatus which may be mounted on the substage. With this type of foot, rigidity is secured without undue weight.

Horseshoe Foot.

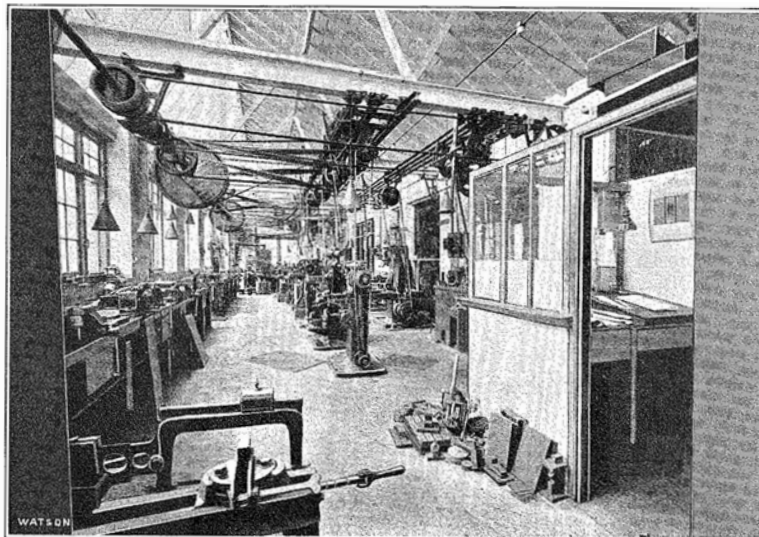
The lack of stability associated with this type of foot has been removed in Watson's design. Actually, the foot is slightly undercut and bears on three points. The backward projection is sufficiently long and heavy for the microscope to be used horizontally without risk of its overbalancing. For use in classes among students this type of foot is recommended, for even if brought to the edge of the bench the back toe can overlap to some extent without fear of the instrument falling to the ground.

All Watson Microscopes can be provided with horseshoe or tripod foot at the option of the purchaser.

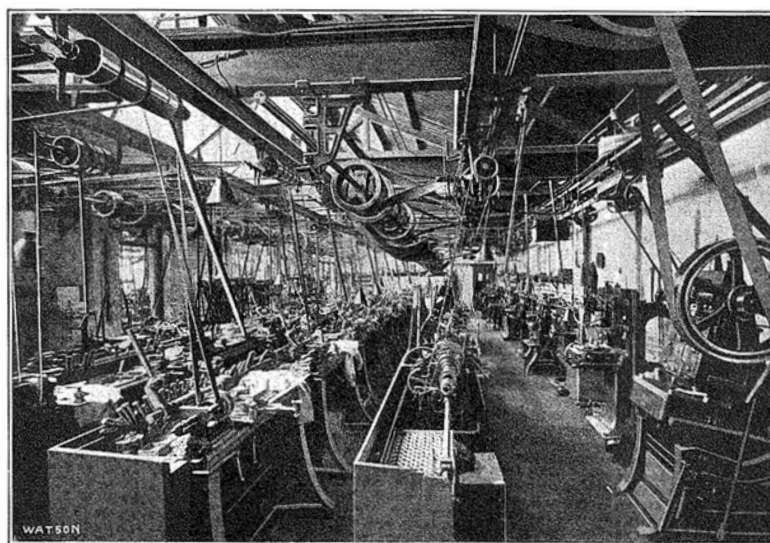
W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.



The Tool Room, Watson's Works, Barnet.



The Machine Shop (looking East), Watson's Works, Barnet.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

MICROSCOPE STAGES

Methods of Attachment.

To all Watson Microscopes the stages are attached in a unique manner. It will be seen from the shadow illustration of the optical bench limb (p. 38), that cast integrally with this limb are two widely-spaced massive brackets; these are the stage carriers which are machined in the same operation as the limb surfaces, thus ensuring their position at right angles to the optic axis, and a freedom from flexion with perfect rigidity is assured.

The stages of microscopes may be divided into two classes one, the plain stage, and the other with mechanical movements.

PLAIN STAGES.

All the Watson plain stages are of METAL and have the surface finely finished so that the object which is moved upon them with the fingers may do so quite freely and exactly.

To ensure the surface being optically flat, it is ground by similar tools and by the same process as that used for plane lenses. Spring clips are provided for holding the object in position, and the size and distance apart of the holes that receive the butts of the springs are standardised, so that any additional stage fittings such as a mechanical stage can be fitted through the same apertures in the stage as are provided for the spring clips.

The two principal forms of plain stages are :

That fitted to the "Kima" Microscope (p. 57), which is 100 mm. \times 95 mm. and is of solid metal, chemically bronzed on the surface; and that of the "Service" Microscope (p. 61), which is mm. 125 \times 125 mm.

At the point where these stages are fixed to the limb, a machined metal to metal contact is made, but the remainder of the "Service" Stage is entirely enclosed in vulcanised rubber, and to ensure that this vulcanised covering will remain flat even under tropical conditions, the metal of the stage has holes drilled at intervals so that the vulcanite meets through these apertures and becomes solid with the stage. (See illustration, p. 39.) The covering cannot buckle or distort.

ROTATING STAGE.

The plain stage is also made with the upper surface to rotate. Such an example is shown on p. 48.

MECHANICAL STAGES.

Mechanical stages are of two types, in each of which there is considerable diversity. One is the fixed mechanical stage which forms part of the microscope itself and cannot be detached, and the other consists of mechanical arrangements which are placed on the surface of the plain stage so that an object can be moved over its surface by means of the rackwork and screws provided.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

In this catalogue the fixed form of mechanical stage is shown on such instruments as the "H" Edinburgh Student's (p. 71), the "Research" (p. 73), "Royal" (p. 79) and the "Van Heurck" (p. 87). The principle of construction of all these is alike, and it is known as Watson's "Standard" mechanical stage. For the highest excellence in working and accuracy of movement, this is unquestionably the most satisfactory pattern of stage that is made. The object is placed on the top plate and when moved horizontally or vertically the object and plate are displaced as a complete unit. Another advantage is that if an oil immersion condenser either of the direct transmitted light type, or the darkground type, be used in conjunction with an oil immersion Objective, the resistance of the immersion oil is overcome and the object is positively carried by the travelling top plate of the stage. With the attachable forms of mechanical stage the immersion oil is apt to retard the travel of the specimen.

This form of stage necessitates a large central aperture to the stage to accommodate the condenser top and the mechanical movements are in consequence limited to some extent. The clear horizontal and vertical motions of such stages is $1\frac{1}{2}$ in. Against this limitation, however, must be set the fact that slides of any thickness and any size from $2\frac{1}{2}$ in. upwards may be used.

THE ATTACHABLE FORM OF STAGE.

The attachable form of stage is made in several different patterns, and will be found illustrated on pages 48 and 49. These are made with extreme care and accuracy and are all arranged to be fitted on the surface of a plain stage, the object being held between two points and carried across the stage by means of rackwork and/or spiral screw in rectangular directions.

To add to the effective working, supplemental springs are fitted to all the Watson stages to secure the object. These have been found to add substantially to the sure action of the mechanical movements when immersion oil or dust might cause obstruction.

The following are some of the stages which are manufactured by W. Watson & Sons, Limited, with their special claims and features:—

The "Service" pattern mechanical stage equivalent to a built-in mechanical stage, that is, a stage that is built as a permanent part of the microscope.

The "Alpha" pattern mechanical stage, a simplified form employing the "Service" motion.

The "Student" mechanical stage, a simple robust enduring pattern of novel design.

The Murray Long Range stage for the examination of serial sections mounted on large plates, specimens up to $\frac{1}{4}$ plate size, i.e. $4\frac{1}{4}$ in. \times $3\frac{1}{4}$ in. (106 mm. \times 81 mm.), may be examined from corner to corner.

The "Bactil" stage, a built-in type with removable motions which permit the substitution of a plain plate for fluid preparations.

The "Patna" stage, a rotating mechanical stage with centring movements.

All these stages are interchangeable on any microscope of Watson's manufacture with the exception of the "Kima" model. The price has been placed against each stage, so that the difference in price may be known and added to the cost of any instrument listed with another form of mechanical stage; the substituted type being capable of adaptation at the price shown.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE "SERVICE" MECHANICAL STAGE *(As described, page 49.)*

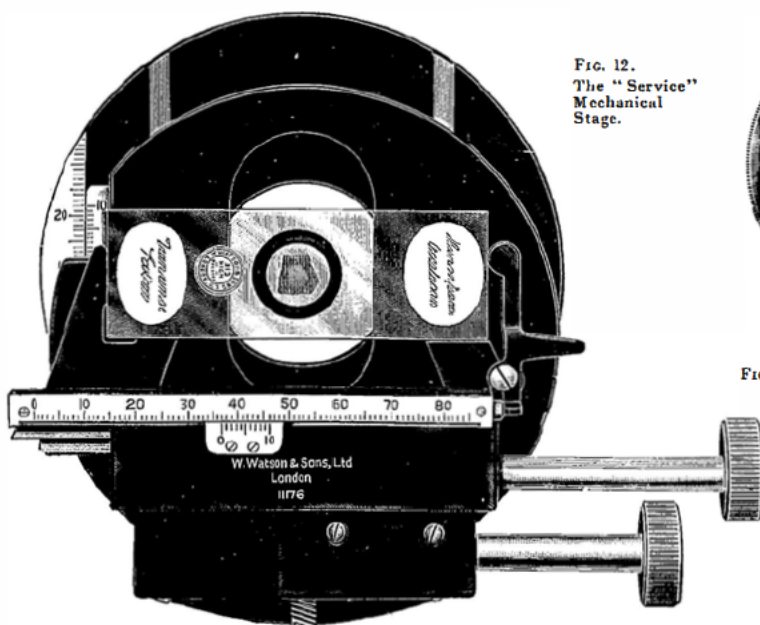


FIG. 12.
The "Service"
Mechanical
Stage.



FIG. 16. Concentric Rotating Stage.

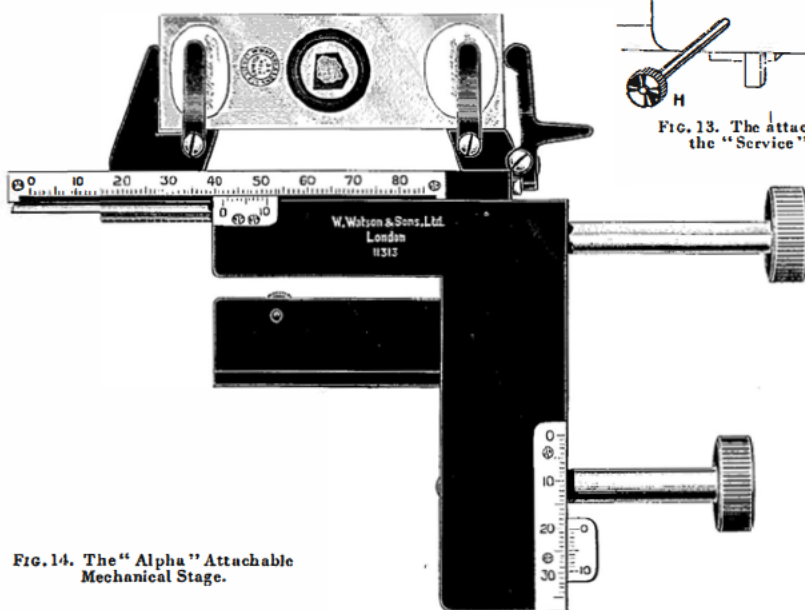


FIG. 14. The "Alpha" Attachable
Mechanical Stage.

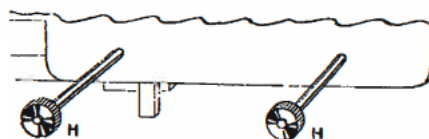


FIG. 13. The attaching studs and screws of
the "Service" and "Alpha" Stages.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

"SERVICE" MECHANICAL STAGE. (*As illustrated on page 48.*)

Contrary to usual practice the horizontal motion of this stage is effected by a $\frac{1}{4}$ -circle rack which engages with a helical screw; actually there are eight teeth in engagement, thus minimising the risk of loss of time resulting from wear common to the horizontal action of all mechanical stages. The rack for the vertical motion is mounted in the centre of the stage instead of at the side, so that the thrust incidental to this form of movement is negligible. Provided with accurately ground base plates this stage fits in intimate contact with the plain stage of the microscope and gives the satisfactory performance of a fully built-in mechanical stage. Horizontally the motion is 3 in. (75 mm.) clear, vertical $1\frac{1}{2}$ in. (37 mm.). Millimetre scales are fitted to each movement and read by verniers to 0.1 mm.

The stage is secured to the microscope in the following manner: two projecting steel rods fit through the apertures provided for the stage springs, which are standardised in respect of size and distance apart. These rods have threads at their lower end to which milled nuts are fitted; these nuts are screwed up from below the plain stage and hold the mechanical stage firmly in position. It can also be adapted to most modern makes of microscopes.

Code Word	No.	
Madba	14901	"Service" Mechanical Stage, price £9 5 0

"ALPHA" MECHANICAL STAGE. (*As illustrated on page 48.*)

This is similar in its horizontal motion to the "Service" pattern stage, the same method being used and the complete movement being 3 in. The vertical motion by rack and pinion is limited to 1 in. clear and mounted at the side of the stage.

This mechanical stage is of the skeleton type but will be found thoroughly efficient. It is fixed to the microscope in the same way as the "Service" stage and provided with scales and verniers.

Code Word	No.	
Madbe	14902	"Alpha" Mechanical Stage, price £7 0 0

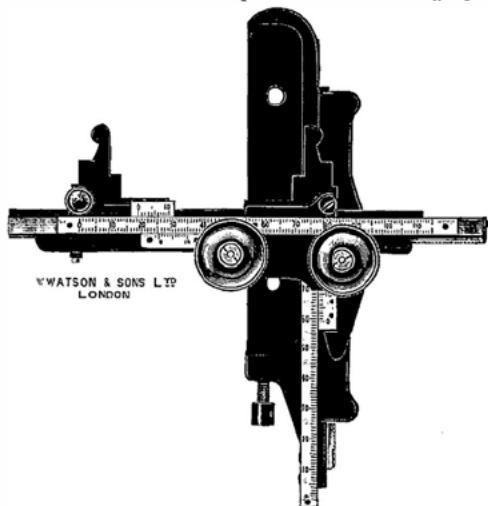


FIG. 15. Murray's Long-Range Mechanical Stage.
Student Mechanical Stage.

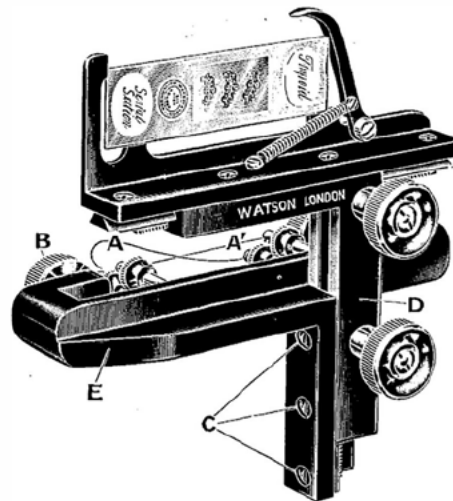


FIG. 16A. Student Mechanical Stage.

Can be fixed to Watson microscopes through stage spring holes or to other makes by clamp. Horizontal and vertical motions are by rack and pinion. Members D and E are solid units, no screws to become loose. 3 in. x 1 in. clear motion, compensating adjustments to movements, deep section bearings ensuring durability.

Code Word	No.	
Madbi	14903	Price with mm. scales and verniers £4 15 0
Madbo	14904	Price without scales and verniers 4 5 0

MURRAY LONG-RANGE ATTACHABLE MECHANICAL STAGE.

For the examination of serial brain, Cytological and other sections,
over an area of 115 mm. x 85 mm.

This stage was devised by Dr. Murray, Director of the Imperial Cancer Research Laboratories, for work in which a mechanical stage having a long range of movement was essential. It

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

differs from other stages of a similar character, particularly in its great stability and the rigid method of attachment to the plain stage.

The horizontal movement is 115 mm., the vertical movement 85 mm. Both movements are provided with millimetre scales and read by verniers.

In addition, both the object clips are movable so that any size of specimen may be accommodated, one of the object clips being fitted with verniers reading on a millimetre scale which is doubly engraved for this purpose.

Glass slides as small as $\frac{3}{4}$ in. \times $\frac{3}{4}$ in. can be held and conveniently examined.

Code Word	No.								
Madbu	15001	Murray's Long-Range Stage	...	...	...	...	...	Price	£11 10 0

CONCENTRIC ROTATING STAGE. (As illustrated on page 48.)

This stage rotates concentrically and can be supplied in place of the ordinary square stage when required. It is $4\frac{1}{2}$ in. diameter.

Code Word	No.								
Madby	15002	The extra cost of this stage in place of the ordinary square pattern is	...	...	...	...	...	£2	0 0
Mafba	15003	Divisions to rotation reading by verniers to five minutes	...	...	...	...	...	2	5 0
Mafbe	15004	Extra for centring screws and clamp to rotation	...	...	...	...	...	1	5 0

"H" EDINBURGH STUDENT'S TYPE MECHANICAL STAGE.

This mechanical stage offers unsurpassed advantages to the research worker who wishes to concentrate upon relatively small areas to attain critical images in conjunction with high-power immersion or dark ground condensers, and oil immersion Objectives. It is fitted to the "H" Edinburgh Student's Microscope, to the "Royal" Microscope and in larger form to the "Van Heurck" series of Microscopes. It is of exceptional rigidity, but the range of motion is limited to 37 mm. horizontally and 37 mm. vertically.

This mechanical stage may be selected in place of other patterns quoted on the other models of microscopes.

Code Word	No.								
Mafbi	15005	"H" Edinburgh Student's Mechanical Stage, including base plate	...	...	...	...	...	Price	£10 15 0

"RESEARCH" PATTERN MECHANICAL STAGE.

This is similar to the "H" Edinburgh Student's form (see page 75) in general design, but the milled heads controlling the horizontal and vertical motions are mounted on the same shaft on the Turrell principle.

For the amateur worker and for those who are prepared to use immersion oil with caution, this stage is exceedingly convenient and may be substituted for any of the other models quoted. The horizontal motion is 45 mm. and the vertical motion 37 mm.

Code Word	No.								
Mafbo	15006	"Research" Mechanical Stage, including base plate	...	...	...	...	...	Price	£12 0 0
Mafbu	15007	For substitution in place of Mechanical Stage on "Bactil" or "H" Edinburgh Student's Microscope, add to cost of Stand	...	...	...	...	...	£1	5 0

"BACTIL" MECHANICAL STAGE.

This is in every way similar to the "Service" mechanical stage save that it is built into the microscope. The horizontal motion and top plate are removable and may be replaced by a plain plate for fluid preparations.

Code Word	No.								
Mafby	15008	"Bactil" Mechanical Stage, including fitting	...	...	...	...	...	Price	£10 15 0

"PATNA" MECHANICAL STAGE.

This mechanical stage is similar to the "Service" pattern, having 3 in. clear horizontal motion, $1\frac{1}{2}$ in. clear vertical motion. It is further, of the rotating type, fitted with centring screws and clamp to rotation. It is mounted direct to the microscope and provided with a separate interchangeable rotating plain stage.

Code Word	No.								
Magba	15009	"Patna" Mechanical Stage, with interchangeable plain stage	...	...	...	...	...	Price	£13 0 0

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

ATTACHABLE RACKWORK DRAWTUBE

The mechanical drawtube is arranged to replace the ordinary sliding drawtube that is supplied with the "H" Edinburgh Student's, the "Bactil" and the "Service" Microscopes.

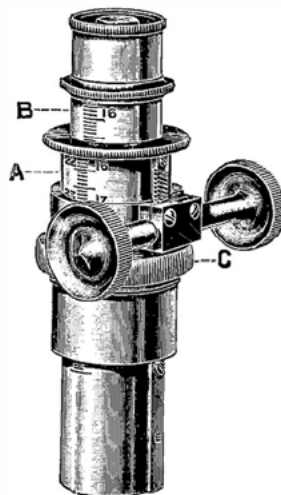


Fig. 17

Reference to the accompanying illustration will show that this mechanical drawtube is an independent attachment consisting of a long bearing fitting, which carries the rackwork drawtube "A" and an inner tube "B," which slides in the ordinary way.

The great convenience of it is that it can be immediately interchanged with the ordinary drawtube fitting, in the above mentioned Microscopes.

The collar which carries the sliding drawtube is unscrewed; the screw attached to the mechanical drawtube, being identical, enables the latter fitting to interchange with the ordinary sliding drawtube.

Lest the milled heads should not come exactly square with the front when the tube is screwed home, a knurled ring "C" is provided, and this enables the fitting to be clamped in any desired position.

The use of the new "Cassegrain" Dark Ground Illuminator (see page 30) has emphasised the necessity for adjustment for exact tube length, to obtain the maximum effect from modern Objectives, and this new attachment is one item in the list of fittings which enables the user to convert his Student's Microscope into a research model.

Cord Word Macac. 15101 Price of the Rackwork Drawtube £4 10 0

NOTE. This Mechanical Drawtube can be fitted to any existing "Bactil" or "Service" Microscope, and the "H" Edinburgh Student's Microscope from 34139 onwards. Further, it can be fitted to any instrument having a body tube with an internal diameter of $1\frac{5}{8}$ in.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

A FIVE YEARS' GUARANTEE

Accompanies all Microscopes made by W. WATSON & SONS, LTD., together with

"THE BOOK OF THE WATSON MICROSCOPE,"

a 32-page illustrated book giving hints on the use of the Microscope, directions for its preservation and adjustment, and much information for beginners in Microscopy. A table showing the magnifications of the Objectives and Eyepieces in the outfit is also provided.

The following is a copy of the guarantee :

W. WATSON & SONS' MICROSCOPES

GUARANTEE

We hereby guarantee

1. That the Microscope No. _____ sold herewith has been made and finished in our works at High Barnet, Herts., and London, and all reasonable precautions taken to secure excellence both of material and workmanship.

2. If any defect not being a defect resulting from wear and tear, improper adjustment, dirt, misuse, neglect or abuse should appear in any part of this instrument within **FIVE YEARS** from the date of invoice, we will make good or replace such defective part free of charge, and will pay carriage on such part both ways, namely, to and from our Head Office, 313 High Holborn, London, W.C.

3. To inspect and adjust this Microscope free of charge at any time within **TWO YEARS** from the date of invoice if sent carriage paid to our Head Office, 313 High Holborn, London, W.C.; and

4. To correct the effects of fair wear and tear to this Microscope free of charge at any time within **TWO YEARS** from the date of invoice if sent carriage paid to 313 High Holborn, London, W.C., provided the instrument has not been exposed to abuse, dirt, misuse or neglect.

This Guarantee is given only to the original purchaser, and is not transferable, and does not apply to any instrument which has been bought second-hand, let out on hire, taken out of the United Kingdom, or from which the name and number have been removed. All instruments excepted from this Guarantee are excluded from any Guarantee of any kind, and are used at the owner's sole risk.

W. WATSON & SONS, LTD.

NOTE. Where a number of Watson's Microscopes are in use in one Laboratory or Institution, a Mechanician will be sent to clean and adjust them on request at any time within two years from the date of supply without any charge whatever for services. The only expenses incurred would be for out-of-pocket, travelling (third-class), and, if necessary, hotel charges.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

REASONS FOR CHOOSING A WATSON MICROSCOPE

It is British made, and has a special claim on British workers.

It is scientifically constructed for scientific work. Whenever a Microscopist is desirous of wresting from his instrument the utmost it is capable of producing, he has of necessity to employ the refinements and conveniences which the long experience of experts has proved to be the sole means for achieving such results. All of these are embodied in the Watson Microscopes.

The following distinctive features are peculiar to Watson Microscopes and will not be found in **combination**, and, in the majority of cases, not individually in any make of British or Continental Microscope.

The Watson Microscope has

The unit construction of the body ensures a rigidity and permanence hitherto unapproached.

The large diameter drawtube overcomes halation and simplifies photomicrography, and permits the use of larger illuminating cones.

The Tripod or modified horseshoe foot which imparts perfect rigidity. A Microscope so mounted does not fall over when touched.

A long range of Coarse Adjustment, enabling it to be used for low magnifications as well as for the highest. A wide range of fully corrected low power Objectives is also supplied.

A mechanical drawtube which allows of precise adjustment of the tube length for thickness of cover glass.

A Mechanical Stage scientifically constructed as a part of the whole instrument, with a long range of motion and long effective life. Where attachable the method of attachment ensures the rigidity of the stage on the microscope and ready repetitions of the vernier readings.

A Compound Substage with centring screws, so that the Condenser or dark ground illuminator may be easily rendered axial with the Objective. It is fitted with rackwork to focus, controlled from both sides of the limb, and can be supplied with a Fine Adjustment.

It is constructed on the **Optical Bench** system, which ensures greater rigidity and perfection of working than any other method.

The fittings carry Substage Apparatus, Eyepieces and Objectives of the Royal Microscopical Society's standard size.

The working parts have sprung fittings with adjusting screws, whereby wear and tear may be compensated for.

The Substage Condensers have the necessary aplanatic cones for developing the fullest capacity of the Objective. They are achromatised and improve the performance of any Objective.

WATSON'S BRITISH-MADE MICROSCOPES

are the instruments of to-day and the future. If you use one of them you will work to the fullest advantage.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE "MYRAL" MICROSCOPE

The essentials for classes in Elementary Botany, Zoology, etc., are to be found in the "Myral" Microscope.

The construction is simple but effective, and is designed to withstand rough handling.

The adjustment to focus has been redesigned and depends upon a rack and pinion of our standard quality which is exceedingly smooth and precise in action. For fine focussing the rack and pinion should be found satisfactory if care is used, but the Eyepiece may be gently rotated and extended or pushed in as required.

The "Myral" Microscope carries Objectives and Eyepieces of standard (Universal) size.

The stage is large and firmly supported.

The mirror is concave.

The limb and foot are in one casting which is durably finished in hard black enamel.

When equipped with the Objectives and Eyepieces supplied in the sets listed below, the "Myral" Microscope will be found an excellent instrument for the use of schools and beginners. The Objectives and Eyepieces are of good performance.

Dimensions. Body tube: Length, 140 mm. ($5\frac{1}{2}$ in.). Stage: 100×100 mm. (4×4 in.). Total height, 280 mm. (11 in.).

<i>Code Word.</i>	<i>No.</i>		<i>£</i>	<i>s.</i>	<i>d.</i>
Myrab	15401	Stand as described, with $\frac{2}{3}$ in. Argus Objective and one Eyepiece (1, 2, 3 or 4), in hard fibre case	4	0	0
Myred	15402	Stand as described, with $1\frac{1}{2}$ in. and $\frac{2}{3}$ in. Argus Objectives, one Eyepiece (1, 2, 3 or 4), and double Nosepiece, in hard fibre case	5	12	6
Myric	15403	Stand as described, with $\frac{2}{3}$ in. and $\frac{1}{8}$ in. Argus Objectives, one Eyepiece (1, 2, 3 or 4), double Nosepiece and Iris Diaphragm in understage sleeve, in hard fibre case	7	15	6
Myrox	15404	Stand as described, with $1\frac{1}{2}$ in., $\frac{2}{3}$ in. and $\frac{1}{8}$ in. Argus Objectives, one Eyepiece (1, 2, 3 or 4), triple Nosepiece, Iris Diaphragm in understage sleeve, in hard fibre case	9	17	6

The "Myral" Microscope is supplied only in sets as above.

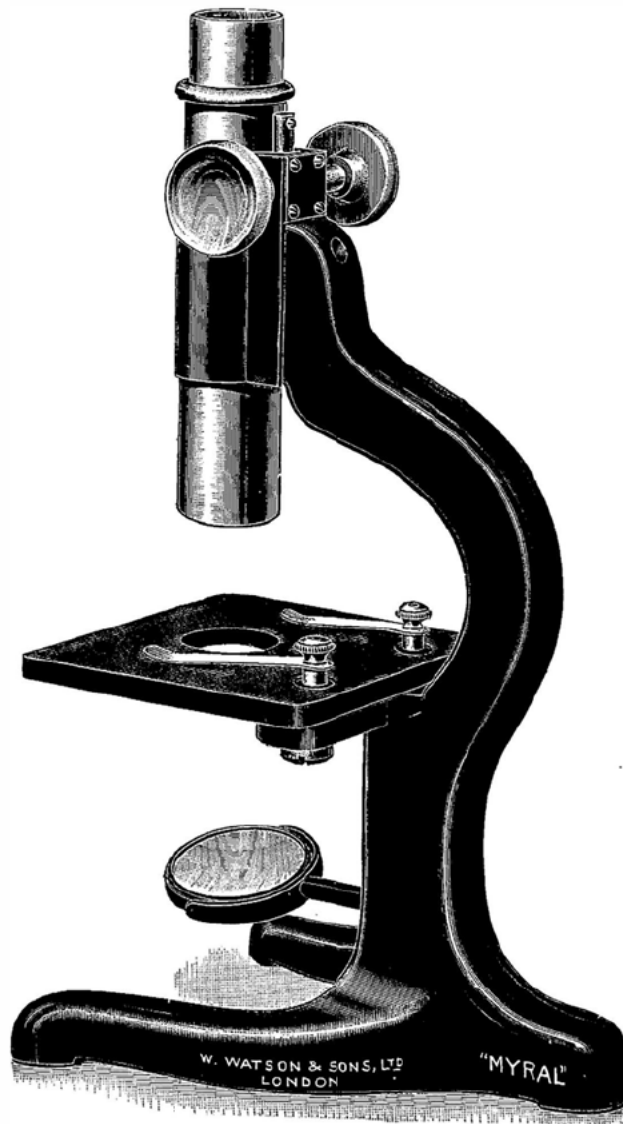
W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE "MYRAL" MICROSCOPE

Height, 11 inches.



W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE " KIMA " MICROSCOPE

This instrument conforms to the specification for a Student's Microscope as drawn up by the British Science Guild.

It has been designed to meet the wishes of those who desire to secure Watson quality but whose needs are satisfied by a somewhat simpler model. The stand is somewhat smaller in design and to reduce expense to a minimum the drawtube is omitted, and the coarse adjustment instead of being fitted with dovetailed slide and compensated bearings is of the less costly Continental (round bar) type. Metal is employed for the stage.

All fittings are to standard sizes, any Eyepieces or Objectives to R.M.S. dimensions may be fitted. The stage will take " Student " or " Alpha " mechanical stages, the underfitting our standard understage mountings.

SPECIFICATION.

Coarse Adjustment. Diagonal rack and pinion of standard quality, with long range of movement for focussing low power Objectives.

Fine Adjustment. Vertical lever pattern, operated by milled heads on **both sides of the limb**. One turn of heads moves the body $\frac{1}{320}$ inch. Stops to travel in each direction making damage through strain impossible.

Body Tube. Total tube length, 160 mm. ($6\frac{1}{2}$ in.), diameter 37 mm. If tube-length is to be varied from the standard a drawtube must be added, see extras, page 58. Universal standard fittings for Objectives and Eyepieces.

Stage of solid metal bronzed on surface. Dimensions 100×95 mm. ($4 \times 3\frac{3}{4}$ in.). Distance from optic axis to limb exceeds 3 in. Mounted on wide lugs cast integrally with the limb.

Underfitting. Universal size. Plain tubular sliding focussing. Alternative the spiral focussing screw underfitting. See extras, page 58. Compound centring and rack focussing sub-stages cannot be supplied for this model.

Limb. Curved for convenience in lifting.

Joint. Inclination through 90 degrees with rigid support at all positions.

Foot. Modified horseshoe, wide spread to toes ensuring perfect rigidity.

Mirrors. Plane and Concave, adjustable independently of stage or condenser.

Finish. Hard black enamel, milled heads in bright lacquer. Bright parts can be supplied in chromium plating if preferred.

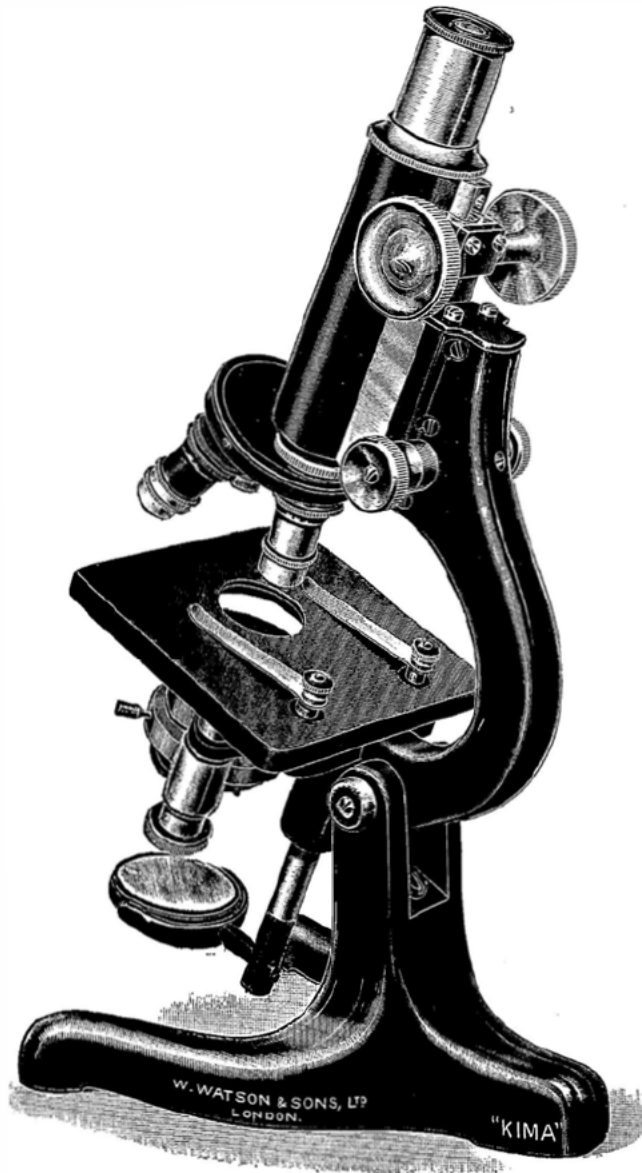
W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE "KIMA" MICROSCOPE

Height, 11½ inches.



Price List see page 58.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

PRICE LIST OF WATSON'S "KIMA" MICROSCOPE

A Fitted Case is included with the Sets specified below, but if not required, a reduction of 20/- will be made from the Set.

Code Word.	No.		£	s.	d.
Kaleb	15801	Stand with Argus Objectives $\frac{2}{3}$ in. and $\frac{1}{8}$ in. One Eyepiece (No. 1, 2, 3 or 4)	8	10	0
Kalid	15802	Stand with Argus Objectives $\frac{2}{3}$ in. and $\frac{1}{8}$ in. One Eyepiece (No. 1, 2, 3 or 4). Iris Diaphragm to fit Understage fitting	9	5	0
Keelo	15803	Stand with Abbe model Illuminator, Iris Diaphragm No. 12803. Argus Objectives $\frac{2}{3}$ in. and $\frac{1}{8}$ in. Two Eyepieces (Nos. 1, 2, 3 or 4). Double Nosepiece	12	10	0
Kegon	15804	Stand with Spiral Screw Underfitting No. 14202. Argus Objectives $\frac{2}{3}$ in. and $\frac{1}{8}$ in. Abbe Illuminator, with Iris Diaphragm No. 12803. Two Eyepieces (Nos. 1, 2, 3 or 4). Triple Nosepiece	13	12	6
Kepol	15805	Stand with Spiral Screw Underfitting No. 14202. Argus Objectives $\frac{2}{3}$ in. and $\frac{1}{8}$ in. and "Utility" $\frac{1}{2}$ in. Oil Immersion. Abbe Illuminator with Iris Diaphragm No. 12803. Two Eyepieces (Nos. 1, 2, 3 or 4). Triple Nosepiece	18	12	6
Kepla	15806	$\frac{1}{2}$ in. "Versalic" instead of $\frac{1}{2}$ in. "Utility," extra to set 15805	1	10	0

EXTRAS.

Kestr	15807	Drawtube	0	8	6
Mason	15808	Spiral Focussing Screw Underfitting	0	17	6
Manfu	15809	"Alpha" Mechanical Stage	7	0	0
Magbe	158010	"Student" type Mechanical Stage, with divisions ...	4	15	0
		Without divisions	4	5	0
Mange	158011	Pointer to Eyepiece	0	5	0

Microscope Stand alone cannot be supplied.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE "SERVICE" MICROSCOPE

FOR BACTERIOLOGY, BOTANY, HISTOLOGY, PATHOLOGY, AND ZOOLOGY

The most efficient, robust, rigid and enduring Student Microscope ever offered. Since it was first introduced in 1919 it has led all design and the latest model is fully as much in advance of present day design as in its time—was the 1919 model.

The "Service" Model Microscope in its varied forms to-day predominates in the British Universities.

This instrument may be supplied in the simplest form with minimum equipment, and by the addition of further fittings all accurately standardised built up into a complete research model. A survey of these many mechanical attachments will be found in the chapter on construction principles.

By stringent manufacturing tests, final inspections of searching thoroughness, service after purchase, Watson Microscopes have established a reputation second to none.

SPECIFICATION

Total Height when body is racked down and drawtube closed, 310 mm. (12½ in.).

Body. Unit construction, 40 mm. diameter. Tube-length including nosepiece, 155 mm. extending to 205 mm. Supplied usually to take standard size Eyepieces, but can be supplied to accommodate any other size up to 1.27 in.

Drawtube. New design, 34 mm. diameter. Fitted with standard R.M.S. Objective thread for photomicrographic Objectives, etc., chromium plated. Double engraved to show tube-lengths with and without nosepiece. Eyepiece fitting removable by unscrewing for photomicrography with photographic Objectives.

Coarse Adjustment by rack and pinion. A specially hard metal is used for the rack. All racks are bedded solidly to the rib. The rack and pinion will mesh on any tooth.

Fine Adjustment by vertical lever controlled from both sides of the limb. One complete rotation moves the body $\frac{1}{500}$ inch. See page 37.

Stage. Metal casting with ebonite moulded over all surfaces. Reagent proof. Optically flat upper surface. Mounted on wide lugs cast with the limb. Distance from back of limb to axis, 90 mm. Size, 125 mm. x 125 mm. Height from table, 125 mm. Will take any Watson mechanical stage. See page 48.

Condenser Fittings. Plain tubular. Rackwork focussing. Rackwork focussing with centring screws. Research type with built-in iris diaphragm, centring screws and condenser slides, see page 43. **All Watson substages focus from both sides of the limb.**

Mirrors. Plane and concave, 50 mm. diameter. Adjustable independently of the condenser.

Limb. Optical bench pattern, slides for fine adjustment and substage machined in same operation ensuring permanent alignment.

Foot. Modified horseshoe pattern, 7 in. from back to front, imparts absolute rigidity to instrument in any position by its perfect proportioning.

Bearings. All movements are fitted with Watson's patented compensating adjustments. They guarantee a lifetime of working efficiency.

Finish. Hard black enamel, acid and reagent resisting, smooth finish. Milled heads and slides bright lacquer. (For tropics, black enamel and chromium.)

Case. Mahogany, hand dovetailed. (For tropics all blocks and joints are screwed.)

Guarantee. Usual Watson, covering five years.

" SERVICE " BOOKLET

A Booklet is published giving interesting information regarding the construction of the "Service" Microscope. It will be sent post free on application.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

WATSON'S "SERVICE" MICROSCOPE

<i>Code Word.</i>	<i>No.</i>	PRICES	<i>£</i>	<i>s.</i>	<i>d.</i>
Malpa	16001	"Service" Microscope Stand only with Plain Understage	9	1	6
Malpy	16002	"Service" Microscope Stand with Rackwork Focussing Substage	10	11	6
Malro	16003	"Service" Microscope Stand only with Compound Centring Substage	13	0	0
Malrx	16004	"Service" Microscope Stand only with Research Substage, Fig. 11, page 43, and two condenser slides	17	5	0
Mamse	16005	"Service" Microscope Stand with Plain Understage Carrier $\frac{2}{3}$ in. and $\frac{1}{8}$ in. Parachromatic Objectives. 1 Eyepiece (Nos. 1, 2, 3 or 4)	15	10	0
Malte	16006	Set 16005, with the addition of an Iris Diaphragm Nosepieces for either of the above Sets, page 22.	16	5	0
Mamon	16007	"Service" Microscope with Rackwork Focussing Substage. $\frac{2}{3}$ in. and $\frac{1}{8}$ in. Parachromatic Objectives. 2 Eyepieces (Nos. 1, 2, 3 or 4). Abbe Illuminator N.A. 1.20 with Iris Diaphragm No. 12803. Triple Nosepiece	20	0	0
Manac	16008	"Service" Microscope with Rackwork Focussing Substage with Objectives, etc., as in Set 16007 with the addition of: $\frac{1}{12}$ in. "Versalic" Oil Immersion Objective	26	10	0
Manag	16009	"Service" Microscope with Compound Centring Substage (Fig. 10), having rackwork to focus and screws to centre, and complete accessories as in Set 16008	28	15	0
Manax	160010	"Service" Microscope with Research Substage (Fig. 11) with two condenser slides. Complete accessories as in Set 16008, with the addition of Holoscopic dark ground Paraboloid and funnel stop	36	0	0

NOTE. "Utility" $\frac{1}{2}$ in. Oil Immersion Objective 1.25 (price £5) can be supplied in Sets 16008 and 16009 at a reduction in price of £1 10 0.

A fitted mahogany cabinet is included with the sets specified above, but if not required deduct £1 4 9 from the price of the set.

EXTRAS

Manda	160013	"Service" Mechanical Stage as described on page 49, Fig. 12, may be included with any of the above Sets at an extra cost of	9	5	0
Manfu	160014	"Alpha" Attachable Mechanical Stage, as described on pages 48 and 49, may be included in any of the above Sets at an extra cost of	7	0	0
		"Student" Type Mechanical Stage (page 49)			
Magbi	160015	With divisions to movements	4	15	0
Magbo	160016	Without divisions to movements	4	5	0

Packing and carriage charged extra.

Special Teak Cabinets with Screwed Joints and Fittings, suitable for Foreign, Colonial and Tropical use, are supplied at a cost of 20/ beyond the prices shown above.

For high-power Binocular bodies for above Microscope, see pages 105-107.

W. WATSON & SONS, LTD.



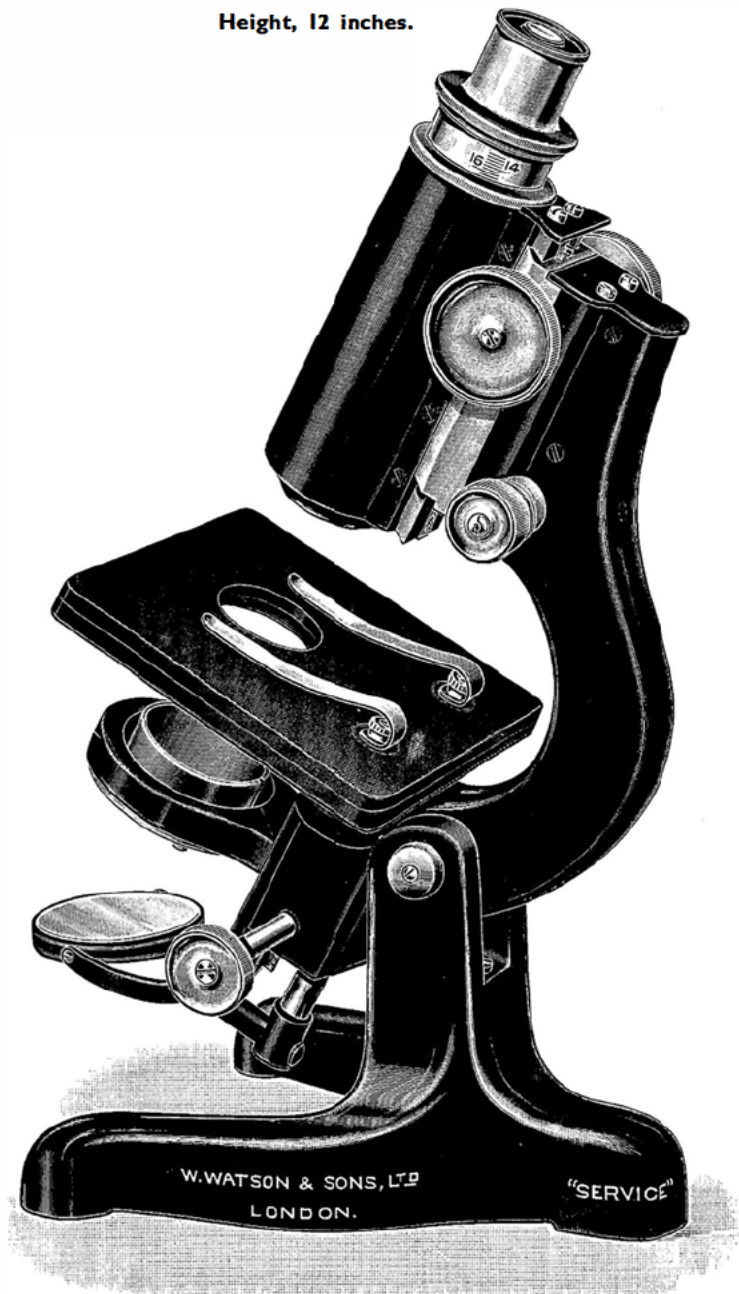
313 HIGH HOLBORN, W.C.

"SERVICE"

61

THE "SERVICE" MICROSCOPE

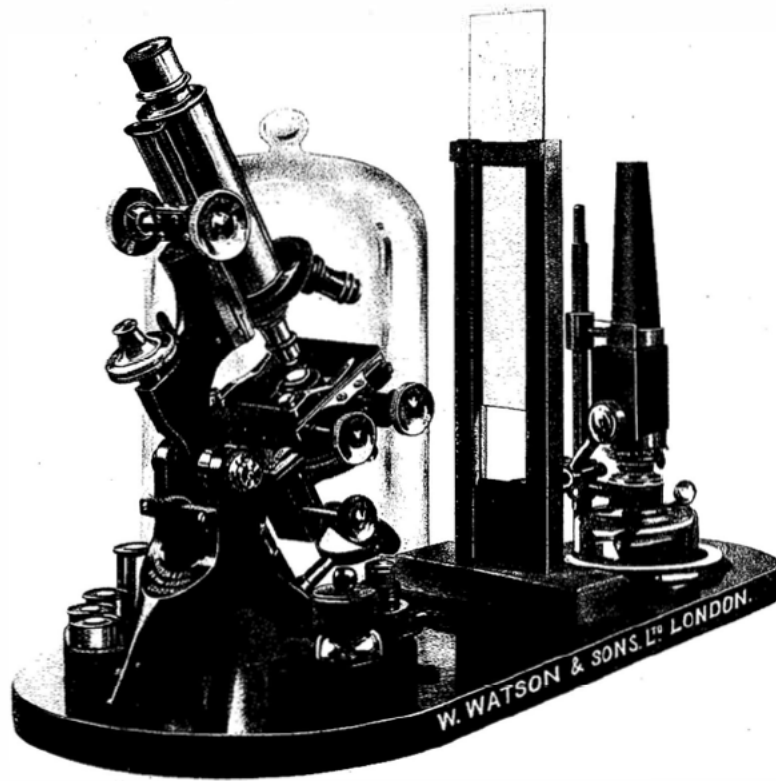
Height, 12 inches.



W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.



The above is an illustration of a conveniently arranged Microscope with equipment ready for immediate use in Consulting-room and Laboratory, as described in Dr. Coles' "Critical Microscopy."

PRICES

Code Word.	No.		£	s.	d.
Magni	16201	The Mahogany Board is fitted to receive Microscope, Lamp and Accessories	3	0	0
Magpi	16202	Lamp is similar to our Standard pattern, but is arranged so that the chimney can be turned aside on the pillar when not in use and is fitted with small condensing Lens with adjustments	4	5	0
Mahog	16203	Bell Glass to cover Microscope, according to size of Microscope from	0	17	6

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE "BACTIL" AND "PATNA" MICROSCOPES (MODIFIED 1933)

(Constructed to the specification of the
British Science Guild, for a High-Power Research Microscope.)

For Research, the Laboratory and General High-Power Work.

These models are in general construction the same as the "Service" Microscope, but with a larger foot and the added and very important modification that the instrument is fitted and adjusted by hand in the same manner as our best Research Microscopes; each part is co-ordinated and the instrument is built up and supplied as a complete entity.

It is possible to add the "Service" Mechanical Stage, and a Compound Substage, to a "Service" Microscope, but the result achieved by building the whole at one time as in the "Bactil" Microscope, is a more satisfactory one, and its advantages will be readily recognised.

In the "Patna" model the mechanical stage is provided in addition with rotation, centring screws clamp to rotation. A plane plate replaces the mechanical stage when required.

For interchangeable high power binocular and monocular bodies, standard type and inclined, see page 106. The unit construction of the body is maintained.

The stage—which is of the "Service" model, Fig. 12, page 48—is now built in on a heavy metal base plate. For work with fluid preparations or under other conditions where a plain stage is an advantage, the whole upper surface and horizontal motion of the stage is racked off and replaced by a plane plate 5" x 5", so providing a level surface and protection for the rack.

The Coarse and Fine Adjustments are as described in connection with the "Service" Microscope on page 37. The Standard Condenser Carrier is a Compound Substage (Fig. 10, page 41) with Centring Screws. If provision for hinging the condenser out of the optical axis be required, specify the new substage mount, page 31. The Research substage may also be fitted if required, for prices see page 43.

The dove-tailed fittings in which all mechanical movements take place are provided with compensating bearings.

The whole instrument receives most careful and accurate adjustment and ensures that smooth and exquisite working that can be imparted only by the expenditure of unrestricted time on the part of the skilled craftsman.

Dr. Murray's Long-Range Stage or any of the other stages described between pages 47 and 50 may be supplied in place of the "Service" Mechanical Stage, if desired, at the prices shown.

Rackwork drawtube, substage lamp, all can be fitted to these models and used to advantage.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE "BACTIL" MICROSCOPE

		PRICES			
Code Word.	No.			£	s. d.
Merid	16401	"Bactil" Microscope Stand only with Mahogany Case	...	27	10 0
		<i>Deduct for case if not required</i>		£2	10 0.
		Complete Sets			
Meria	16402	"Bactil" Microscope, Mahogany Case. Two Eyepieces (at choice) $\times 5$, $\times 6$, $\times 8$, $\times 10$. Objectives Para. $\frac{2}{3}$ in. N.A. 0.28, Semi Apo. $\frac{1}{8}$ in. N.A. 0.70. Abbe Condenser N.A. 1.20 fully mounted.			
		Double Nosepiece		36	12 6
Merit	16403	"Bactil" Microscope, Mahogany Case equipped as B 16402 with the addition of "Versalic" Oil Immersion. $\frac{1}{2}$ in. Objective. Triple in place of double Nosepiece		42	10 0
Merle	16404	"Bactil" Microscope, Mahogany Case. Eyepieces two Holo: Series, $\times 7$, $\times 10$, $\times 14$, $\times 20$, at choice. Objectives Holo: 16 mm. N.A. 0.45. " " 4 mm. N.A. 0.95. " " 2 mm. N.A. 1.37 oil. imm.			
		Triple Nosepiece. Universal Condenser fully mounted		60	10 0
Merma	16405	"Bactil" Microscope, Mahogany Case. Eyepieces three Holo: Series, $\times 7$, $\times 10$, $\times 20$. Objectives Apochromatic: 16 mm. N.A. 0.30. " " 8 mm. N.A. 0.65. " " 4 mm. N.A. 0.85 " " 2 mm. N.A. 1.37 oil imm.			
		Research Substage. Parachromatic Condenser. Quadruple Nosepiece. One spare Condenser Slide		76	0 0

EXTRAS

Merri	16406	Universal or Parachromatic Condenser in place of Abbe pattern in Sets 16402/3		4	5 0
Macac	16407	Rackwork and Plain Drawtubes, page 51		4	10 0
Pragm	16408	Research Substage and two slides, page 43, Sets 16402/3/4		4	15 0
Sabre	16409	High Power Binocular Bodies, page 105 7 from		10	0 0

The Sets quoted on page 60 can be supplied with the "Bactil" Microscope at a reduction in price of £2 10 0.

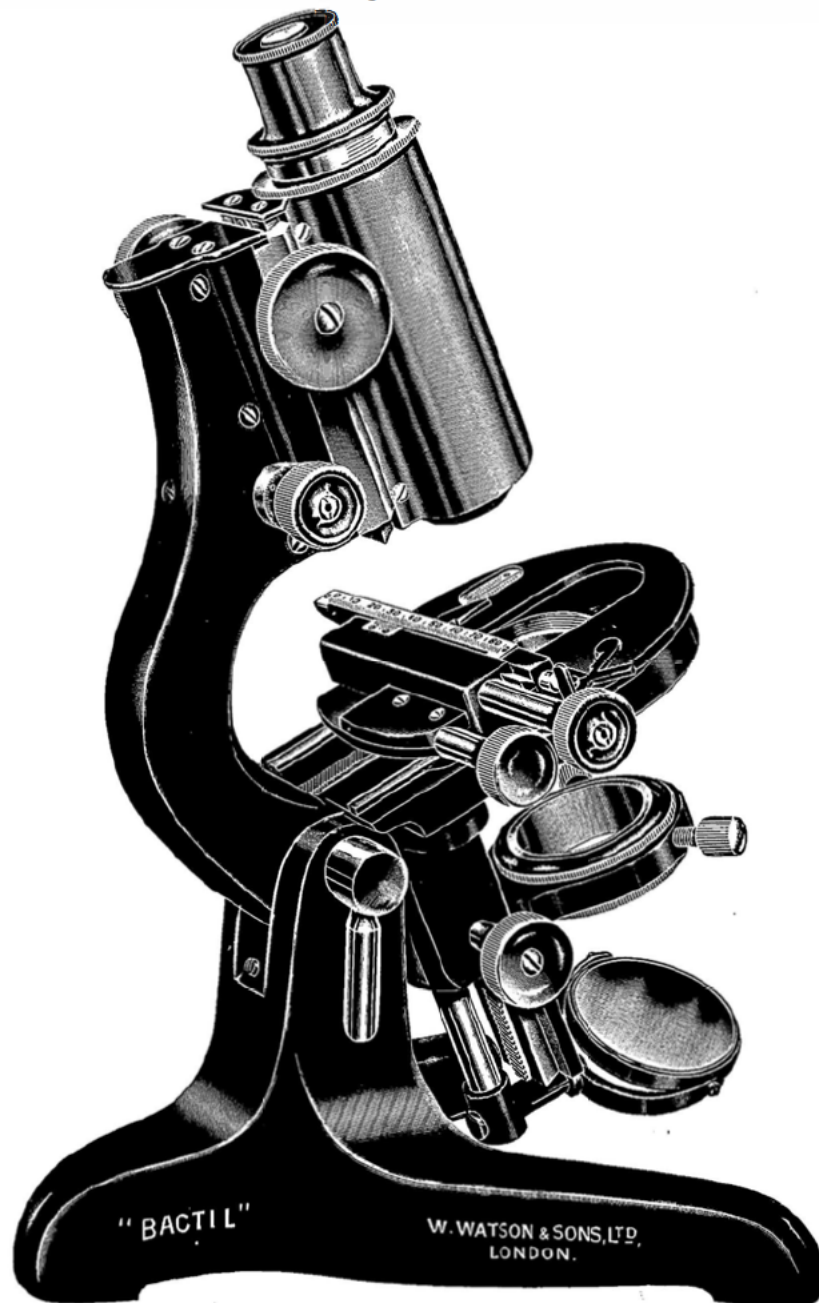
W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE "BACTIL" MICROSCOPE

Height, 12 inches.



W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE "PATNA" MICROSCOPE

This Microscope corresponds in general details and construction with the "Bactil" instrument described on page 63, but instead of the fixed Stage supplied with that instrument, the "Patna" has a concentric rotating Stage, $4\frac{1}{2}$ in. diameter, with centring movement by means of screws, on which mechanical movements are fitted, giving a range of 75 mm. horizontally and 25 mm. vertically.

Scales and verniers enable readings to be taken to one-tenth of a millimetre.

A clamp to the rotation is provided.

A second plain circular metal stage 5 ins. (125 mm.) diam. is included, and can be interchanged with the Mechanical Stage, giving a perfectly plain surface for rough work.

PRICES

Code Word.	No.		£	s.	d.
Synco	16601	"Patna" Microscope, as illustrated on page 67, complete with two Stages, as described above, with concentric rotation in mahogany case	30	0	0
		<i>Deduct for case if not required</i> £2 10 0.			
Synta	16602	"Patna" Microscope as described, in mahogany case :— 2 Eyepieces at choice $\times 5$, $\times 6$, $\times 8$, $\times 10$. Objectives: Parachromatic 16 mm. ($\frac{3}{8}$ in.) N.A. 0.28. " Semi Apochromatic 4 mm. ($\frac{1}{8}$ in.) N.A. 0.70. Abbe Condenser, N.A. 1.20 fully mounted. Triple Nosepiece	39	2	6
Syfax	16603	"Patna" Microscope, equipped as 16602 with the addition of "Versalic" $\frac{1}{12}$ Oil Immersion Objective	45	0	0
Sybil	16604	"Patna" Microscope, mahogany case. Research substage and 2 Condenser Slides. Holoscopic Eyepieces, $\times 7$, $\times 10$ and $\times 14$. Objectives, Apochromatic 16 mm. 0.30 N.A. " " 8 mm. 0.65 N.A. " " 4 mm. 0.85 N.A. " " 2 mm. 1.37 N.A. Oil Imm. Universal Condenser 1.0 N.A. mounted on substage slide. Holos Immersion Paraboloid, Optical part, mounted on substage slide. Funnel stop, for 2 mm. Objective. Quadruple Nosepiece. Colour screens	90	0	0

Any of the sets above can be supplied with the "Bactil" Microscope, on page 64, at a reduction in the total price of £2 10 0.

Any of the sets of Accessories, as described with the "Bactil" Microscope (page 64), can be supplied with the "Patna" Microscope, complete in case, at an additional cost of £2 10 0.

For High-power Binocular Bodies for above Microscope, see pages 105-107.

W. WATSON & SONS, LTD.



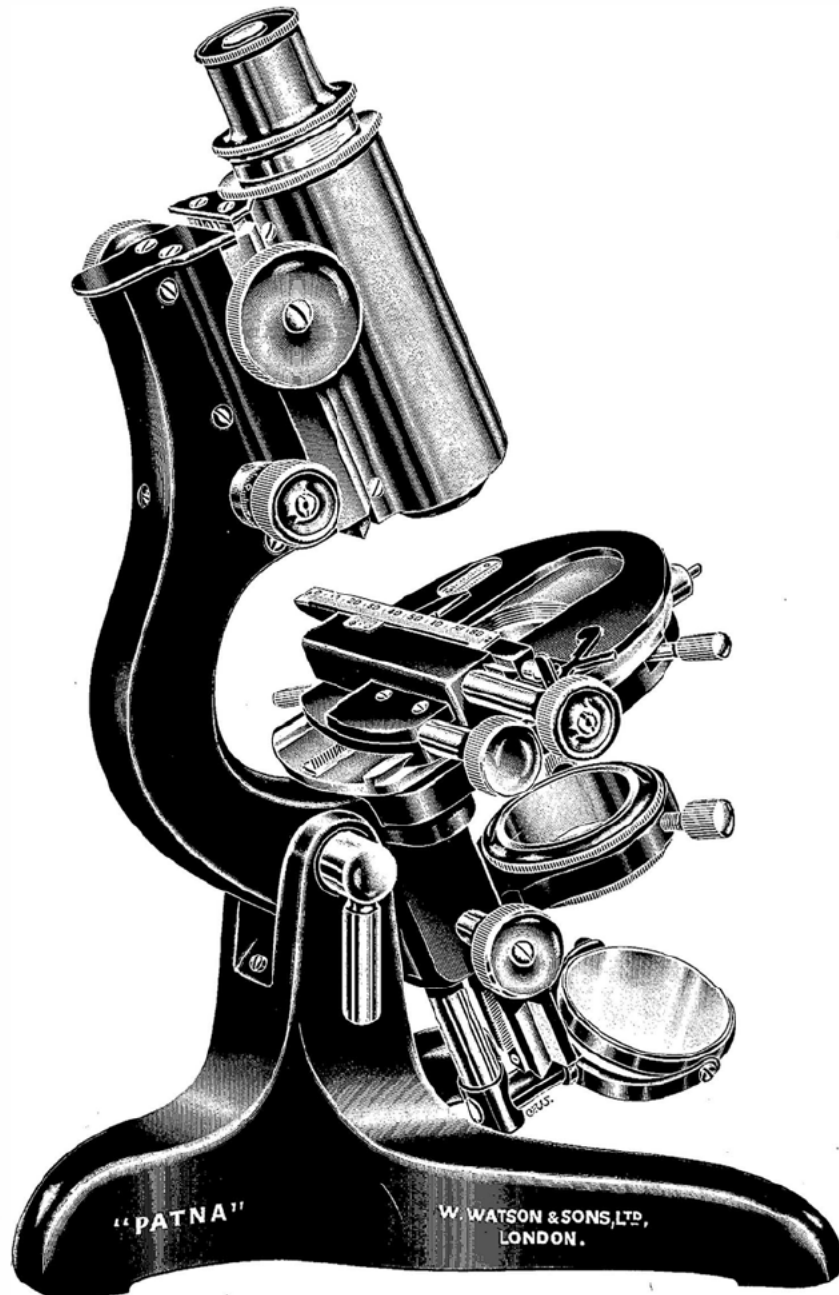
313 HIGH HOLBORN, W.C.

"PATNA"

67

THE "PATNA" MICROSCOPE

Height, 12 inches.



W. WATSON & SONS, LTD.

313 HIGH HOLBORN, W.C.

MICROSCOPES FOR RESEARCH

The Student uses his Microscope principally to see known structures, or to determine the absence or presence of definite appearances. For this purpose a satisfactory equipment can be readily specified.

When the purpose of the Microscope is to reveal the unknown and perhaps the unexpected, every resource which science can offer in both mechanical and optical equipment becomes essential.

It often happens that a structure or an organism can only be observed by means of the most refined optical equipment.

The use of Objectives, Eyepieces and substage apparatus to the limit of their capacities can only be accomplished in conjunction with Microscopes that are provided with the necessary mechanical movements, acting in the most precise manner and of extreme rigidity.

Such delicacy of action can be and is provided in a robust form for continuous use in Watson Research instruments, but they are neither essential nor advantageous in the ordinary laboratory routine.

A special type of Microscope is therefore made in a class by itself, and Watson's are the only manufacturers in the world who offer a series of microscopes so designed that the optical equipment is able to perform under optimum conditions and fully develop the resolving power. They have a specialised knowledge of requirements, and retain for manufacture, skilled craftsmen who have spent their lives in the handwork that is essential in this particular class of instrument, both making, fitting and adjusting. No other firm to day has such men on their staff.

Certain important movements should be included in research instruments. Among them are the **rackwork** adjustment to **draw tube**, which enables the precise tube-length to be used to compensate for the slight aberrations caused by the difference in the thickness of cover slips, or depth of object in the mountant. The **fine adjustment** is Watson's standard lever, which long experience has shown to be the most precise, sensitive, and durable in design that has ever been made. This excellence is in part due to the care and precision with which it is made, added to its simple yet very sound design.

An outstanding fact is that it is the only fine adjustment at present made which has stood the test of sixty years and is still the best.

The **Mechanical Stage** is built into the Microscope, and gives a facility in working of which none of the skeleton or attachable patterns is capable. Where rotation of the object is necessary the stage is built to revolve concentrically, and centring screws to adjust the axis of rotation to the centre of the field can be provided.

The focussing of the Substage Condenser is always by rack and pinion, and where desired a **fine adjustment** can be added. This is a most valuable ally when high-power Condensers and Dark Ground Illuminators are used.

In every case the instrument is supported by a tripod, the spread of which ensures the utmost stability, and a properly balanced support, but a horseshoe type foot can be fitted if preferred.

All mechanical movements are fitted with compensating screws to adjust for wear and tear.

A lifetime of satisfactory working service is secured by using a

Watson Microscope for Research.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE EDINBURGH STUDENT'S MICROSCOPE

STAND "H"

The Standard Model for use of the British Navy.

REMODELLED WITH MANY IMPROVEMENTS

This instrument is illustrated on page 71 of this list. It is the most popular model that we make, and, as such, merits a few words of special description and commendation.

In its general design, this microscope leaves nothing to be desired. It is massive, without being cumbersome, and the arrangements and proportions of its various parts will be found in practice exceedingly convenient. Constructed, as it is, with a perfect-working mechanical stage and substage, furnished with a graduated drawtube, and the most sensitive of fine and coarse adjustments, this microscope is capable of any class of work. Thus, with one twelfth inch oil immersion objective and other apparatus, as detailed in Set 17005, it is extensively used in bacteriological work and is unsurpassed for the purpose. Arranged with a projection eyepiece and objectives of high aperture, it will stand the severest test of high-power photomicrographic work. The range of rackwork to the Coarse Adjustment is sufficient for the use of very low-power Objectives, giving a distance between the Stage surface and nosepiece end of body of $3\frac{1}{2}$ inches. It is thus a Microscope that meets the demands of the worker, no matter what they may be, in the most satisfactory manner, and while its many conveniences make it always advantageous and appreciated in the Laboratory, it is no less a favourite with the amateur worker, who will always find it unequalled for ease and satisfaction in working. Further, it offers for its price fuller combined advantages in completeness of design and perfection of workmanship, than any other Microscope.

GENERAL SPECIFICATION

General Construction. The limb is cast in one piece from top to tailpiece; the various fittings body, stage, substage, etc. are all mounted in alignment on this limb, giving the effect of an optical bench, with wonderful rigidity.

The dovetailed bearings of the substage and fine adjustment are machined in the same operation.

The **Body** of unit construction is of large (40 mm.) diameter and the drawtube (34 mm. diam.) usually supplied carries Eyepieces of the Student's size, but can be fitted for large Eyepieces 1.27 in. diameter if required without extra charge.

The **Foot**, of tripod form, is extremely rigid and efficient. We always recommend the tripod pattern where extreme portability has not to be considered. It is altogether superior to other patterns. Its spread is 7 inches.

The **Mechanical Stage** is our Standard pattern with compensating screws as described, pages 75 and 76. The range of horizontal movement has been increased to $1\frac{1}{2}$ in. The milled head controlling the horizontal motion is stationary, and the plates so arranged that the condenser is not fouled at any point of the travel. The surface of the stage has a thin covering of ebonite attached by vulcanizing.

The **Substage** has rackwork to focus and screws to centre. The controlling milled heads are mounted on both sides of the limb. The bearing, machined in the solid extension piece of the limb, is in the same plane as the fine adjustment bearing.

The **Fine adjustment** is of our horizontal lever pattern. One revolution of the milled head moves the body one three-hundredth of an inch. The action is sensitive to one-hundredth of a turn of the milled head, thus giving a motion of one thirty-thousandth of an inch to the Objective.

The **height** is $11\frac{1}{2}$ inches.

Each instrument has **plane and concave mirrors**.

All fittings are of R.M.S. Standard gauge, and all bearings have compensating screws.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

EDINBURGH STUDENT'S MICROSCOPE STAND "H"

As supplied to H.M. Navy.

A detailed description of the "H" Model of the Edinburgh Student's Series appears on page 69.

Code Word.	No.	PRICES	£	s.	d.
Manum	17001	"H" Microscope, Stand only, as figured on page 71	25	0	0
Mapoy	17002	Mahogany Case	2	10	0
COMPLETE SETS					
Maple	17003	"H" Microscope Stand as described. Mahogany case : Eyepiece 1 at choice $\times 5, \times 6, \times 8, \times 10$. Objectives, Parachromatic $\frac{2}{3}$ in. (16 mm.) N.A. 0.28. " Semi-Apochromatic $\frac{1}{8}$ in. (4 mm.) N.A. 0.70	32	0	0
Maran	17004	"H" Microscope Stand as described. Mahogany case : Eyepieces 2 at choice— $\times 5, \times 6, \times 8, \times 10$. Objectives, Parachromatic $\frac{2}{3}$ in. (16 mm.) N.A. 0.28. " Semi-Apochromatic $\frac{1}{8}$ in. (4 mm.) N.A. 0.70. Abbe Illuminator fully mounted N.A. 1.20. Double Nosepiece	36	12	6
Marb	17005	"H" Microscope Stand equipped as foregoing Set 17004 but with triple instead of double Nosepiece and with "Versalic" $\frac{1}{2}$ in. Oil Immersion Objective N.A. 1.28	42	10	0
With Holoscopic Objectives—					
Maril	17006	"H" Microscope Stand as described. Mahogany case :— Eyepieces 2 at choice— $\times 7, \times 10, \times 14, \times 20$ Holoscopic. Objectives, Holoscopic 16 mm. ($\frac{2}{3}$ in.) N.A. 0.45. " " 4 mm. ($\frac{1}{8}$ in.) N.A. 0.95. " " 2 mm. ($\frac{1}{16}$ in.) N.A. 1.37 oil imm. Triple Nosepiece. Condenser. Parachromatic N.A. 1.0. Achro-Apl. fully mounted	60	10	0
For General and Amateurs' Use—					
Marme	17007	"H" Microscope Stand as described. Mahogany case : Eyepieces 2 at choice— $\times 5, \times 6, \times 8, \times 10$. Objectives, Parachromatic 2 in.— $\frac{2}{3}$ in. (16 mm.) N.A. 0.28. " Semi-Apochromatic $\frac{1}{8}$ in. (4 mm.) N.A. 0.70. Universal Condenser fully mounted. Box of d.g. stops. Stand Condenser. Stage Forceps. Live Cage...	44	0	0
EXTRAS					
March	17008	Sliding Bar to Mechanical Stage	1	10	0
Marla	17009	Division to Stage Movements, reading by verniers to $\frac{1}{10}$ mm.	1	10	0
Marge	170010	Universal Condenser in Substage Iris Mount No. 12603 in place of Abbe Illuminator	4	5	0
Macac	170011	Attachable Rackwork Drawtube	4	10	0
Maryl	170012	$\frac{1}{2}$ in. "Utility" Oil Immersion Objective This can be supplied in Set 17005 instead of the "Versalic" $\frac{1}{2}$ in. at a reduction of £1 7 6.	5	0	0

For Binocular bodies for the above Microscope, see pages 105-107.

For Research type substage and slides, see page 43.

NOTE. A plain stage, ebonite covered, may be substituted for the mechanical stage
at a reduction in cost of ... 7 10 0

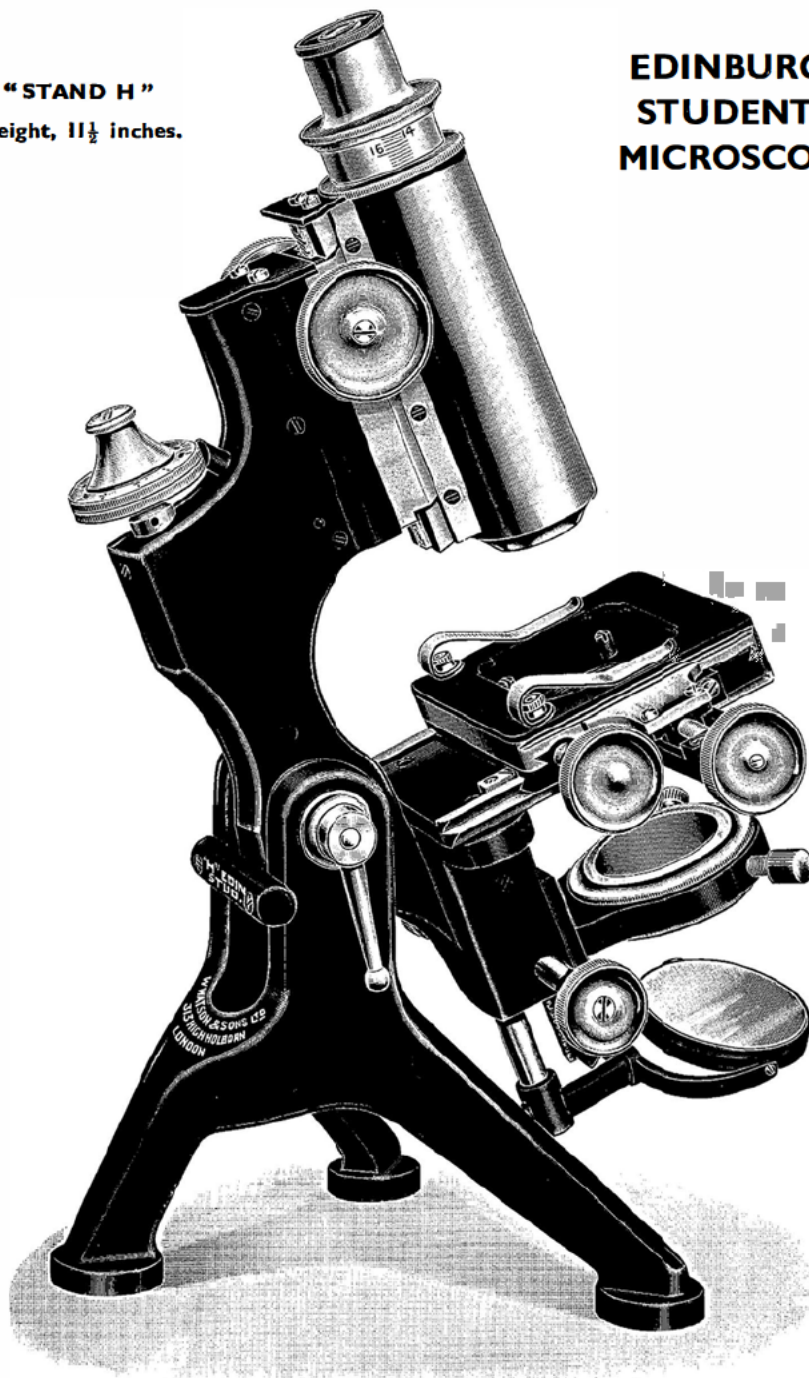
W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

"STAND H"
Height, 11½ inches.

**EDINBURGH
STUDENT'S
MICROSCOPE**



W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE "RESEARCH" MICROSCOPE

The general construction of this Microscope is identical with that of our popular "H" Edinburgh Student's Model, and it is of the same proportions, except that the fine adjustment is by means of our vertical lever, working from both sides of the limb, as described on page 37.

Code Word.	No.	PRICES	£	s.	d.
Marud	17201	"Research" Microscope Stand only as illustrated ...	26	5	0
Marit	17202	Mahogany Case for same ...	2	10	0

COMPLETE SETS

Marjo	17203	"Research" Microscope as described. Mahogany case : 1 Eyepiece at choice— $\times 5$, $\times 6$, $\times 8$, $\times 10$. Objectives, Parachromatic $\frac{3}{8}$ in. (16 mm.) N.A. 0.28. " Semi-Apochromatic $\frac{1}{8}$ in. (4 mm.) N.A. 0.70 ...	33	5	0
Marke	17204	"Research" Microscope as described. Mahogany case : 2 Eyepieces at choice $\times 5$, $\times 6$, $\times 8$, $\times 10$. Objectives, Parachromatic $\frac{3}{8}$ in. (16 mm.) N.A. 0.28. " Semi-Apochromatic $\frac{1}{8}$ in. (4 mm.) N.A. 0.70. Double Nosepiece. Abbe Illuminator N.A. 1.20 fully mounted with iris, etc. ...	37	5	0
Marqu	17205	"Research" Microscope as described and equipped as Set 17204 with triple in lieu of double Nosepiece. "Versalic" $\frac{1}{2}$ in. oil imm. Objective N.A. 1.28 ...	43	10	0

For Research, Photomicrography, etc.

Marso	17206	"Research" Microscope as described. Mahogany case : 2 Holoscopic Eyepieces at choice $\times 7$, $\times 10$, $\times 14$, $\times 20$. Objectives, Holoscopic $\frac{3}{8}$ in. (16 mm.) N.A. 0.45. " " $\frac{1}{8}$ in. (4 mm.) N.A. 0.95. " " $\frac{1}{2}$ in. (2 mm.) N.A. 1.37 oil imm. Parachromatic Apl. Achro. Condenser N.A. 1.0 fully mounted. Triple Nosepiece ...	61	15	0
Marsx	17207	"Research" Microscope equipped as Set 17206 but with Apochromatic Objectives of similar focal lengths in lieu of Holoscopic Objectives ...	72	15	0
Mardl	17208	"Research" Microscope and Case, completely fitted as Set 17007, for General and Amateurs' use... ...	45	5	0

EXTRAS

Marre	17209	Sliding Bar to Mechanical Stage ...	1	10	0
Marow	172010	Divisions to Stage movements, reading by verniers to $\frac{1}{10}$ mm. ...	1	10	0
Macac	172011	Attachable Rackwork Drawtube ...	4	10	0
Maryl	172012	$\frac{1}{2}$ in. "Utility" Oil Immersion Objective ... This can be supplied in Set 17205 instead of the "Versalic" $\frac{1}{2}$ in., at a reduction of £1 7 6	5	0	0

Binocular Bodies for the above Instrument, see pages 105-107.

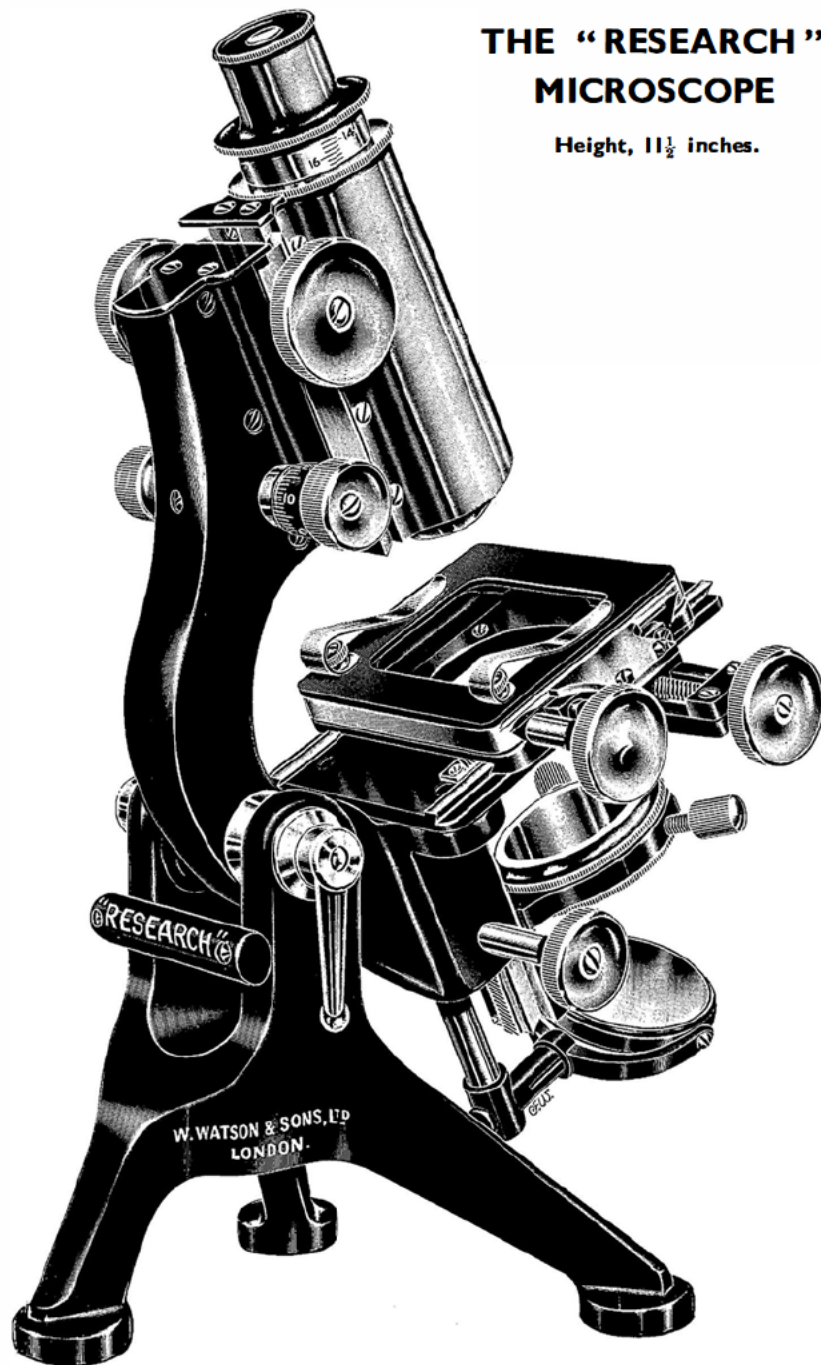
W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE "RESEARCH" MICROSCOPE

Height, 11½ inches.



W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

EXTRAS FOR THE EDINBURGH STUDENT'S AND OTHER MICROSCOPES

	£	s.	d.
Ruled Glass Measuring Disc for Eyepieces for use with divisions to stage	0	7	6
Studs to stage, for use when divisions are fitted	0	10	0
(These are not needed if a sliding bar is included.)			
Clamping Screw to centring movement of substage	0	5	0
Rackwork Drawtube as described page 51	4	10	0

FOR ALL MICROSCOPES WITHOUT MECHANICAL STAGE

Concentric Rotating Stage in place of plain Stage, as described page 50	2	0	0
Divisions to circumference of stage in degrees and reading by vernier to ... add	2	5	0
Centring Screws to rotation of stage add	1	5	0
Sliding Bar to Stage	1	10	0

FOR ALL MODELS

Parachromatic or Universal Achromatic Condenser (1.0 N.A.), specially suitable for Photo Micrography, Nos. 12601 and 12703. Price with Iris Diaphragm.			
For understage, £6 10 0; For substage	7	0	0

Either of these may be taken in place of the Abbe Illuminator, No. 12802 or 12803 included in the sets, at the difference in price viz. £4 5 0 and £4 0 0 respectively.

Set of Stops for either Achromatic Condenser or Abbe Illuminator, for dark ground and oblique light, in brass box	0	10	0
Disc of Blue or Yellow Glass, for Abbe Illuminator, each	0	1	6
$\frac{1}{2}$ in. Parachromatic Objective, giving very flat field	2	0	0
2 in. Parachromatic Objective	2	0	0
Stage Micrometer, $\frac{1}{10}$ and $\frac{1}{100}$ mm.... ..	0	12	6
Micrometer, to drop into Eyepiece	0	10	0
Eyepieces, No. 1, 2, 3 or 4, 10/0 each; Nos. 5 and 6, each	0	15	6
Polariscope, fitted with Selenite	3	2	6
Camera Lucida, Beale's	0	7	6
Stand Condenser, medium size	1	2	6
Triple Nosepiece, new dust-proof pattern	1	10	0
Double Nosepiece	1	5	0
Milled Head of Fine Adjustment divided to $\frac{1}{1000}$ ths (instead of $\frac{1}{10}$ ths) extra	0	5	0
$\frac{1}{2}$ th in. (2 mm.) Oil Immersion "Holoscopic" Series 1.37 in place of the $\frac{1}{2}$ th in. 1.28 included with the Sets "for Bacteriology," extra	3	10	0

BELL-GLASS COVERS

For Edinburgh Student's "Service" and "Bactil" Microscopes	0	17	6
Ditto. with ebonised base	1	5	0

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

MECHANICAL STAGES

WATSON'S STANDARD MECHANICAL STAGE

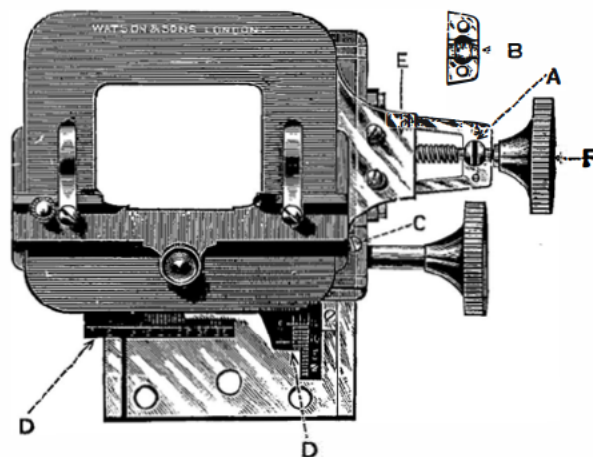


FIG. 18. Surface view of the Watson Standard Stage showing sliding-bar scales and verniers, and method of fitting stationary milled head.

True mechanical stages of the English pattern, in which the object is carried in two directions (and not slid upon the surface of the stage) are so superior for delicate and high-power observations that no one who has used one will be content with the other kind. Such a mechanical stage is part of the Microscope stand, and cannot be added as required. The precision with which the object is moved across the field of view in two directions is dependent upon metal slides and bearings accurately machined and fixed at right angles to the optic axis. The movements of the slides are controlled by rack and pinion for the vertical direction and by a four-thread screw for the horizontal. The bearings have special adjustments for wear. The size of the upper plate exceeds 80×80 mm., and is ample, as the slide is not moved over but with the plate. The range of movement, 1 in. vertical, $1\frac{1}{2}$ in. horizontal, enables a surface of that size to be explored without disturbance of the Objective or Substage Condenser.

The great and many advantages of this type of mechanical stage are a special cause for the favour enjoyed by the Watson Microscopes to which it is fitted. These Microscopes are the Edinburgh "H," "Research," "Royal," Grand Model "Van Heurck."

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

WATSON'S STANDARD MECHANICAL STAGE

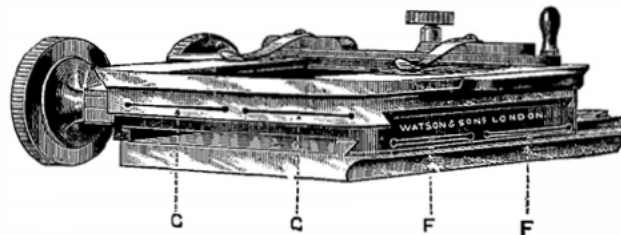


FIG. 19. Corner view of Standard Stage to show system of springing.

The Stage surface is in full view, Fig. 18, and the manner in which the movements are effected will be plainly seen. The horizontal travel to the Stage is made by the rotation of the stationary milled head F, that is, it does not move with the traversing plates of the Stage. The plate E is connected with the long screw operated by the milled head F, and the screw is supported by a slotted collar, which gives adjustment for wear. To give the smoothest possible motion, the screw has a ball fitting (A): in this is a groove, which acts as a receptacle for foreign matter. The little plate B fits over the ball, and is so attached that no internal shake takes place. C is the adjusting screw for regulating the pressure of the pinion upon the rack in the vertical movement of the Stage. The Verniers D, Fig. 18, which can be used for measuring or for "finding" objects, are an extra, costing 30/-. When verniers are supplied it is advantageous to have the sliding bar, as illustrated, at an extra cost of 30/-.

The planed fittings of the Stage have slots through which screws pass at FF and GG (Fig. 19) so that any wear in the plates can be immediately taken up.

The advantages of this stage are manifold, and at once occur to the experienced worker.

The methods used in the above Stages, which give a lifetime of working efficiency, are adopted in other mechanical stages of our make.

A variety of Mechanical Stages of the Attachable pattern, concentric rotating, etc., are described in this list on pages 47-50.

Mechanical Stages are made in several different patterns so as to give workers as wide a range of choice as possible. Each is described and illustrated in conjunction with the various models, but in several instances the Stage is applicable to a different style of Microscope.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE " ROYAL " MICROSCOPE

A RESEARCH MICROSCOPE OF MEDIUM SIZE

This Microscope incorporates all the fine details which are so advantageous in critical work and is intended for those who require a Microscope of highest class, adequate, but not too large in size and in effect provides the advantages which have gained so high a reputation for the " Van Heurck " Microscope, see page 81, but in a more compact form and at a lower cost.

The height, when placed vertical and racked down, is $12\frac{3}{4}$ in.

The tripod foot is shod with cork and has a spread of $8\frac{1}{2}$ in.

The Body is of large size 40 mm. diameter, of unit construction, and is fitted with both mechanical and sliding draw tubes, giving an available range of tube-length from 140 mm. to 270 mm.

The Mechanical Drawtube with inner sliding draw tube, as described page 51, is incorporated. It carries eyepieces 1.27 in. diameter, but, if so desired, can be supplied to carry eyepieces of the Student's or Continental size.

The Mechanical Stage is of our Standard pattern as described pages 75 and 76. It has a horizontal movement of $1\frac{1}{2}$ in. and is covered with ebonite attached by a vulcanizing process. It is fitted with a sliding bar.

The Limb While conforming to the general design which imparts the rigidity for which these instruments are so justly famous, the limb has been lengthened to extend above the coarse adjustment milled head fitting and at the same time increased in thickness. The dovetailed bearings of the fine adjustment slide and of the substage are machined in one operation so ensuring permanent alignment. Cast integrally with the limb are massive widely spaced lugs to which the mechanical stage is bolted. These form a support across the whole width of the stage baseplate.

Below the stage mounting is the bearing on the limb extension for the substage. Thus when the substage is focussed the object upon the stage is unaffected by any stress or flexure and remains in focus.

The Axis Joint is an actual ground fitting and not a spring fit between two cheeks. Bearing collars are also employed.

The Substage has a clear focussing range of $1\frac{1}{4}$ inches and may be used conveniently with low power condensers for photomicrography. In the regular model it now has coarse adjustment and centring screws with fine adjustment without extra charge. This should be specified when ordering. The substage fitting and slide are now a solid casting achieving a further advance in rigidity and a special substage mount has been designed in which the optical part can, if desired, be hinged out of the optic axis. Accuracy of return is provided for by fitting a hardened steel lever catch.

Modern research requires the use of at least two and often three separate substage condensers, and we therefore recommend the inclusion of the Research substage when ordering this instrument. The comfort and increased efficiency resulting from the use of this apparatus with its co-axial condensers cannot be too greatly stressed.

The Coarse Adjustment is by diagonal rack and pinion, as described page 36, and in connection with the " Van Heurck " Microscope, on page 82.

The Fine Adjustment is our standard lever pattern.

It will thus be seen that the many special features combined in this Microscope render it suitable for those who require an instrument of the highest class. It will be found to respond in the fullest manner to the exacting demands of the photomicrographer and research-power worker, particularly those whose work demands the use in combination of oil immersion Objectives and Condensers. Its many conveniences ensure that theoretical resolution is obtained with all types of objectives and condensers. It is invaluable in the laboratory, for which its strong construction and excellent mechanical stage are especially advantageous, while for the varied purposes of the amateur it is unsurpassed.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

" ROYAL " MICROSCOPE

<i>Code Word.</i>	<i>No.</i>	PRICES	<i>£ s. d.</i>
Mesho	17801	Royal Microscope, stand only, as described	42 10 0
Metag	17802	Mahogany Cabinet, hand dovetailed, to contain Microscope and apparatus	2 10 0
Meta	17803	Mahogany Cabinet, hand dovetailed, to contain Microscope and apparatus and binocular body	4 0 0
Metam	17804	Mahogany Cabinet, hand dovetailed, dustproof, cupboard door, apparatus drawer	5 10 0
Meteo	17805	Bell-Glass Shade 17/6; Ebonised and Velvet Covered Base 10/-	1 7 6

EXTRAS

Mileg	17806	Adapter to carry Eyepieces of Continental size	0 7 6
Metaz	17807	Research Substage with 2 condenser slides in place of compound substage	4 5 0
Metax	17808	Interchangeable high-power Binocular Body with 1 pr. Student size Eyepieces	14 0 0

COMPLETE SETS consisting of:

ROYAL MICROSCOPE, as described, with Mahogany Case, Outfit accompanying Microscope.

Metre	17809	Eyepieces, best capped 2 ($\times 6$, $\times 8$, $\times 10$). Objectives, Parachromatic $\frac{3}{8}$ in. N.A. 0.28. " Semi-Apochromatic $\frac{1}{8}$ in. N.A. 0.70. Condenser Abbe N.A. 1.20 fully mounted	54 12 6
Miado	178010	Eyepieces, best capped 2 ($\times 5$, $\times 6$, $\times 10$). Objectives, Parachromatic $\frac{3}{8}$ in. N.A. 0.28. " Semi-Apochromatic $\frac{1}{8}$ in. N.A. 0.70 " "Versalic" Oil Immersion $\frac{1}{2}$ in. N.A. 1.28. Condenser Abbe N.A. 1.20 fully mounted. Triple Nosepiece with tangential centring screws. Colour Filters	62 17 6

FOR RESEARCH

Midat	178011	Eyepieces, Holoscopic, best capped 2 ($\times 7$, $\times 10$, $\times 14$, $\times 20$) Objectives, Holoscopic, 16 mm. N.A. 0.45. " " 4 mm. N.A. 0.95. Condenser Universal Apl.-Achromatic N.A. 1.0 fully mounted. Triple Nosepiece	68 0 0
Midge	178012	As above but with addition of Holoscopic 2 mm. oil imm. Objective N.A. 1.37	77 0 0
Midog	178013	As above but with Research Substage—Funnel stop for 2 mm. Objective 2 Interchangeable condenser slides having independent centring. Parachromatic condenser Apl.-Achromatic N.A. 1.0 Holoscopic immersion dark ground condenser	84 15 0

FOR ADVANCED RESEARCH & PHOTOMICROGRAPHY

Midol	178014	Royal Microscope as described with the addition of fine adjustment to Substage, mahogany case. Eyepieces, Holoscopic, best capped pattern 3 ($\times 5$, $\times 7$, $\times 10$, $\times 14$, $\times 20$) Objectives, Holoscopic, $1\frac{1}{2}$ in. (37 mm.). Apochromatic, 16 mm. N.A. 0.30. 8 mm. N.A. 0.65. " 4 mm. N.A. 0.85. 2 mm. oil imm. N.A. 1.37. Quadruple Nosepiece. Research Substage with 3 condenser slides. Funnel Stop for Objective. Colour Filters. Condensers, Universal Apl.-Achromatic N.A. 1.0. " Holoscopic Immersion Achromatic N.A. 1.35. " " imm. dark ground	120 0 0
-------	--------	---	---------

For detailed estimate of a complete outfit for General Microscopy, see p. 80.

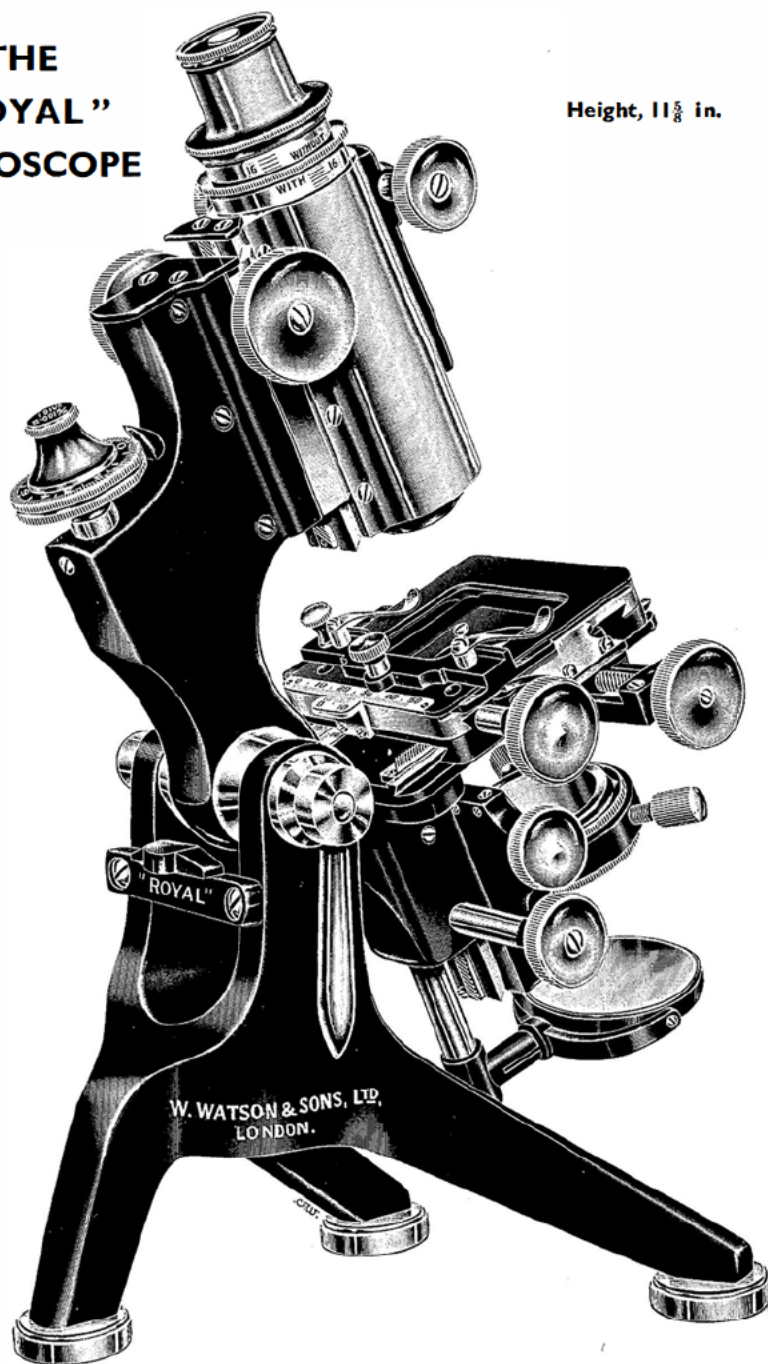
W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE
"ROYAL"
MICROSCOPE

Height, $11\frac{5}{8}$ in.



W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE ROYAL OUTFIT

AN AMATEUR'S FIRST-CLASS SET

MICROSCOPE

	£	s.	d.
The Royal, stand only, as described pages 77 and 79	42	10	0
High power Binocular body, interchangeable with monocular	14	0	0
Inclination unit for binocular and monocular bodies	5	0	0
Wenham Binocular body to interchange with monocular, see page 103	14	0	0
Research Substage with 2 substage slides add to price of microscope	4	5	0
Additional Substage slides, each with centering adjustments	1	7	6
Best Mahogany Cabinet	5	10	0

OBJECTIVES

Holooscopic (page 13)				£	s.	d.	OR	Apochromatic (page 11)			
50 mm.	...	...	...	2	10	0		16 mm. 0.30	...	...	5 0 0
25 "	0.25	...	...	4	10	0		8 " 0.65	...	...	7 0 0
12 "	0.65	...	...	5	5	0		4 " 0.85	...	...	9 0 0
4 "	0.95	...	...	6	5	0		2 " 1.37	...	...
2 "	1.37	...	...					Oil Immersion	...	...	17 10 0
Oil Immersion	...	...	...	10	0	0					

EYEPIECES—HOLOSCOPIC SERIES (page 19)

1 pair each, $\times 5$ and $\times 7$, large capped, £2 15 0	...	...	...	11	0	0
1 each $\times 10$ and $\times 14$	2	15	0	5	10	0

CONDENSERS

Macro Illuminator for low power visual and photomicrographic work	3	10	0
Universal Apl-achro. N.A. 1.0 fully mounted with Iris diaphragm	7	0	0
Holooscopic Oil Immersion Apl.-achro. N.A. 1.30 fully mounted with Iris diaphragm	9	10	0
Holooscopic Dark ground Oil Immersion Paraboloid, fully mounted with Iris diaphragm	4	5	0

ACCESSORIES

Polarising Apparatus,	3	2	6
Mica-Selenite Stage,	2	12	6
Bull's-Eye Condenser,	1	7	6
Silver Parabolic Side Reflector,	1	10	0
Beale's Neutral Tint Camera Lucida,	0	7	6
Triple dust-proof Nosepiece,	1	10	0
Aluminium Reversible Compressor,	2	2	0
Rousselot Live Box, 2263, 17/6; Extra Covers, 2264, 2/6 doz.	1	2	6
2 Troughs, 2272: 3 in. \times 1 in., 1/6; and 3 in. \times 1½ in., 2/6	0	4	0
Stage Forceps, 2481	0	12	6
Micrometer, one each for Eyepiece, 2324, 10/0; and Stage, 2329, 12/6	1	2	6
Standard Lamp, 2144, £1 10 0; and Case, 2147, £1 0 0	2	10	0

MOUNTING MATERIALS

Universal Dissecting Microscope, and set of 3 Aplanatic Magnifiers, see Part II.	7	5	0
Mounting Cabinet, 2382	5	15	0
Cathcart Microtome, pattern 2347	3	5	0
Complete Cabinet of 200 Microscopic Slides of general interest,	18	10	0

The total may be arrived at after the selection of the objectives.

This Set may be varied to meet individual requirements, and every assistance toward a suitable selection will be afforded intending purchasers. Any of the Sets included with the Royal Microscope on page 78 could be arranged with the above.

Code word with Holooscopic Objectives Milfo.

" " with Apochromatic Objectives Milia.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE VAN HEURCK MICROSCOPE

For Research and General Purposes.

Grand Model. The most completely fitted Microscope extant, and of handsome proportions and build throughout.

Can be supplied with tripod or horseshoe foot at choice.

The Van Heurck is the most completely fitted model manufactured, and represents all that is most modern in microscope design and manufacture; it is hand made throughout and embodies that "craftsmanship" for which the British workman has always been famous; Watson microscope makers take a pride in these instruments. Their finish gives that sense of satisfaction which is never felt to quite the same extent in other productions.

The aim in its construction has been to present, in the most efficient form possible, mechanical movements of complete and comprehensive description, in a design of maximum rigidity, and to maintain every feature in the most up-to-date manner. We can assert unhesitatingly that the complete control which is afforded in working enables the finest results to be secured with a rapidity and comfort which is unique. It has brought the most gratifying testimony from many of the leading microscopists of the day, and this, coupled with the fact that the Van Heurck is now used by many of the foremost workers in every branch of research, is a sufficient guarantee of the perfection attained.

When first introduced it was the most complete and efficient model of its time, and ever since its inception every improvement and every feature which makes for enduring efficiency and ability to extract the uttermost from the optical equipment has been included in this model.

Photomicrography, especially with high powers of large aperture, demands a working excellence and accuracy of the highest grade in every part it is, in fact, the severest test to which a microscope can be put. In the construction of this Instrument the usual causes of failure have been eliminated. It will at once be recognised that the precision which is requisite for high-power photography and which is provided in this Instrument, is of immense value to the ordinary visual worker, for it enables him to secure the fullest and most effective means of conducting his researches. Especially does this apply to Laboratory work, in which reliance has to be placed on the results obtained; and to those who are doing original and accurate work, this microscope will be found to embody every convenience for rendering such work more easy and exact.

The Van Heurck is, in fact, the last word in modern microscope construction.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

VAN HEURCK MICROSCOPE—Continued

The general construction of this instrument merits special consideration.

The Coarse Adjustment is effected by Watson's diagonal rack and pinion, and has sufficient range for a 4-inch Objective. The pressure of the pinion on the rack is adjusted by the two screws shown in the accompanying Fig. 20. N is a block of anti-friction metal which supports the pinion shaft on each side, and it is on this supporting block that two adjusting screws act, one of which, M, is shown in Fig. 20. The most sensitive relation of pinion to rack can be established and maintained at all times. These adjusting screws are shown in position on the fitting plate in Fig. 21.

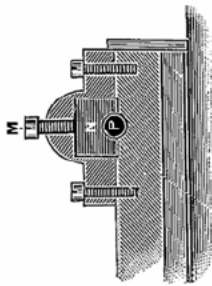


FIG. 20. Sectional View of adjustable fittings of rack and pinion.

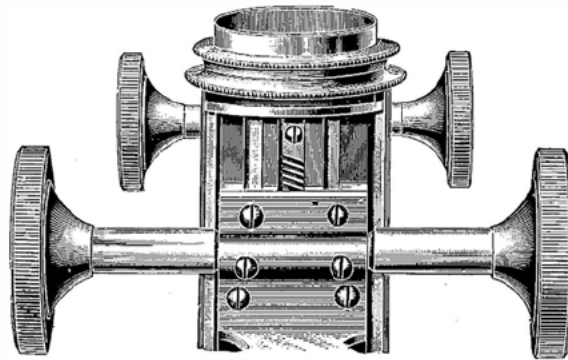


FIG. 21. View of fitting plate of coarse adjustment.

The Fine Adjustment is our Standard lever form, but, being made with a very long lever, the motion imparted is very slow and precise.

The milled head is divided into hundredths, and one revolution moves the body, up or down, the thirteenth of a millimetre. The adjustment is sensitive to the hundredth of a turn of the milled head, which would give the one thirteen-hundredth of a millimetre, or the $1/33300$ th of an inch of motion.

The Body is provided with two Drawtubes, one actuated by Rackwork and the other sliding inside it, as figured above. The advantage of having these is that the body can be made very short, or extremely long. Thus sufficient latitude can be obtained to use Objectives corrected for either English or Continental tube-lengths, and to adjust them for thickness of cover glass by variation of tube-length; both drawtubes are engraved in millimetres to show tube-length.

The lower end of the drawtube has the universal screw for low-power Photographic Objectives, the Apertometer, etc., and the nosepiece is removable by unscrewing. The usual size of Eyepiece fitting is the Royal Microscopical Society's gauge, 1.27 in. diameter, but any smaller size can be employed, and larger sizes can be had specially to order.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

VAN HEURCK MICROSCOPE—Continued

The Stage Mounted upon a wide supported bracket the utmost rigidity of support is secured. Concentric rotation is provided, there is a large rectangular central aperture, and the plates are as thin as is compatible with rigidity. In this type the top plate and specimen move across the optic axis as a complete unit. Above all a large clear surface is afforded for the free movement of specimens with the fingers, and a sliding bar is provided to support the object when desired. Any special arrangement for holding specimens, other than the usual sliding bar and springs, can be supplied to order, if required. Compensating adjustments are fitted to all movements.

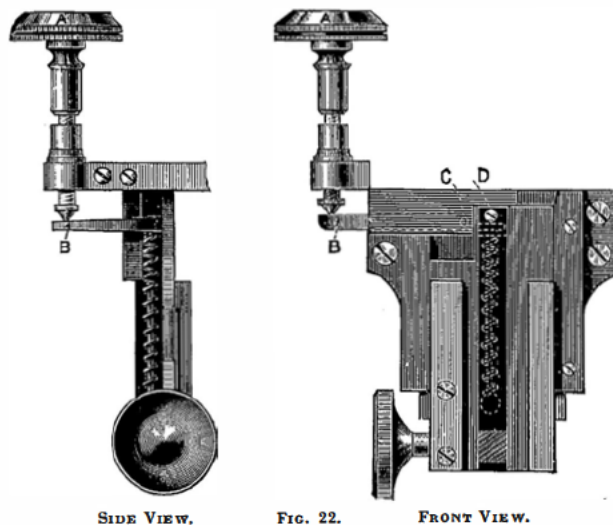


FIG. 22.
Fine Adjustment as fitted to the Substage of the Van Heurck Microscope, working from upper surface of stage. The Substage itself is removed to show the construction.

The Substage is of specially substantial construction; it has rectangular screw adjustments to centre, very fine rackwork to focus, and is arranged to swing out of the optical axis. A **Fine Adjustment** is included with the Grand Model instrument. It may be either of two patterns: (1) to work from above the Stage surface by the method shown in Fig. 22 and in position on the Instrument on page 87, or (2) by means of a vertical lever worked by a milled head, mounted parallel with and just above the rackwork milled head of the Substage, as shown (F) on the Royal Instrument on p. 79. The former method of mounting entails a slight extra charge (£1 5 0).

A Fine Adjustment is essential for highest power Research work with modern Immersion Condensers of wide aperture and precise focus. Slight alterations to focus can be effected without disturbing the film of oil, specimen or setting up vibration.

A Special Feature. The maximum stability is imparted in an original manner. Instead of the various parts being merely screwed together, they are fitted one into the other, thus rendering the structure as solid as though it were one piece of metal. As will be seen from the accompanying figure, the Bracket CC carrying the stage, instead of being screwed to the front of the limb, as is customary, is made in one solid casting, taking the substage beneath on the plate D, and going right into the joint at the top of the pillar. The limb A is fitted into the Stage Bracket D, held firmly by screws, and the joint bolt B goes through the whole Limb and Stage Bracket making the Limb, Stage, and Substage as if they were one piece. The strength and freedom from spring obtained by this Optical Bench system is unique in microscope construction, and altogether superior to microscopes which depend on screws only for the joining together of their parts.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

VAN HEURCK MICROSCOPE—Continued

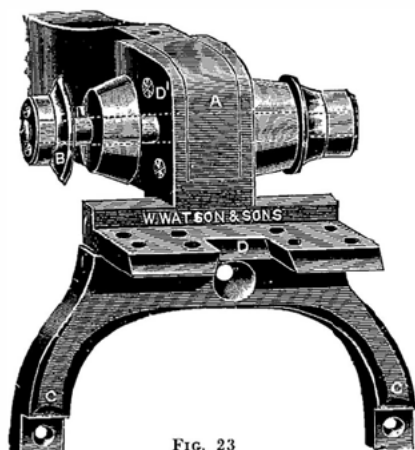


FIG. 23

View of the method of fitting the Stage and Limb in the Van Heurck Microscope.

A—Limb. CC and D—Stage Bracket.

The Foot. The original Foot for this

Instrument was of the Continental form, but the Tripod has met with so much favour and is so strongly recommended by most of the leading Microscopists, that it has entirely superseded it. At the points of contact with the table the foot is provided with cork pads, to further reduce vibration, while preventing the Instrument from slipping and the table from being scratched.

The stand is perfectly steady in any position, and the joint has a steel clamping bar, to fix it at any desired angle.

All the fittings are of the universal (R.M.S.) size.



The foot of the Van Heurck Microscope, either Model, may be of the horseshoe pattern as here illustrated. The price is the same as with the tripod.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

EXTRAS FOR THE GRAND MODEL VAN HEURCK MICROSCOPE

TO THE STAGE

<i>Code Word.</i>	<i>No.</i>		<i>Prices</i> £ s. d.
Monad	18501	Centring Screws to Stage, and Clamp Screws to fix Stage when centred	8 10 0
Monke	18502	Rackwork rotation to Stage, with means of throwing pinion in and out of gear	5 10 0
Monom	18503	Circumference of Stage divided to degrees, reading by verniers to five minutes	3 3 0
Month	18504	Divisions to movements of Stage, reading by verniers to one-tenth of a millimetre	3 5 0
Moody	18505	Plate to fit in dovetailed grooves to cover surface of Stage, for rough work	2 10 0

TO THE SUBSTAGE

Moral	18506	Rackwork rotation to Substage	4 15 0
Morbo	18507	Substage mounted on bar, sliding in extra dovetailed fittings, so that the Substage may be set in any desired position, irrespective of the rackwork, which operates independently, thus allowing the use of every variety of Substage apparatus. With clamp screw	4 15 0
		Research Substage with incorporated Iris diaphragm dovetailed slides to receive condenser changer slides, with 2 condenser slides screwed to receive any size condensers and with centring adjustment to each slide	4 5 0

BODIES

Magbo	18508	Interchangeable High Power prism Binocular Body with interpupillary adjustment and adjustment for differences in sight between the two eyes (see p. 105)	14 0 0
Magbu	18509	Interchangeable Wenham Binocular Body with rackwork adjustment to draw-tubes (see p. 103)	14 0 0
Magby	185010	Inclination Unit (page 107) for use in combination with both monocular and binocular bodies	5 0 0

CABINETS

Moros	185011	Mahogany Cabinet to contain Instrument and Apparatus	5 15 0
Morph	185012	Mahogany Cabinet, superior construction, with cupboard door to exclude dust, and drawers to contain apparatus	9 0 0
Morse	185013	Mahogany Cabinet, with cupboard door to exclude dust, and having fitted inside a flat mahogany case to contain apparatus. Of handsome design and best construction	15 10 0
Morta	185014	Bell Glass Cover on polished ebonised base, for Van Heurck Microscope	1 15 0

As the Bell-Glass Cover has to be packed separately, the expense of so doing will be charged at cost, and the risk of breakage in transit must be borne by the purchaser.

For list of Objectives, Eyepieces, Condensers, etc., see page 11 onwards.

A suggestion for a complete high class outfit is given on page 88. We are at all times glad to assist and advise intending purchasers, and to arrange special outfits for various classes of research. Customers are invited to examine our models before purchasing, as it is only by critical inspection that the superiority of our instruments can be fully appreciated.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

VAN HEURCK GRAND MODEL MICROSCOPE

This Model has been altered in several respects in order that the demand for a long range of Mechanical Stage movement with complete rotation at any position may be met. The stage now has 2 inches of horizontal traverse and is fitted with movable object clips and removable spring bar clips. It will be readily seen that the shape of the limb gives great freedom to the stage surface, and incidentally acts as a convenient handle.

It is especially recommended to those who require a full sized instrument of highest grade for the most critical work.

SPECIFICATION

The **height** of the stand, when placed vertically and racked down, is 14 in. The height to optical centre, when the stand is horizontal, is 10 in.

The **tripod** is shod with cork and has a spread of $9\frac{3}{4}$ in.

The **stage** is capable of complete rotation, and has a range of 2 in. in the horizontal and about $1\frac{1}{4}$ in. in the vertical directions. The milled heads work on one centre, and, if desired, can both be rotated simultaneously, imparting a diagonal movement. The diameter of the stage is 5 in. It has complete concentric rotation. The object is gripped by double sliding bars. Ordinary object clips are also supplied, but are removable. The Instrument may be fitted with a less expensive pattern of stage as quoted below, if desired.

The **fine adjustment** is our Standard horizontal lever.

The **compound substage** is arranged to be turned aside from the optical axis and is fitted with a fine adjustment.

The **mirrors** are plane and concave, and are $2\frac{3}{4}$ in. diameter.

All fittings are of R.M.S. standard gauge.

The instrument is accurately balanced and remains firm and rigid in any position, and is therefore especially recommended for photo-micrographic, analytical, and general high-class work.

The construction has been detailed on pages 81 to 84.

PRICES

Code Word.	No.		£	s.	d.
Moile	18601	Grand Model Microscope Stand, as described	100	0	0
Moist	18602	Microscope, as described above, but with stage as fitted to the Royal Model, having in addition concentric rotation through 27°	90	0	0

PRESENTATION FORM

Momel	18603	Grand Model Van Heurck Microscope, on Tripod foot, fitted with centring screws to Stage, and clamp screws to fix centred Stage, Rackwork rotation to stage, with means of throwing pinion in and out of gear. Rotation of Stage divided to degrees, reading by verniers to five minutes. Divisions to movements of Stage, reading by verniers to one-tenth of a millimetre. Rackwork rotation to Substage. Finished throughout in bright polished lacquered brass. Stand only	150	0	0
-------	-------	--	-----	---	---

For extra fittings to the Grand Model, see page 85.

For **Binocular bodies** suitable for the above Instrument, see pages 105-107.

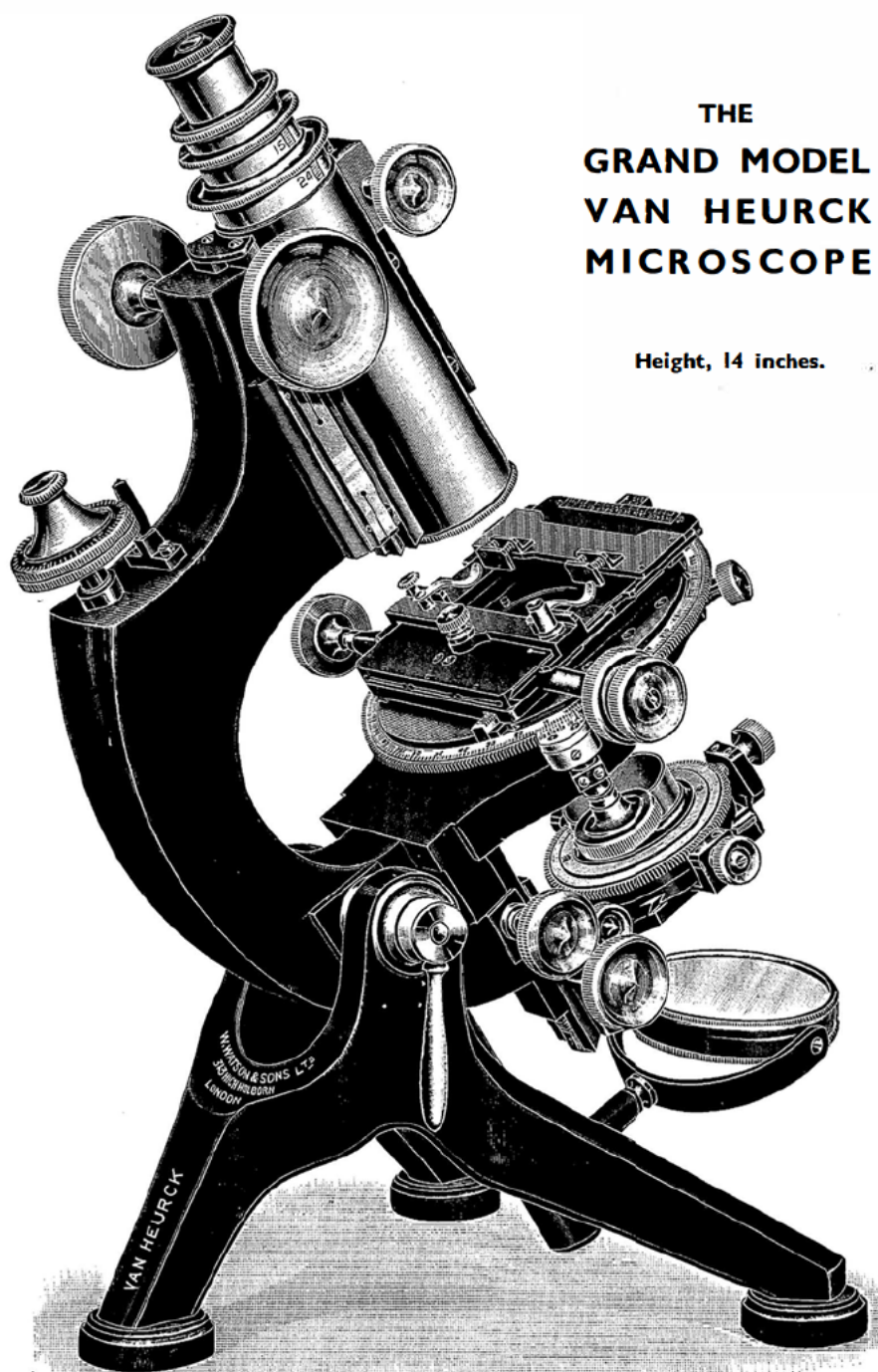
W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE
GRAND MODEL
VAN HEURCK
MICROSCOPE

Height, 14 inches.



W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

COMPLETE RESEARCH OUTFIT

	Price.		
	£	s.	d.
The Grand Model Van Heurck Microscope Stand, on Tripod foot, as illustrated, page 87	67	10	0
Divisions to Stage, reading to $\frac{1}{10}$ millimetre	3	5	0
Plate to cover Stage for rough work	2	10	0
Centring Screws to Rotation of Stage	8	10	0
Rackwork Rotation to Stage	5	10	0
Divisions to Rotation of Stage	3	3	0
Research Substage with 2 slides fitted to carry condensers specified below	4	5	0
Best Mahogany Case to contain Instrument and Apparatus	7	15	0
Extra High-power or Wenham Binocular Body to interchange with the Monocular	14	0	0

*** OBJECTIVES** (see page 13), Watson's Holoscopic Series—

	£	s.	d.
25 mm., £4 10 0, 12 mm. .65 N.A., £5 5 0, 4 mm. 0.95	6	5	0
2 mm. Oil Immersion, 1.37 N.A.	10	0	0
2 in., £2 10 0; 3 in., £3 0 0	5	10	0

EYEPIECES, Holoscopic Series

Magnifying powers 5, 7, 10 and 14 diameters	2	15	0
Extra to make pairs for Binocular, 1 each, 5 and 7 diameters	11	0	0
	5	10	0

If the high-power Binocular Body is specified, Eyepieces
will be student size, £2 instead of £2 15 0 each.

ACCESSORIES

Parachromatic Condenser 1.0 N.A. with Iris diaphragm and set of stops for dark ground and oblique illumination	7	0	0
Abbe Model Illuminator (1.2 N.A.), No. 12802 and set of stops	3	10	0
Ramsden Screw Micrometer Eyepiece, 2321 £7 15 0; Stage Micrometer, 2329, 12/6	8	7	6
Polariser, and Analyser, 2456	3	2	6
Dust-proof Triple Nosepiece with tangential centring screws	1	10	0
2 Live Boxes, 2262, 17/6; and 2271, £1 0 0	1	17	6
Lamp, 2144, and Case, 2147...	2	10	0
Bull's-Eye Stand Condenser, 2169	1	7	6
Set of 12 Test Objects (see Object Catalogue)	1	5	0
Abbe Pattern Camera Lucida, 2251	4	5	0

MOUNTING APPARATUS

Pine Cabinet of Mounting Apparatus, 2382	5	15	0
"Universal" Dissecting Microscope with two Aplanatic Magnifiers	6	10	0
Cathcart-Darlaston Microtome for Embedding and Freezing, 2351	4	7	6
Section Razor 2354, ...	0	2	9

PHOTO-MICROGRAPHIC APPARATUS

Laboratory Camera (see separate list, part 5)	37	10	0
2 Inner Frames, fitting Microscope and supplying connecting Flanges	2	12	0
Watson-Conrady Condenser on Stand with Centring screws and Iris diaphragm	11	10	0
Focussing Glass, 16/6, and Projection Eyepiece, £2 10 0	3	6	6
Trough on Stand, to contain Light and Heat Absorbing Media, No. 2292	3	3	0
Chemicals for Development, etc., in case	4	10	0

All the necessities for Photo-Micrography are included above.

Complete Cabinets of Choice Microscope Objects (see Part II.).

Code word for above outfit Mime.

* Apochromatic Objectives, as per page 11, may be substituted for above if desired.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

COMPLETE VAN HEURCK MICROSCOPE OUTFITS

GRAND MODEL VAN HEURCK MICROSCOPE

Stand as described, pages 81 87, No. 18601

<i>Code Word.</i>	<i>No.</i>							
Mitel	18901	With Parachromatic Objectives. Two Parachromatic Objectives $\frac{1}{8}$ in., -80 N.A., and choice of 1 in., $\frac{3}{8}$ in. or $\frac{1}{2}$ in. Two Eyepieces, large capped pattern. Abbe Illuminator, No. 12802. Mahogany Cabinet ...	£	s.	d.			
			115	17	6			
Mixid	18902	Same as 18901, but with the additions of dust-proof triple Nosepiece and $\frac{1}{2}$ in. Oil Immersion Objective ...	122	7	6			
Mizen	18903	With Holoscopic Objectives. Two Holoscopic Objectives 25 mm. (1 in.) and 4 mm. ($\frac{1}{8}$ in.) Two Eyepieces, Holoscopic, capped pattern. Universal Condenser, No. 12603. Complete in Mahogany Cabinet ...	129	10	0			
Moans	18904	Same as 18903 but with the addition of 2 mm. ($\frac{1}{16}$ in.) 1.37 N.A. Oil Immersion Objective, Holoscopic Series and dust- proof triple Nosepiece, complete in best Mahogany Cabinet, with drawers for apparatus ...	143	10	0			
Mobil	18905	With Apochromatic Objectives. Two Apochromatic Objectives, 16 mm. ($\frac{5}{8}$ in.) and 4 mm. ($\frac{1}{8}$ in.) Two Eyepieces, Holoscopic capped pattern. Universal Condenser, No. 12603. Complete in Mahogany Cabinet ...	132	5	0			
Mocke	18906	Same as 18905, but with the addition of 2 mm. ($\frac{1}{16}$ in.) Oil Immersion, Apochromatic Series, dustproof triple Nosepiece. Oil Immersion Holoscopic Condenser, to replace the Universal Condenser, complete in best Mahogany Cabinet with drawers for apparatus ...	156	15	0			
Model	18907	For Amateurs' Use. Binocular and Monocular bodies to interchange. Five Holoscopic Objectives 75 mm., 50 mm., 25 mm., 12 mm., -65 N.A. 4 mm. ... Holoscopic Eyepieces 1 pair, $\times 7$, one only $\times 10$. Universal Condenser, with set of Stops for dark ground and oblique illumination. Bull's Eye Stand Condenser, 21610. Rousselet's Live Cage, 2263, and Compressor, 2262. Stage Forceps, 2482. Complete in best Mahogany Cabinet ...	166	15	0			

The above sets are suggestive and may be varied at the differences in the Catalogue prices. Extras, such as Divisions to movements of Stage, additional Mechanical Screws, etc., etc., can be added at the respective prices given on page 85.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

ULTRA-VIOLET LIGHT (INVISIBLE RADIATIONS) AND DARK GROUND ILLUMINATION

PHOTO-MICROGRAPHY WITH ULTRA-VIOLET LIGHT.

In "Practical Microscopy," by Dr. Shillington Scales, published in 1909, appears a very concise description of the apparatus necessary, and we extract from it some of the important points and difficulties which are associated with the work :

"The resolving power of a lens depends upon its aperture, and with cedar oil as an immersion medium we are limited to an N.A. of about 1.4. An immersion lens has been constructed for use with monobromide of naphthalene which has an N.A. of about 1.6, and proportionately greater resolving power, but this medium is, unfortunately, unsuitable for mounting most objects, so that this lens has not come into general use. But we can increase the resolution in two other ways either by increasing the refractive index of the mounting medium, and so shortening the wave-length of light, or by using light of shorter wave-length. White light is known to be made up of rays of different wave-lengths and refrangibility, those at the violet end of the spectrum being much shorter than those at the red end. Monochromatic light, selected by means of a prism or screen, and taken from the blue, or, still better, the violet end of the spectrum, will consequently give us greater resolution than ordinary white light, which combines so many rays of longer wave-length. This is taken advantage of in photo-micrography, and the result is a very definite increase in resolution say, of the markings of a difficult diatom. Unfortunately, the eye itself is but little sensitive to such rays, so that it is not easy to see the object directly, or to focus it, though such light has high actinic value. Dr. Köhler, of Jena, has, however, experimented with ultra violet rays of a still shorter wave-length— $275\mu\mu$. which have even greater power of resolution, but are, of course, invisible, and has lenses made of crystal and fused quartz corrected for this wave-length, which, as monochromatic light is used, have the incidental advantage of needing correction only for spherical, and not for chromatic aberration. The N.A. of the strongest system is 1.25, which gives a resolving power, as compared with an imaginary ordinary lens used in daylight, equivalent to N.A. 2.5, on account of the small wave-length of the light used. The light itself is obtained from a 2 mm. spark between cadmium electrodes of a Leyden jar, worked with an induction machine, and light of the required wavelength is separated by an iris diaphragm and passed through a condenser made of quartz.

"But the human eye, as has just been stated, cannot see these rays, and so cannot focus and adjust them. Therefore Dr. Köhler has devised what may be called an artificial eye; in other words, he constructs what corresponds to the lens of the eye—i.e., an Eyepiece, made also of quartz, and a retina or screen made of fluorescent glass, which responds to the ultra-violet rays.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

ULTRA-VIOLET LIGHT, Etc.—*Continued*

The image on the screen is examined visually by means of an ordinary pocket magnifying—' lens,' in which case Dr. Köhler has found magnesium light, having a wave-length of $280\mu\mu$., more suitable than cadmium light. This lens, impervious to the injurious ultra violet rays, lengthens them, and so renders them visible for rough examination and focussing. A photograph is then taken, showing the finer detail. It is to be noted that these quartz lenses can only be used with light of the wave length for which they are constructed, that an immersion medium of suitable refractive index (made of glycerine and water in proportions calculated to give such a definite refractive index) must be used, and that the cover-glasses and slides must also be made of fused quartz, or the latter can be made of ultra-violet permeable glass."

For comparative purposes it must be stated that Objectives composed of quartz lenses having numerical apertures respectively of $\cdot 35$ and $\cdot 85$ would give, if illuminated by ultra-violet light as already described, relative apertures of $\cdot 70$ and $1\cdot 7$ respectively.

It has to be remembered that this work is limited to photography only, that it requires a number of special lenses, mountings and fittings generally for the exclusive purpose, and consideration would have to be given to any value which might attach to its use before a purchase were embarked upon.

An estimate of the cost of an outfit is shown on a succeeding page.

It must not be overlooked that Mr. Barnard says in his contribution to the "Lancet" on the subject that "Focussing by means of the fluorescent image is both difficult and dangerous owing to the action of ultra-violet light on living organisms. Changes can be set up which might be regarded as normal appearances in the organisms. The actual exposure, therefore, of any material to ultra-violet must be the shortest possible. There is no reason to regard the action on living organisms as a trigger action, a certain time factor is involved, but precautions must be observed to ensure that no change due to the light itself is set up."

DARK GROUND ILLUMINATION.

Of much greater practical value is the dark ground illuminator, and especially that pattern which can be used with any Oil Immersion Objective utilising its full aperture without a funnel stop in the Objective to reduce its efficiency, and which is effective through the thickness of an ordinary 3 in. by 1 in. slip. Such is the Nelson Cassegrain of Watson's make. Mr. Barnard remarks "In the light of recent experiments it is, in fact, clear that full resolving power is obtained more certainly by an efficient dark ground illumination method than by any other means," and this undoubtedly is true. The effects obtained by its means are so widely and appreciatively known that full details are not necessary. It is now made in a new form of quartz for ultra-violet light.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

ESSENTIALS FOR ULTRA-VIOLET LIGHT WORK (INVISIBLE RADIATIONS)

Useful for Photographic Purposes only.

- | | |
|-------------------------------------|--------------------------------|
| 1. Source of Light. | 6. Quartz Slips and Covers. |
| 2. Quartz Condenser. | 7. Special Fluorescent Screen. |
| 3. Quartz Substage Condenser. | 8. Camera. |
| 4. Microscope. | 9. Bench. |
| 5. Quartz Objectives and Eyepieces. | |

1. **Source of Light.** The two best illuminants are (a) The Mercury Vapour Lamp and (b) Arc Lamp with Tungsten Cored Carbons. A suitable enclosing house is needed for the Arc Lamp.

PRICES

Code Word.	No.		£	s.	d.
Scalx	19201	Mercury Vapour Lamp with Quartz Condensing Lens, Iris Diaphragm and Light Modifier Holder, complete with wire plug, etc., on special saddle			
		Arc Lamp with Tungsten Cored Carbons and enclosing house. Lamp mounted to interchange on saddle with Mercury Vapour Lamp			
		Quartz Condenser with Iris Diaphragm and adjustment for height, mounted on saddle			
		Quartz Substage Condenser for use with Glycerine Immersion, with Iris Diaphragm and Filter Carrier, complete			
		Quartz Dark Ground Condenser, Cassegrain type, mounted to interchange with the Substage Condenser			
		Microscope of new design mounted upon a solid casting incorporating in its base an optical bench with slides carrying the saddles of the illuminating system. The Microscope itself is mounted in a vertical position upon the casting which also carries the Photomicrographic Camera in a position at right angles to the Microscope. The Camera is $\frac{1}{2}$ -plate size and fitted with rackwork extension and special adjustments to ensure the plate lying at right angles with the optic axis. The whole design ensures complete rigidity and entire absence of vibration			
		Centring Substage, Mechanical Stage, and Interchangeable Objective Holders are fitted to the Microscope. The fine adjustment is by lever, ensuring a positive motion while the design is such as to impart the slowest movement yet obtained compatible with efficiency			
		Eyepieces, Quartz, $\times 5, \times 7, \times 10, \times 14, \times 20$			
		Objectives, Quartz, $\times 13.75$ N.A. 0.256			
		$\times 70$ N.A. 1.19			
		$\times 67$ N.A. 1.14			
		12 pairs Quartz Slips 3 in. \times 1 in. and cover glasses			
		Flourescent Screen to fit over Eyepieces for focussing purposes			
		Price for the Outfit, complete	600	0	0

Drawings and further specifications submitted on request. Variations can be made to suit special requirements.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

ULTRA-VIOLET LIGHT MICROSCOPY AND DARK GROUND ILLUMINATION

Research Microscopes can be used with ultra violet light, by the addition of certain accessories, a set of which is detailed below. The essentials are :

The Ultra-Violet Light Lamp.

Quartz Condenser.

Quartz Dark Ground Illuminator.

Quartz Slips on which the objects are mounted, and a Light Modifier.

Research Microscopes of good quality, and of modern construction, with centring screws to Substage, and mechanical movements to Stage, are absolutely necessary. We recommend the Horizontal type of Microscope. See page 94.

		PRICES			
Code Word.	No.			£	s. d.
Scarl	1930a	Mercury Vapour Lamp, of latest construction, specially designed for microscopical work, arranged to work on 100 to 150 volt direct current, or alternatively 200 to 250 volt direct current, complete with adjustable series resistance and holder, fitted with Quartz Condensing Lens, having Iris Diaphragm and Light Modifier Holder, complete, ready for use with supplies of connecting wire, plug, etc. ...	...	38	10 0
Scald	1930b	Special Arc Lamp with 50 Tungsten Cored Carbons and enclosing house for Arc Lamp ...	...	16	10 0
Scamp	1930c	Quartz Condenser with Iris Diaphragm on stand ...	...	5	5 0
Scarp	1930d	Glass Screen to reduce light intensity ...	...	0	10 6
Scand	1930e	Quartz Substage Condenser for use with Glycerine Immersion, with Iris Diaphragm Mounting complete ...	...	18	10 0
Scatc	1930f	Cassegrain Dark Ground Illuminator in Quartz complete with requisite stops, fully mounted for Understage ...	...	7	5 0
Scant	1930g	Quartz Eyepieces $\times 5, \times 7, \times 10, \times 14, \times 20$...	each	5	0 0
Scano	1930h	Quartz Objectives $\times 13.75$ N.A. 0.256 ...	...	30	0 0
		$\times 70$ N.A. 1.19 ...	...	50	0 0
		$\times 67$ N.A. 1.14 ...	...	50	0 0
Scape	1930l	Quartz Slips (3 in. \times 1 in.) and cover glasses for use with the above ...	per pair	0	10 0
Scapa	1930m	Laboratory (or other) Photo Micrographic Camera as per Part V of Catalogue of Microscopes, with double dark slide, etc.		37	10 0

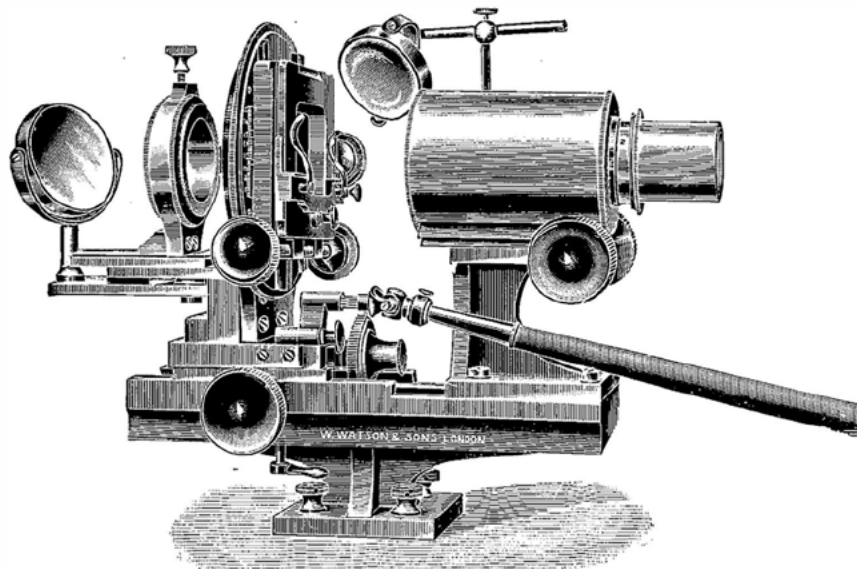
The foregoing are suggestive for those who wish to adapt existing apparatus for this form of Microscopy. Quotations and specifications will be submitted for the alteration and equipment of apparatus upon receipt of enquiries.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE "HORIZONTAL" MICROSCOPE



The most rigid microscope extant for Photomicrography and Projection.

This instrument is designed as a fixed horizontal Microscope of the highest class, arranged for attachment to a photographic bench. The base, which is a solid metal one, has four clamp screws, both the Body and Stage being supported on metal pillars so as to impart the maximum of stability.

The Body is of extra large diameter, and is fitted with a Draw-tube. Focussing is effected by means of a diagonal rackwork and pinion.

The Stage, which corresponds with the one fitted to our Van Heurck Microscope, rotates concentrically and has mechanical movements with long range of traverse. The movements are divided, and read by verniers to $\frac{1}{10}$ of a millimetre. This Stage is moved to and from the Objective in substantial bearings by means of a rackwork and pinion.

The construction is unusual in that the Fine Adjustment moves the Stage instead of acting on the Body. This obviates the necessity for re-setting of the light source when a Vertical Illuminator is in use, and very exact adjustment to focus can be obtained by the Fine Adjustment that is provided, which is of the lever pattern.

To enable focussing to be carried out on the focussing screen of the Camera which may be some distance from the Microscope, a Hooks' Joint Handle is provided which gears with the Fine Adjustment milled head. A Bull's-Eye Condenser for illuminating opaque objects is also supplied.

The Substage and Mirror, as shown in illustrations are extra.

PRICES

Code Word.	No.								
Baldor	19401	" Horizontal " Microscope ...	...	...	...	...	...	£50	0 0
Baldent	19402	Mahogany Case extra	...	...	...	...	...	3 10	0

FOR TRANSPARENT OBJECTS

Baldoso	19403	A Compound Substage with screws to centre and rackwork to focus, also large double mirror can be included as figured, at an extra cost of	£8 10	0
---------	-------	---	-----	-----	-----	-----	-----	-------	---

For particulars of Photomicrographic cameras for use with this instrument, see Part 5 of this catalogue.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE RAMSDEN MICROGRAPH

The need for simplified apparatus for general use in
Examination of Structures by Projection,
Measurement of Structures, Crystals, etc.,
by Projection.

Photographic Records of Raw Materials or
Finished Products,

has been long and increasingly felt under modern
methods of production and inspection.

Many admirably designed instruments are
available for this purpose, but the heavy initial cost,
complexity of design, difficulty of manipulation
save by a specially trained technician, provision of
extra movements and fittings necessary only for
research, operate against their general employment.

An added difficulty with the ordinary micro-
scope devices is that of indicating and explaining
structure to non-technical observers, but with the
Ramsden Micrograph the image is projected, thus
structure may be examined and discussed in con-
junction with other observers.

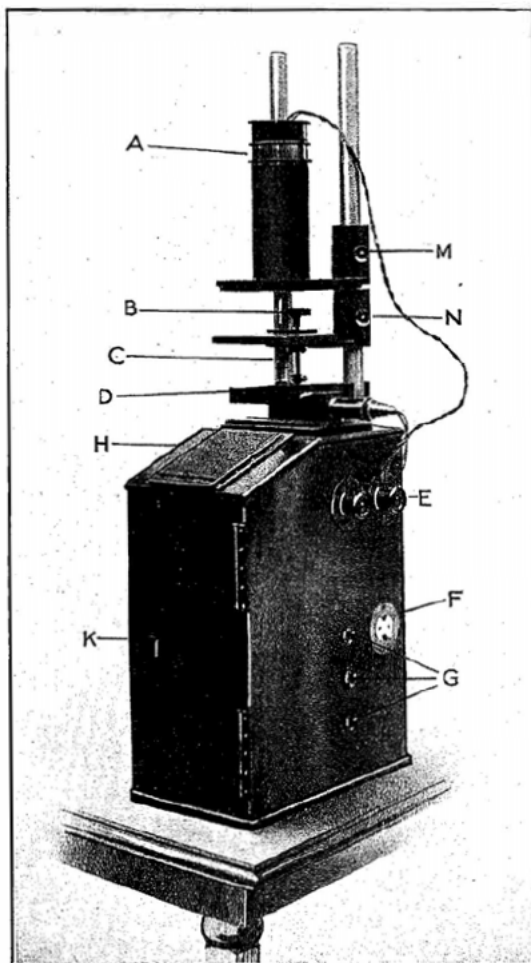
The Ramsden Micrograph, which is the out-
come of research by Colonel Ramsden, and which has
been in constant use for over four years, is now
being made available for general use by manu-
facture on a quantity basis.

As will be seen from the specification, the
instrument is robust and of the simplest design; it
will give satisfactory performance even under con-
ditions of the roughest use.

METHOD OF OPERATION

*To set up for the examination of transparent
objects by transmitted light.*—Place the object on the
stage; switch on the light in the upper lamp
holder. The objective being screwed into the
objective collar, focus by turning the focussing
screw. The image should appear sharply on the
ground-glass screen in the sloping front of the body.

To set up for examination by reflected light.—Slide
the vertical illuminator into its guide slots on the
top of the body, taking care that it is centrally
under the objective. Switch on the current to this
illuminator. Lay a piece of thin paper on the stage
and move the stages up and down the vertical guide
rods till the spot of light is at its smallest size.
Then clamp the main stage on to the vertical guide
rods by the clamping screw on the right side. Place
the object to be examined face downwards on the
stage, using a card with a small hole in it to support
very small objects. Focus the object as above by
means of the focussing screw.



PRICES

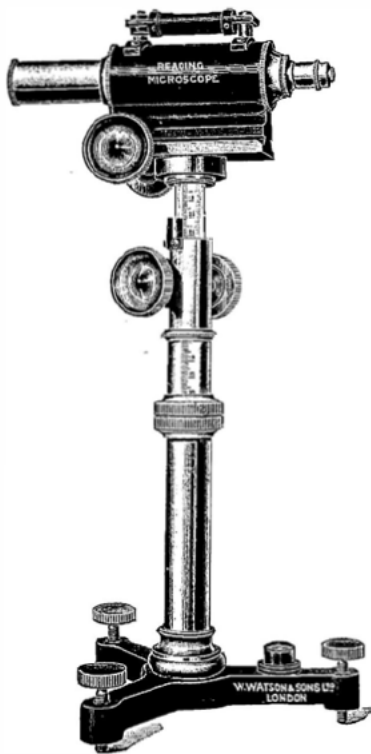
Code Word	No.		£	s.	d.
Makba	19501	Ramsden Micrograph with lamp-holder, ground- and plain-glass focussing screens, lamps for transmitted light illumination, dark slide (3-pl.) lamp for label camera	35	0	0

EXTRAS

Makod	19502	Watson-Conrady Vertical Illuminator, with lamp (for metallurgical and opaque specimens)	6	5	0
Makad	19503	Polarizer and Analyser (for crystalline structures)	3	10	0
Mamol	19504	Eyepieces, $\times 5$, $\times 6$, $\times 8$, $\times 10$	0	10	0
Makot	19505	Objectives, $2''$, $1\frac{1}{2}''$, $1''$	2	0	0
Makge	19506	$1''$, $\frac{3}{4}''$	1	12	6
Mamit	19507	Condenser, Abbe pattern, with iris diaphragm	2	5	0
Makit	19508	Universal "	7	0	0
Molid	19509	Revolving Stage, graduated to degrees "	2	5	0
Malon	195010	Stage Plates, to carry small specimens for examination with reflected light, varying apertures	0	5	0
Malot	195011	Extra Dark Slides, 3-pl., metal	0	4	6
Malwe	195012	Scales, divided on glass for direct measurement of projected images	0	15	0
Malew	195013	Extra Lamps, for Micrograph	0	5	6
Malle	195014	" " for Vertical illuminator and label camera	0	1	8

Descriptive leaflet sent on request.

HORIZONTAL READING MICROSCOPE



The Horizontal Microscope is for the purpose of measuring small vertical distances, or small differences between vertical distances of moderate length.

The base is a flat tripod fitted with levelling screws and bearing a circular spirit bubble.

From this base rises a tubular column in which a graduated tube slides and can be clamped at any height. At the upper end of this inner tube is a bearing for a bar of triangular section which slides within it and is graduated. The movement of this bar is controlled by rack and pinion. A vernier is attached to the bearing. Upon the upper end of the triangular bar rotates a casting which carries the microscope focussing movement which is by rack and pinion. The horizontal body tube moved thereby is similar to that of an ordinary microscope except that it carries a long spirit bubble for precise levelling.

A 2 in. Objective is supplied with the instrument. The Eyepiece is fitted with a micrometer scale at the focus of the eye lens.

A telescope object-glass can be supplied to interchange with the microscope objective for distant readings.

DIMENSIONS

Maximum height of axis	...	...	...	...	...	...	...	...	...	555 mm.
Minimum height of axis	...	...	...	...	...	...	...	...	...	370 mm.
Adjustment of tube in pillar	...	...	...	...	...	...	...	...	...	110 mm.
Rack movement of vertical bar	...	...	...	...	...	...	...	...	...	75 mm.
Length of body-tube...	...	...	...	...	...	...	...	...	...	160 mm.

PRICES

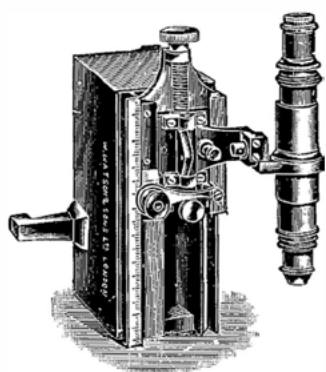
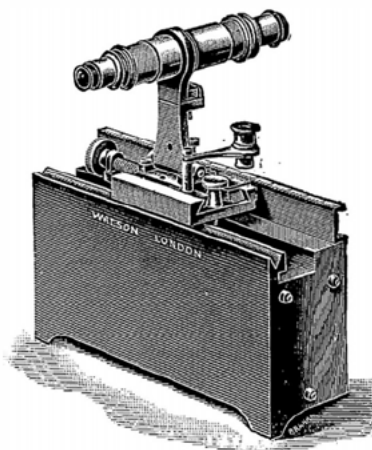
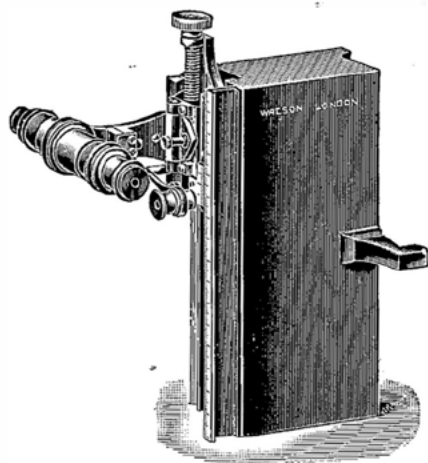
Code Word.	No.		£	s.	d.
Motle	19601	Microscope as described, complete with Objective and Eyepiece	12	10	0
Saben	19602	Telescope Object-glass in cell to interchange with Objective, with focussing sleeve	1	10	0

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

VERNIER MEASURING MICROSCOPES



VERNIER MICROSCOPES

With cast iron bed, upper surface planed with a V and flat and fitted with a slide, which can be clamped at any point. This slide carries a second slide, which is moved by a fine screw and fitted with a vernier, by which the scale on the bed plate can be read to 0.02 mm., the total length of scale being 16 cm. A microscope is carried by a knuckle-jointed projecting arm attached to the second slide, by which it can be set, vertically and horizontally—or turned through an angle of 90° on an axis at right angles to the axis of the microscope. Thus it can be set in several different positions with respect to the position of the scale, some of which are shown above.

A glass micrometer scale, with which the size of small objects can be measured to one fiftieth of a millimetre and, by estimation, to at least one-fourth of this size, is placed at the common focus of eyepiece and objective.

A telescope object glass can be used in place of the microscope objective, thus converting the instrument into a short range cathetometer.

PRICES

Code Word.	No.		£	s.	d.
Sabao	19701	The Instrument as above, with one objective, 1 in., 2 in., or 3 in.	12	16	0
Sabat	19702	Additional Microscope Objectives of the powers stated, each	1	18	6
Sabba	19703	Telescope Object Glass, interchangeable with above ... extra	1	12	0
Sabel	19704	Case to carry Vernier Microscope, with lock	0	19	6
Sabla	19705	Dividing on Silver	1	6	0

W. WATSON & SONS, LTD.

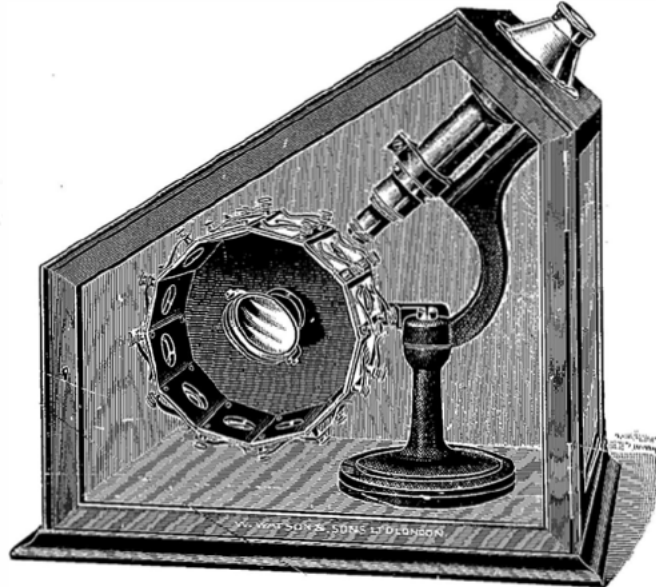


313 HIGH HOLBORN, W.C.

MUSEUM MICROSCOPE

THE WATERHOUSE PATTERN

As supplied to the South Kensington and other Museums.



The Museum Microscope gives facilities for the display of a number of mounted microscopic objects in a museum or exhibition, where it is required to leave the instrument unattended, and at the same time prevent injury to microscope and specimens. As here illustrated, it will be found thoroughly reliable and adequate in every way.

It consists of a dust proof mahogany-framed glass case, in which the Microscope is fitted. The 3×1 in. slides, twelve in number, are placed upon a brass drum, which can be rotated from outside the case, a spring catch indicating when the object is centred. The Eyepiece of the Microscope projects outside the case, and fine focussing is effected by rotating the eyepiece in a spiral slot.

This new pattern embodies useful features suggested by past experience and combines convenience in observation with security against any interference with or removal of parts of the instrument. The door by which alone the inside of the case is accessible is fitted with a good lock.

Code Word.	No.	PRICES	
Musky	19801	Complete, with one Eyepiece and $1\frac{1}{2}$ in. or 2 in. Parachromatic Objective	£31 10 0

Museum Microscope, No. 2 Pattern, Museum Microscope, No. 2 pattern, is similar in general construction to the large Waterhouse pattern, but is arranged to carry only five mounted objects on 3×1 in. slides.

The focussing adjustment is by rack controlled from the outside right-hand of case. All the projecting milled heads, etc., are effectually protected against improper treatment. Owing to the smaller number of objects exhibited, this model is recommended where large numbers of visitors are to be provided for without undue waiting.

Muste	19802	With Eyepiece and $1\frac{1}{2}$ or 2 in. Objective	£27 10 0
-------	-------	---	----------

W. WATSON & SONS, LTD.



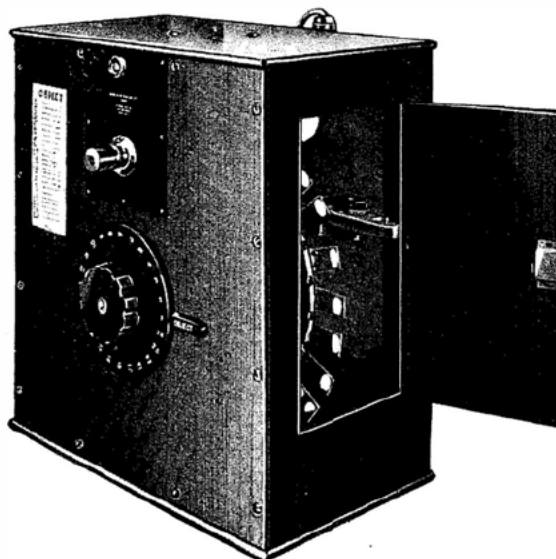
313 HIGH HOLBORN, W.C.

MUSEUM MICROSCOPE

No. 3 PATTERN

One of the difficulties associated with revision work in teaching is that owing to restricted space and need for microscopes in classes, demonstrations can only be staged for a matter of a few hours. The hitherto accepted design of Museum Microscope has not provided for its use with high power dry objectives.

Model No. 3, constructed originally for an Indian University, meets both these needs. The drum carries twenty-four prepared specimens, these can be easily changed as frequently as may be required and if left in departmental museum or the Laboratory can be used as a demonstration set. All objectives up to and including the $\frac{1}{8}$ in. (4 mm.) can be used efficiently.



As will be seen from the illustration the Microscope consists of a teak (or mahogany if preferred) containing case having at the back an aperture to admit light from a lamp mounted exterior to the case. Inside and on the back surface of the case is mounted a substage of standard size carrying an Abbe condenser to efficiently illuminate higher power objectives. Mounted upon a central pivot and with appropriate stops is a revolving wheel carrying at its periphery a series of clamps which serve not only to secure the prepared specimen but to which also an adjustment is fitted so that all specimens may be brought to the same plane of focus. This wheel takes the place of the microscope stage.

On the front surface and within the case is mounted a microscope body, fitted with rackwork coarse and lever fine adjustments. On the front of the case will be seen the handle controlling rotation, numbered to correspond with the slide in the field of view, also a roughened surface ivory plate (easily washed) upon which may be written the names of the specimens mounted within and their order of examination.

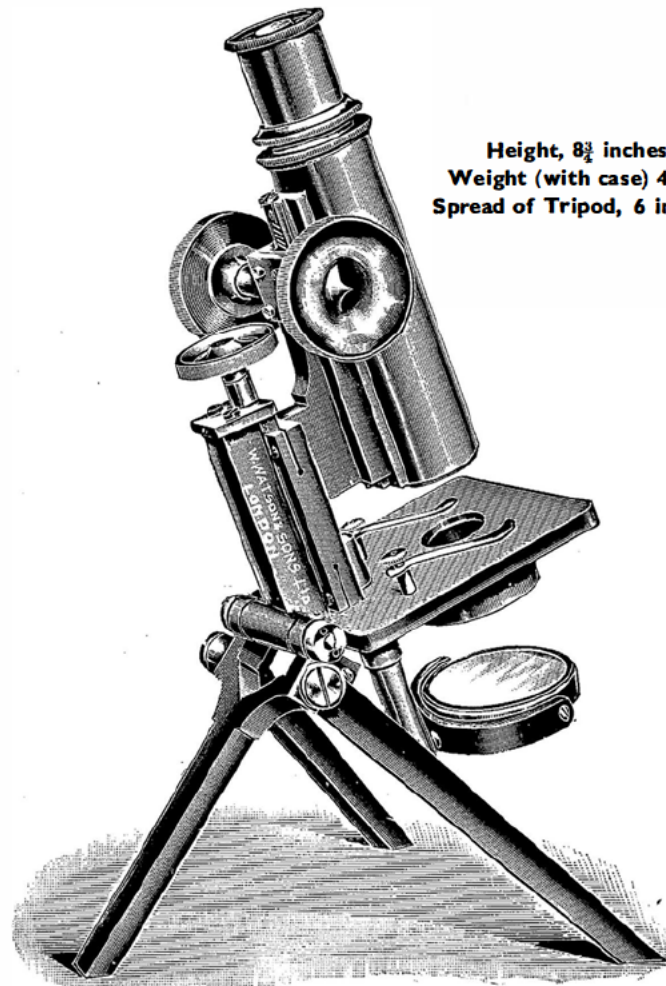
To set up for use : After switching on the current for the lamp, focus the condenser to illuminate the field, place each specimen in its clamp, secure lightly until the desired structure has been found (specimens from $2 \times \frac{1}{2}$ in. to $3\frac{1}{2} \times 1\frac{1}{2}$ in. can be used), secure firmly by tightening the clamp. Set fine adjustment to its middle position to allow ample focussing latitude for all visions, adjust object to desired plane of focus with fine adjustment as set. Repeat for each specimen, lock and close the case. The instrument may then be left ready for students, etc., the specimens cannot be touched or damaged. The fine adjustment only is available to the observer after the case has been closed.

Code Word.	No.		£	s.	d.
Malbe	19901	No. 3 Museum Microscope as figured and described with provision for 24 Specimens, 1 Eyepiece $\times 6$ with cross line gratunile for centering the specimen, Objective Parachromatic 1 in. and $\frac{1}{2}$ in. or $\frac{3}{4}$ in. and $\frac{1}{8}$ in. at choice, Abbe condenser, holder for lamp	45	0	0

W. WATSON & SONS, LTD.

313 HIGH HOLBORN, W.C.

THE "CLUB" PORTABLE MICROSCOPE



Height, $8\frac{1}{2}$ inches.
Weight (with case) 4 lbs.
Spread of Tripod, 6 inches.

A rigid, compact, and thoroughly efficient Microscope, built to bear constant travelling. Packing does not necessitate taking any part to pieces, the legs fold backwards against the limb; the mirror tailpiece pushes upwards through the Stage, and the whole packs completely in a stiff leather case, measuring about $7\frac{1}{2} \times 4\frac{1}{2} \times 3\frac{1}{2}$ in. with space for Eyepieces and Objectives.

The Coarse Adjustment is of Standard pattern, and enables a 3 in. Objective to be focussed. The Fine Adjustment is a direct-acting one with Micrometer Screw.

The Mirrors are Plane and Concave.

The Body, which is fitted with draw-tube, carries Eyepieces of universal size.

It is a microscope suitable for high-power work and carries apparatus of standard size, so that the accessories of larger instruments can be used with it.

Code Word.	No.		Price.
Mosac	11001	Stand only, as figured, in Stiff Leather Case	£ 12 s. 10 d.

W. WATSON & SONS, LTD.

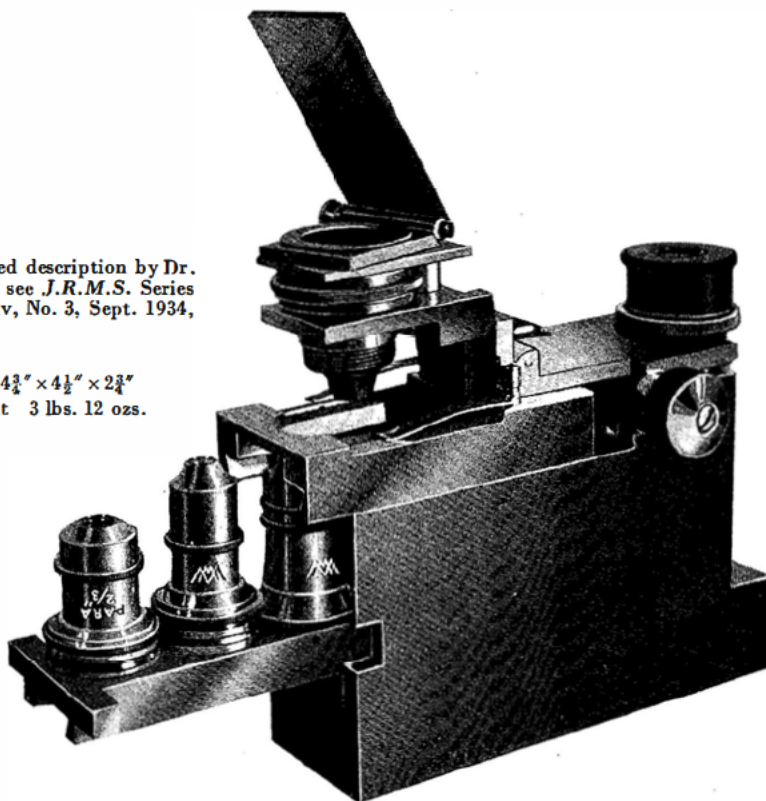


313 HIGH HOLBORN, W.C.

McARTHUR WATSON PORTABLE MICROSCOPE

For detailed description by Dr. McArthur see *J.R.M.S.* Series III, vol. liv, No. 3, Sept. 1934, p. 182/5.

Size $4\frac{3}{4}" \times 4\frac{1}{2}" \times 2\frac{3}{4}"$
Weight 3 lbs. 12 ozs.



This instrument incorporates many unique features and constitutes a radical departure from conventional design. Its portability and simplicity of use, freedom from risk of damage in transit will immediately be appreciated by all who require a travelling microscope and where it may be used far from a base laboratory or research station. For rapid bedside diagnosis the consultant will find this instrument invaluable.

The entire microscope is contained between the two stout metal side plates. The mirror folds flat down upon the condenser, for use it is raised and may be inclined and rotated to any convenient angle for light. The Object stage slides forward between stops and the instrument is ready for use. Light from the mirror is reflected down through the condenser, which is provided with an iris diaphragm, through the specimen to be examined, to the Objective. Provision is made on a moving number for mounting three Objectives, we recommend $1\frac{1}{2}$, $\frac{3}{4}$ and $\frac{1}{2}$ or $\frac{3}{8}$, $\frac{1}{4}$ and $\frac{1}{8}$ 0-mm., according to the work to be undertaken. The sliding number carrying the Objectives serves as a nosepiece and can be moved forward against spring stops bringing each objective into alignment. These Objectives being accurately parfocussed a fine adjustment only is needed for focussing. The image formed by the Objective is displaced through an angle of 90° by means of a prism mounted in the base of the microscope frame, a similar prism at the base of the Eyepiece tube diverts the image formed by the Objective up through the Eyepiece to the observer. *The prism box is removable for cleaning in tropical climates.*

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

McARTHUR WATSON PORTABLE MICROSCOPE—Continued

The containing case presents little difference from that of a pair of prism binoculars and is of solid bridle leather, stiffened, and will be found efficient under all conditions. It has sufficient space to accommodate tubes of solid stains, slides, coverglasses, pipette, etc.

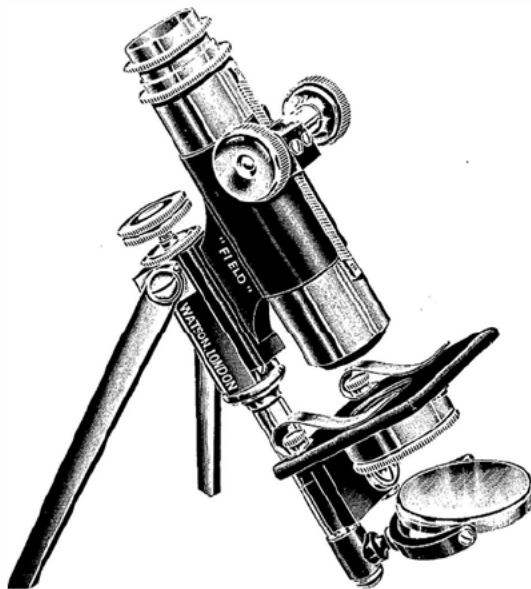
Code Word.	No.		£	s.	d.
Malby	110201	McArthur Watson Portable Microscope with condenser NA 1.0 and iris diaphragm, one Eyepiece at choice $\times 6$, $\times 8$, $\times 10$. Saddle leather case, stiffened	15	10	0

The case can be supplied to contain special accessories, stains, etc. at a small extra charge to cover the cost of the fitting.

Purchasers wishing to use their own Objectives can have them parfocussed to the instrument at a small supplementary charge. Any of our own Objectives, if ordered at the same time for use with the instrument, will be parfocussed free.

For Objectives see pages 6-17. We recommend Parachromatic series for this model.

FIELD PORTABLE MICROSCOPE



A simple instrument, light and rigid, of the greatest value to the Zoologist or Botanist of any of the many microscope users whose profession demands a considerable amount of field work. The microscope stand consists essentially of a central pillar forming the front leg of the tripod and carrying the fine and coarse adjustments. The fine adjustment is of the spring loaded direct acting type while the coarse adjustment, effected by rack and pinion, carries a stout metal sleeve within which is the microscope body tube. The tube may be slid up and down within this sleeve to afford an extra focussing latitude for the use of very low power Objectives.

Mounted upon the main pillar is the microscope stage, fitted with stage springs, made of metal and of sufficient size to carry a slide with trough or live cell. Dependant from the stage is a tube to carry iris diaphragm or condenser and at the end of the foot pillar the mirror is mounted.

For packing purposes the two side legs of the tripod fold inwards to the body, the body is racked downwards to the stage and the whole instrument when closed measures $6\frac{1}{2}$ " , weight 1 lb. 13 ozs.

Objective, Eyepiece and Condenser fittings are all of Standard R.M.S. sizes.

Code Word.	No.		£	s.	d.
Malbi	110201	Field Portable Microscope as figured and described, without Eyepiece or condenser, stand only	7	10	0
Malbo	110202	Leather Carrying Case with sling and with fittings for one Eyepiece and two Objectives	1	0	0
Malbu	110203	Abbe type illuminator with iris diaphragm and colour filter carrier in specially shallow mount	2	15	0

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

BINOCULAR MICROSCOPES

The Microscopist who has always used the monocular form of microscope can have no conception of the assistance accruing from a three dimensional picture of the structure or of the beauties that are to be found among the specimens he is constantly examining. Through the monocular type only one plane of the object can be focussed at a time, consequently the true interrelationship of the cells and other tissues forming the picture must be built up mentally by focussing the different planes in turn. With the binocular instrument the several planes of the objects examined stand up clearly in stereoscopic relief. This three dimensional picture is of assistance in the rapid determination and classification of structures. To lovers of pond life, entomology, etc., it gives a new field of pleasure and study. To the constant worker the use of both eyes affords relief and the Microscope can be used for prolonged periods without any strain or discomfort.

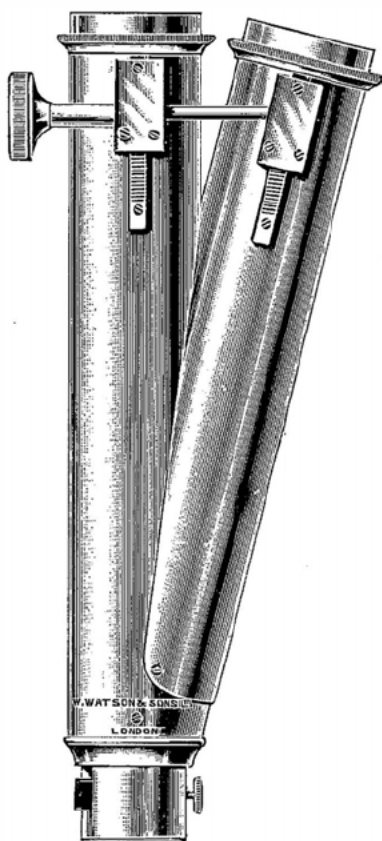
There are four forms of Binocular Microscope body available for the Microscopist :

The Watson Wenham Stereoscopic System.

The Watson High-Power " "
—the "Universal."

The Watson Greenough " "

The Watson Low-Power " "



Wenham Binocular
Body for Microscope.

THE WATSON WENHAM BINOCULAR MICROSCOPES

This well-known pattern has had great popularity with the amateur worker.

One instead of paired Objectives is used, and a prism reflects the image into the second tube, while the direct rays pass up the main tube.

The Wenham System gives excellent stereoscopic effects, but its practical use is limited to Objectives not higher than $\frac{1}{2}$ in. (12 mm.). Provision is made for sliding the prism out of the axis so that the monocular body only can be used for higher-power work.

When a Microscope is to be used for a number of purposes, it is advantageous to have two bodies fitted to the one Microscope Stand, one having a Wenham binocular body, and the other an ordinary monocular tube. Two such bodies can be supplied to interchange in the same fittings.

The Wenham Binocular Microscope is highly appreciated for the study of insects, pond life, foraminifera and objects that have several planes. For prices, see page 106.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

THE UNIVERSAL BINOCULAR BODY

It is well known that, however good the image of an object may be, viewed with either eye singly, it is inferior to the image seen with both eyes.

Binocular vision with the Microscope is no less striking. The object is seen in a manner that has never been possible monocularly. It is natural to use the two eyes simultaneously, and the comfort of microscopical work in such circumstances is very pronounced.

Disadvantages that have been associated with former attempts to make a high-power Binocular Microscope do not exist in the Universal, as the following outstanding qualities will show.

THE UNIVERSAL BINOCULAR BODY

It can be used with the lowest power up to the highest power Oil Immersion Objectives. It performs equally well with either.

There is no diminution in resolving power of definition, the full aperture of the Objective being utilised in each body.

A pronounced stereoscopic effect is produced.

Ocular fatigue is obviated.

The design is so sturdy that no part is likely to become deranged.

It is the ideal form of Binocular Microscope, and the best.

No special Eyepieces are required.

Maximum efficiency with maximum comfort is secured.

CONSTRUCTION. The Universal Body is intended primarily to be an interchangeable unit, which can be immediately attached to a slide on the coarse adjustment fittings of the Microscope to replace an existing Monocular body, and *vice versa*. The Nosepiece and Objectives, being mounted separately, remain in position during the exchange; the Object under examination therefore is undisturbed. **It can be fitted to any Microscope described in our Catalogue, excepting the "Kima" model.** It is also supplied in a complete microscope, with the binocular body only.

The method of interchanging monocular and binocular bodies is by the provision of a separate receiving slide, on which either of the bodies can be immediately fitted and clamped.

The inter-ocular adjustment is by means of a horizontal spiral screw, a divided scale being provided to show the exact measurements. The milled head of the screw is seen projecting from the body and leaves the space between the Eyepieces free. An adjustment is fitted to the right-hand Eyepiece for difference of vision, enabling those with unequal sight to obtain the best possible focus for each eye.

The prisms are of finest optical glass, of guaranteed durability.

Recommendations. The "Service," "Bactil" and "Patna" Microscopes will be found particularly appropriate for use with the Universal body, or interchangeable bodies. The latter are particularly recommended for laboratory work.

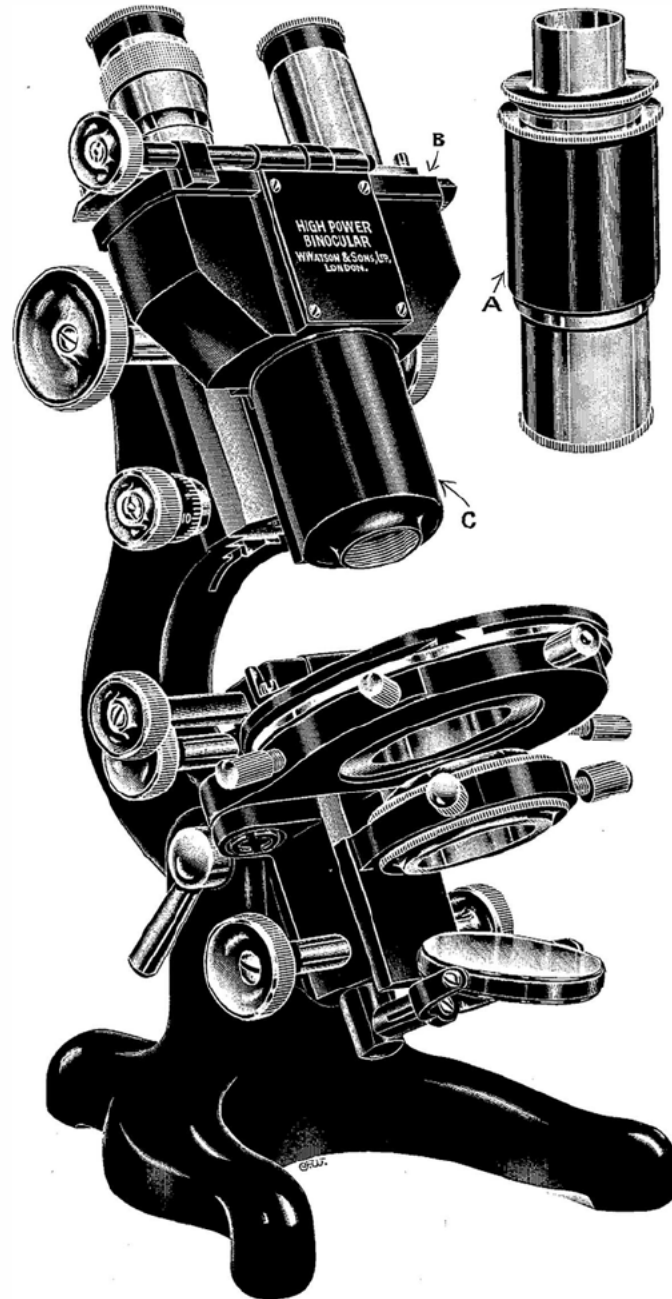
The Universal Binocular Body **cannot** usually be adapted to existing Microscopes. It should be specified when ordering a new instrument or, if specified at the time of ordering, provision can be made by the addition of the extra slide fitting for the binocular interchangeable body to be purchased at any later date. For all existing Microscopes the Universal High-Power System mounted as an Eyepiece to fit into the body tube in place of the ordinary Eyepiece, is supplied.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

WATSON'S BINOCULAR MICROSCOPE



For prices see page 106.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

PRICE LIST OF THE "WENHAM" AND "UNIVERSAL" HIGH-POWER BINOCULAR BODIES

For the "Service," "Patna," "Edinburgh Student's," and Research models, for the Binocular body in addition to and interchangeable with the Monocular body, with one pair of Eyepieces, add :

		PRICES					£	s.	d.
Code Word.	No.								
Sabot	11061	For the "Wenham" Pattern (see page 103)	...	...	...		14	0	0
Sabre	11062	For the "Universal" High Power Pattern (see page 105)	...	...	...		14	0	0

For either of the above instruments, fitted with a Binocular body, instead of the usual Monocular, with one pair of Eyepieces, add :

Sacbu	11063	For the "Wenham" Pattern	...	...	...		12	0	0
Sacad	11064	For the "Universal" High-Power Pattern	...	...	...		12	0	0

For the "Royal" and "Van Heurck" Microscopes add to the price of the instrument for a Binocular body in addition to and interchangeable with the Monocular body :

Sacch	11065	For the "Wenham" Pattern	...	...	...		14	0	0
Saccu	11066	For the "Universal" High-Power Pattern	...	...	...		14	0	0

For either of the above instruments fitted with a Binocular Body instead of the usual Monocular, with one pair of Eyepieces, add :

Syrin	11067	For the "Wenham" Pattern	...	...	...		9	10	0
Syste	11068	For the "Universal" High Power Pattern	...	...	...		9	10	0
Synco	11069	"Universal" High-Power Binocular Body, mounted as an Eyepiece to fit into the body tube of any Microscope, complete with one pair of Eyepieces	...	...	...		10	0	0
Synxz	110610	Inclining unit for use with any Watson High-Power Binocular Body (see page 107)	...	...	...		5	0	0

The above Binocular Bodies can be fitted to any Microscope described in this Catalogue, with the exception of the "Kima" Model, provided it is specified at the time of ordering.

W. WATSON & SONS, LTD.

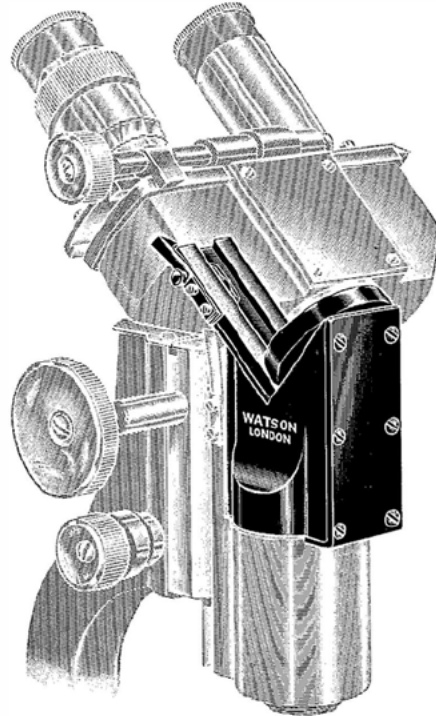


313 HIGH HOLBORN, W.C.

INCLINING UNIT

The increasing use of tissue culture technique, the examination of colloids, of materials mounted in serum, and other preparations of a similar nature, necessitates the use of the microscope in a vertical position. The fatigue consequent upon the use of the instrument in this manner has led to a demand for apparatus to relieve the worker. Many users to-day have grown accustomed to and prefer the High-Power Binocular Microscope, and because of this the Inclining Unit, as illustrated, has been developed. Thus, the instrument may either be used with the monocular body or the high power binocular body in the conventional position, or if it is essential that the microscope be used in the upright position so that the stage remains horizontal, the Inclining Unit can be inserted and the microscope used with either the monocular or the high power binocular body. It is of course only possible to add this to an instrument provided with the intermediate slide for the interchangeable bodies.

Code Word No.
Makbo 11071 Inclining Unit, as
figured ... £5 0 0



TUBE LENGTH CORRECTOR

COMPUTED BY SIR HERBERT JACKSON, F.R.S.

The high standard of correction of modern Microscope Objectives entails a great sensitiveness to accurate Tube Length setting. It is not sufficient to use standardized cover glasses, as the actual depths of the mountant between the specimen under examination and the cover glass may effectively increase cover glass thickness. High-Power Binocular bodies, although fitted with correcting lenses, have no further provision for Tube Length adjustment. Sir Herbert Jackson, Director of the British Research Association, has evolved a piece of apparatus which may be mounted as part of the microscope body, or between the nosepiece and body, whereby Tube Length correction can be carried out simply with all Objectives. Watson's have always objected to the use of the correction collar, owing to the difficulty in incorporating it in objectives, but as the optical components of this adjunct consist of a concave lens system, sensitivity to accurate centring is not so great and the apparatus enables the most sensitive of apochromatic objectives to perform at its best.



Code Word No.
Makbo 110702 Sir Herbert Jackson Tube Length Corrector, as figured ... Price £7 10 0

N.B. Ranges of Tube Length equivalent to 100-300 mm. are obtainable with this accessory.

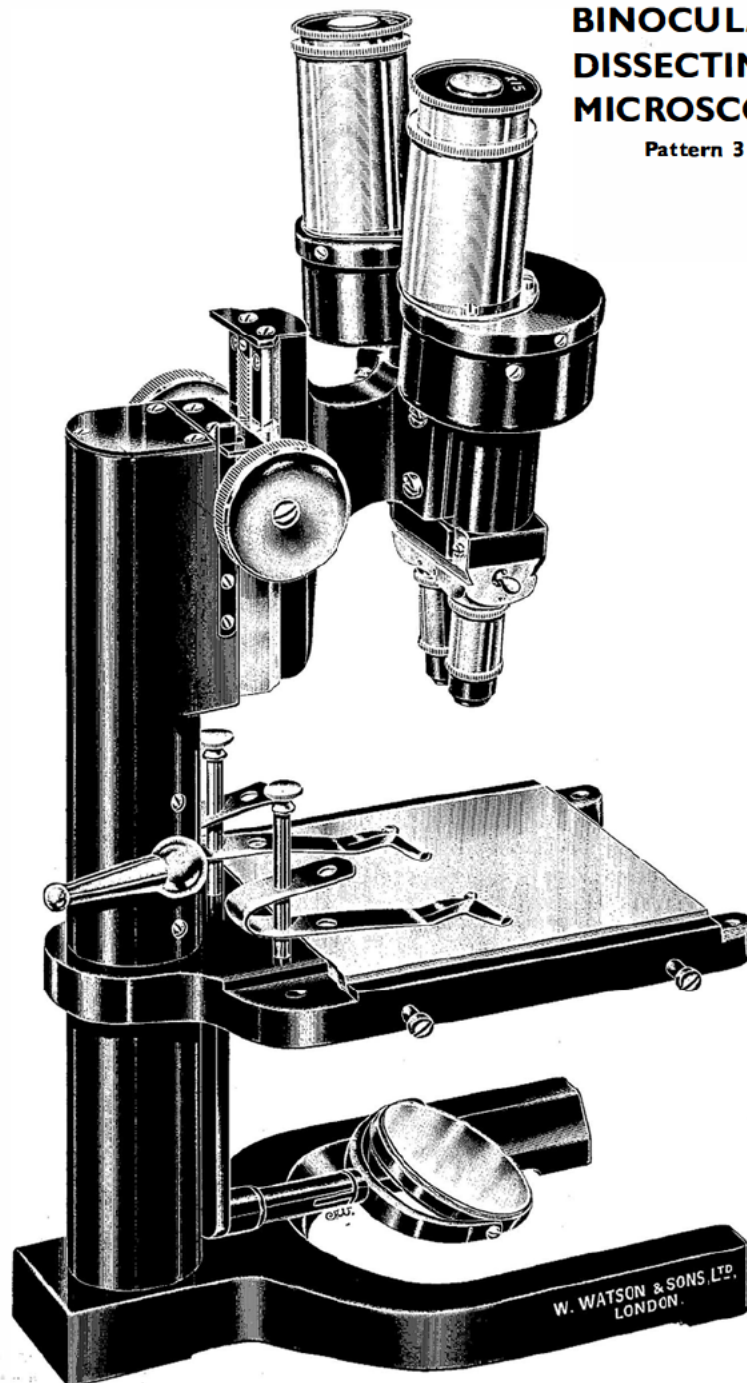
W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

**WATSON GREENOUGH
BINOCULAR
DISSECTING
MICROSCOPE**

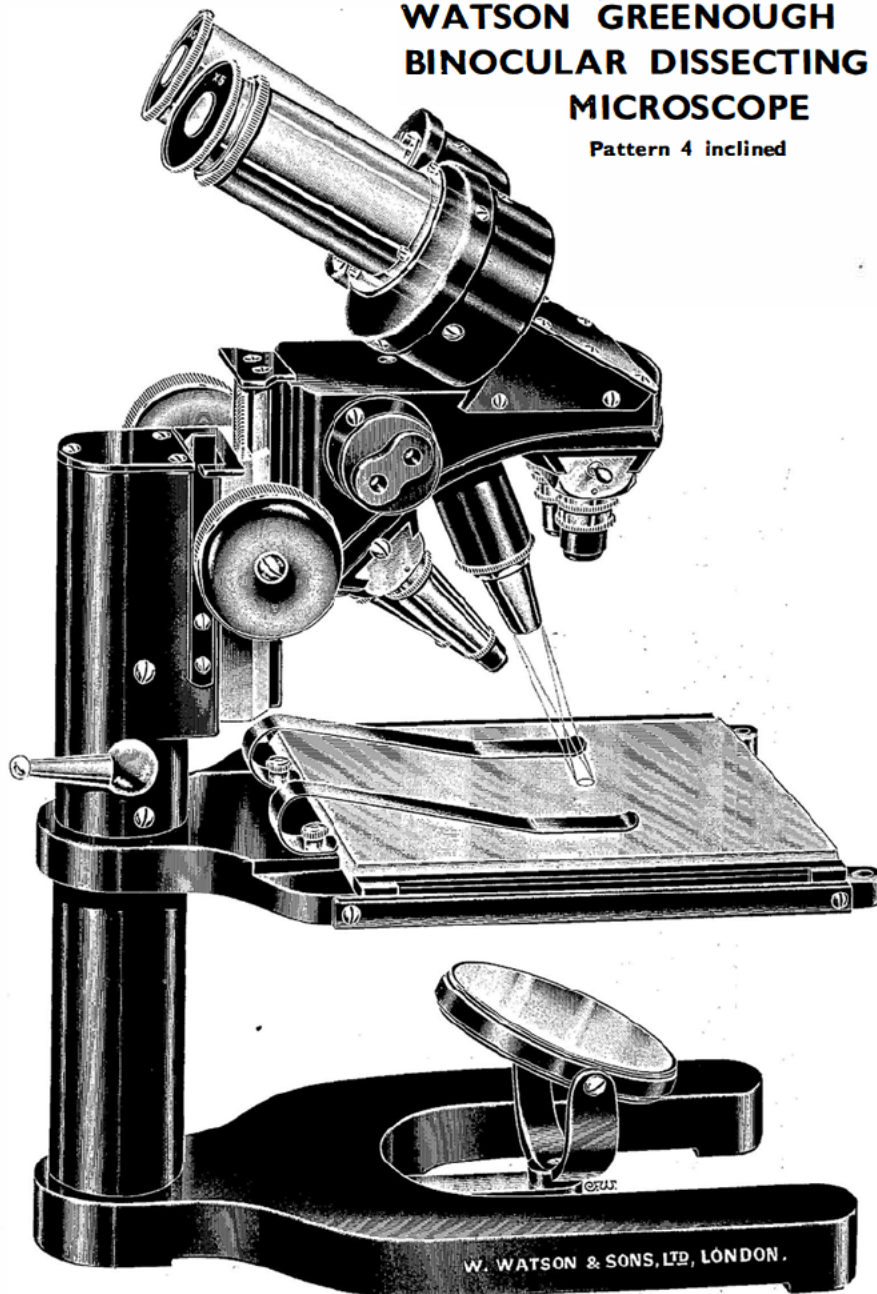
Pattern 3



For
description
see page 110.

**WATSON GREENOUGH
BINOCULAR DISSECTING
MICROSCOPE**

Pattern 4 inclined



For description see pages 110-112

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

WATSON GREENOUGH BINOCULAR MICROSCOPE

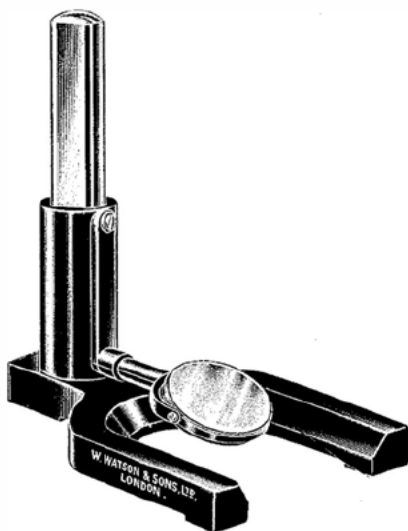


Fig. 1

rest in a natural position to the arms and wrists during a long dissection or series of dissections. The stage itself is drilled with a series of holes to accommodate either the stage springs of conventional design as shown with Microscope Pattern 4 Incl. or the new type figured on this instrument. The stage springs can be accommodated near the pillar, at the edges of the stage or at the front, according to the specimen under examination. It will be noted that the new design is such that petri dishes, pieces of rock, etc. may be firmly held without strain by sliding the spring itself up and down the stem while the forked ends ensure a spaced grip of unusual strength during a dissection.

The binocular body itself is of the conventional type but new eyepieces of the large field type, having diameter greater than the standard R.M.S. size and with relatively long eyepoints have been fitted. The field is thus increased and greater comfort in working secured.

Rackwork coarse adjustment by rack and pinion is provided but of such range that objects having a thickness up to 2 inches may be placed upon the stage and examined with ample latitude in the coarse focussing.

Differences in vision between the two eyes are provided for by fitting to each pair of Eyepieces an individual focussing motion on one Eyepiece.

Many occasions arise when it is desired to make an examination of an object *in situ*, some fungus on a tree bark, a large metal casting, etc. For this

By reason of its wide field of view, long working distance, erect image and true stereoscopic effect, the Greenough type of binocular microscope has found increasing favour among all microscopists there is in fact no science in which the microscope is used where additional assistance in the elucidation of problems can not be obtained by the employment of this model. The increasing demand for the Watson Greenough Binocular Microscope and a study of the needs of the workers in every field, has led to a complete reconsideration of our patterns and the introduction of a series which it is hoped will meet every requirement.

GREENOUGH BINOCULAR MICROSCOPE

Pattern 3 (Illustrated on page 108)

As will be seen from the illustration the base consists of an extra large flat horseshoe foot rising from which is a stout solid metal pillar. Upon this pillar is supported a stage, cast integrally with a stout metal sleeve which fits over the pillar rising from the base (Fig. 2). The stage measures $5\frac{1}{2}$ in. \times $4\frac{3}{4}$ in. and consists of a polished glass plate, and etched on the lower surface to disperse the light evenly, mounted in a metal frame. The frame incorporates slots to carry hand and arm rests which are swept backwards giving

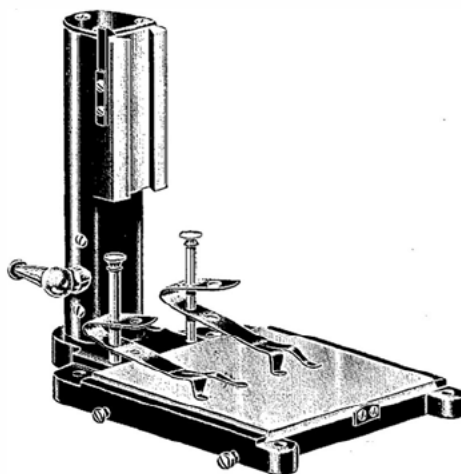


Fig. 2

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

WATSON GREENOUGH BINOCULAR MICROSCOPE

—Continued

purpose the whole body and stage are removable (see illustration p. 112). The stage then serves as a foot and the specimen may be slid over and across the stage or the glass plate can be removed and the frame used not only as a foot but also to confine and where possible flatten the specimen.

For certain examinations and dissections the Long Arm Stand, p. 114, is essential and Greenough Binocular Microscopes, patterns 3 and 4, as well as the Low Power Binocular are fitted as standard with an additional slide permitting the removal of the body and coarse adjustment for mounting upon such a stand or other apparatus.

Low power dark ground illumination is frequently of the greatest assistance when used in conjunction with these instruments and for this purpose we supply a metal stage, as an extra, to interchange with the glass stage. This metal stage has mounted upon its under surface a spiral focussing screw or plain tube at choice to carry appropriate condensers. For prices see page 112.

GREENOUGH BINOCULAR MICROSCOPE

Pattern 4 Inclined

For much, if not all, routine work the Entomologist now uses the Greenough Binocular and the fatigue associated with working for long hours over a vertical microscope is obviated by the use of this new model. A great deal of the work also necessitates the use of top light, with the attendant disadvantages of variable intensity and direction if daylight be used or of an illuminant and lamp condenser external to the microscope.

These difficulties have been met in Watson's Pattern 4 Greenough Microscope. The Eyepieces are inclined to a convenient angle, in the body is mounted an electric lamp with plug on the right hand side of the unit. This lamp is provided with a condensing system and inclined at such an angle that the illuminated area is in the same plane as the focus of the Objective.

Users of the Greenough Microscope seem to use principally two pairs of Objectives at a time, very rarely are all five available forms employed simultaneously. Watson's have incorporated in the Pattern 4 Greenough Binocular Microscope, in addition to the electric illumination, a revolving double nosepiece. This nosepiece is so arranged that any two pairs of objectives can be selected as required and mounted in the slides provided and to ensure ease in working all Greenough Objectives are parfocussed.

From the foregoing it will be seen that these two new models constitute a real advance in design, and owing to the high degree of standardisation achieved it is only necessary to purchase one stand and to this all the three bodies can be fitted interchangeably.

RANGE OF MAGNIFICATIONS LOW POWER BINOCULAR MICROSCOPE

								Ramsden Eyepiece.	
								× 8	× 12
Low power Objective	...	...	...	...	...	...	...	× 12	× 18
High power Objective	...	...	...	...	...	...	...	× 24	× 36

GREENOUGH BINOCULAR MICROSCOPE

								Wide Field Eyepieces.		
								× 5	× 10	× 15
Objectives, 54 mm.	...	...	...	...	...	...	...	× 14	× 26	× 37
47 mm.	...	...	...	...	...	...	...	× 19	× 34	× 48
37 mm.	...	...	...	...	...	...	...	× 25	× 45	× 64
27 mm.	...	...	...	...	...	...	...	× 43	× 78	× 111
22 mm. water immersion	...	...	...	...	...	...	...	× 45	× 81	× 116

W. WATSON & SONS, LTD.

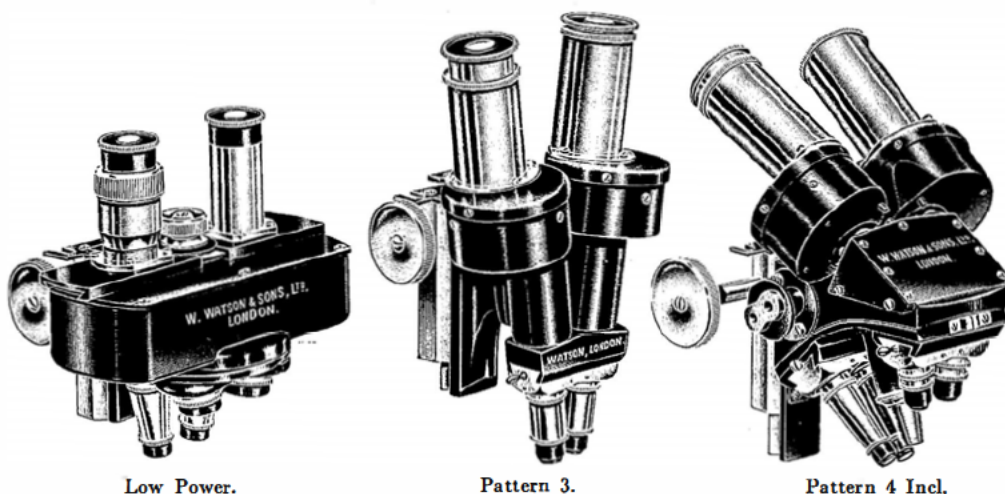


313 HIGH HOLBORN, W.C.

GREENOUGH BINOCULARS

Code Word.	No.		£	s.	d.
Mamba	111201	Pattern 3 as figured and described, with handrests and mahogany case having fittings for eyepieces and objectives, complete with foot, stage and extra slide for interchangeable bodies	20	0	0
Mambe	111202	Pattern 4. Inclined as figured and described, complete with built-in electric bulb and condenser, foot, stage, extra slide for interchangeable bodies, revolving double nosepiece to carry any Watson Greenough Objectives. Resistance for any voltage or transformer, 1 pr. handrests, complete in mahogany case	37	10	0
		Extras suitable for either pattern microscope.			
Mambo	111203	Eyepieces—large field type, $\times 7$, $\times 10$, $\times 15$... per pair One eyepiece in each pair is provided with adjustment for correction, two differences in vision between the two eyes.	2	0	0
Mambu	111204	Objectives, 54 mm., 45 mm., 37 mm., 27 mm. ... per pair	4	0	0
		22 mm. water immersion ...	5	0	0
Mamby	111205	Interchangeable stage of metal provided with plain tubular condenser carrier	1	12	6
Mapba	111206	Extra for spiral focussing screw to above	0	17	6
Mapbe	111207	Greenough pattern lamp, for direct illumination in place of mirror, p. 210	1	1	0
Mapbo	111208	Projector lamp for top light with Greenough Microscope Pattern 3 p. 210	1	5	0

Resistance extra according to voltage.



Low Power.

Pattern 3.

Pattern 4 Incl.

PRICES FOR BODIES ONLY

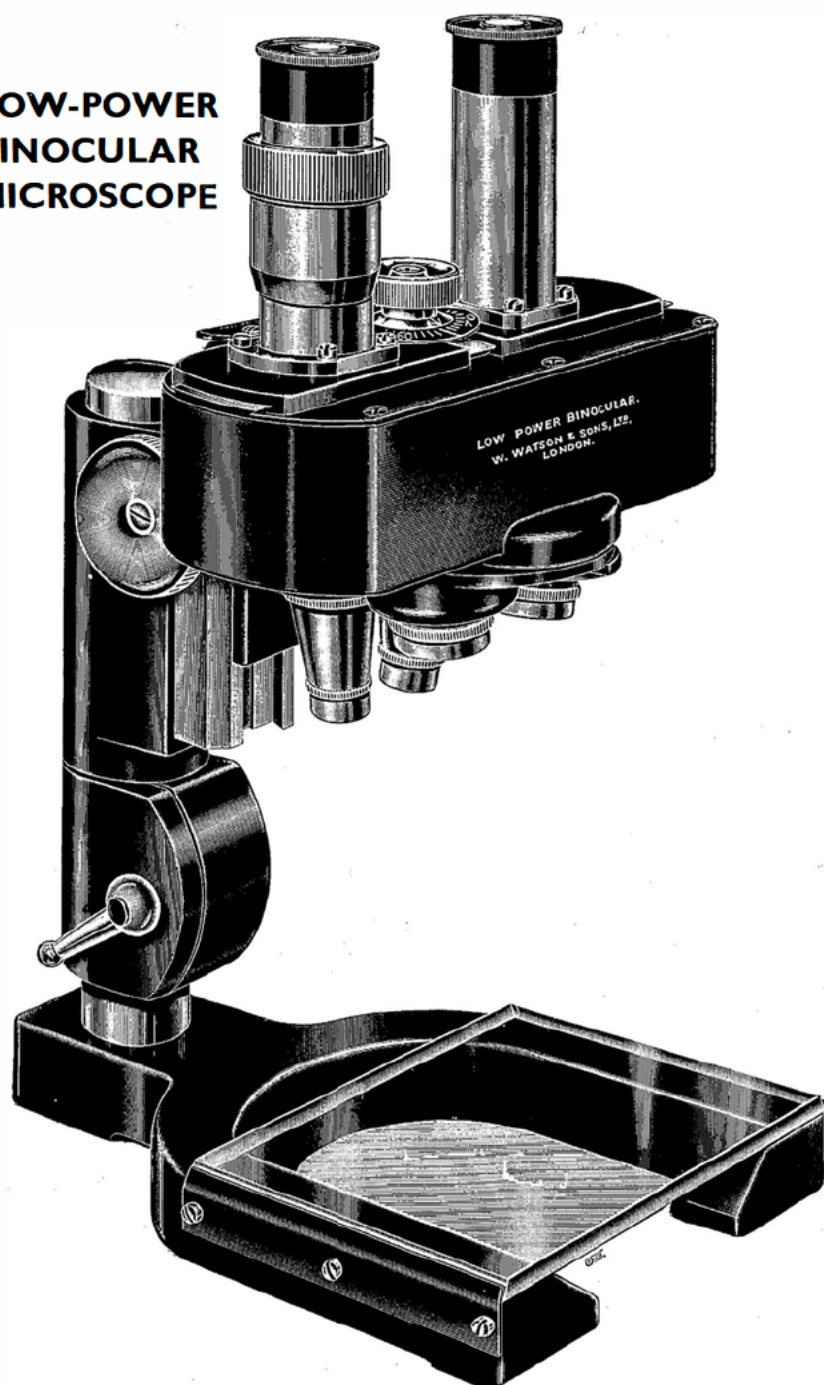
Mapbu	111209	LOW POWER BINOCULAR body, complete with rackwork focussing motion, dovetail slide for attachment to other stands, 1 pair Ramsden Eyepieces $\times 8$ $\times 12$ parfocussed, 2 pairs Objectives mounted on revolving double nosepiece	15	0	0
Mapby	111210	PATTERN 3 GREENOUGH BINOCULAR body with rack and pinion coarse adjustment, slide for Objectives but without eyepieces or objectives	12	10	0
Marba	111211	PATTERN 4 Incl. GREENOUGH BINOCULAR body with rack and pinion focussing motion, built-in electric lamp with condenser system, double nosepiece to carry any two pairs of Objectives but without Eyepieces or Objectives	30	0	0

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

**LOW-POWER
BINOCULAR
MICROSCOPE**



W. WATSON & SONS, LTD.

313 HIGH HOLBORN, W.C.

WATSON'S LOW-POWER BINOCULAR DISSECTING MICROSCOPE

Embodies new features guaranteeing a robustness and durability which renders this instrument ideal for dissections and for class demonstration purposes. All occupied in teaching will recognise the assistance accruing from showing in addition to thin sections thick sections the structure of which, i.e. co-relationship of cells, capillaries, etc., may be seen and grasped in a manner impossible when the specimens are prepared conventionally.

For demonstration purposes something more robust than the ordinary Greenough pattern is essential. The Microscope has been designed to stand up to laboratory treatment in the hands of students.

The prism system is now incorporated in one box and interpupillary adjustment effected by means of a rack and pinion. As with high-power binocular microscopes, differences in sight between the two eyes are corrected by the milled collar on the right eyepiece.

The foot is of large dimensions to ensure absolute stability, and provided with a wide section pillar, flat on one side. The complete binocular body slides up and down on this pillar, and in addition rackwork focussing is provided. By the removal of the glass plate mounted on the foot objects at table level or even below it may be examined and by sliding the complete fitting up the pillar objects up to 6 in. in thickness may be focussed with ease.

Two pairs of Objectives are provided and these are mounted on a double nosepiece so arranged that the pair of Objectives not in use is at the back towards the limb and thus protected.

The Eyepieces are of Ramsden type, X8, X12, and the working distance with either pair of Objectives is $3\frac{1}{2}$ in.

Objectives and Eyepieces are parfocal.

PRICES

			£ s. d
Moupt	111401	Stand, as illustrated, stage-foot with removable glass plate, heavy upright post, sleeve with clamp, slide to fit on sleeve and carrying focussing movement by rack and pinion, special prism systems in one box, parallel eye-tubes with adjustment for interpupillary distance, revolving nosepiece with two pairs of Objectives, two pairs of large-field Ramsden Eyepieces giving magnifications of X12, X18, X24, X36, price complete	17 10 0
Moust	111402	Mahogany Case	1 0 0
Mouvt	111403	Stage for the examination of objects with transmitted light sliding in dovetails on the foot in place of the glass plate, complete with hand rests and mirror	2 10 0
Mouxt	111404	Long arm stand giving 15 inches horizontal motion with counterpoise to equalise the weights, sliding vertical motion	16 10 0

The binocular body complete with the rackwork focussing adjustment
is removable from the stand.

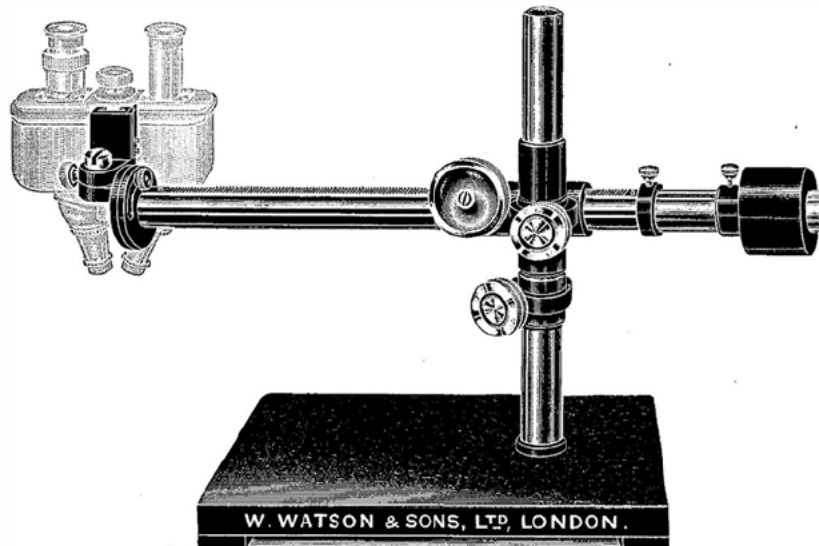
W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

BINOCULAR DISSECTING MICROSCOPE ACCESSORY FITTING

Long Arm Stand, for either Greenough or Low-Power Binocular Bodies



The examination of large specimens in dishes or in museum jars, the dissection of coarse tissue, the examination of barks, and similar large specimens which are difficult to handle, is facilitated if the whole microscope can be moved backwards and forwards over the specimen instead of a bulky specimen being moved backwards and forwards under the microscope. A special Long Arm Stand has been constructed for this purpose.

The pillar supporting the arm, as will be seen by reference to the illustration, is of stout build and is mounted towards one end of a heavy metal base. Thus, specimens in dishes may, if desired, be placed on the base which then forms a rigid stage; or, if the specimen is to be examined *in situ* the whole arm may be rotated through 180°, and then projected over the material itself. The various Binocular bodies, complete with the rackwork coarse adjustment, as shown on page 112, can be detached from the stand and fitted into the dovetailed slide on the Long Arm Stand which is provided for the purpose. Adjustment vertically, in addition to the ordinary adjustment to the body by rack and pinion, is secured by sliding the transverse arm up and down on the pillar, and a separate clamping collar is fitted. A horizontal movement of 15 in. is given by rack and pinion, while a counterpoise fitted at the end of the arm overcomes the strain on the horizontal motion sometimes associated with this type of mounting. The body may be rotated through 180° on its own axis, or inclined through an angle of 90°, so that specimens mounted in a vertical position can be readily examined.

Code Word No.

Makby 111501 Long Arm Stand, as described, price £16 10 0

Allowance for horseshoe foot, glass plate, and upright pillar to Low-Power Binocular
Microscope, if not required £2 0 0

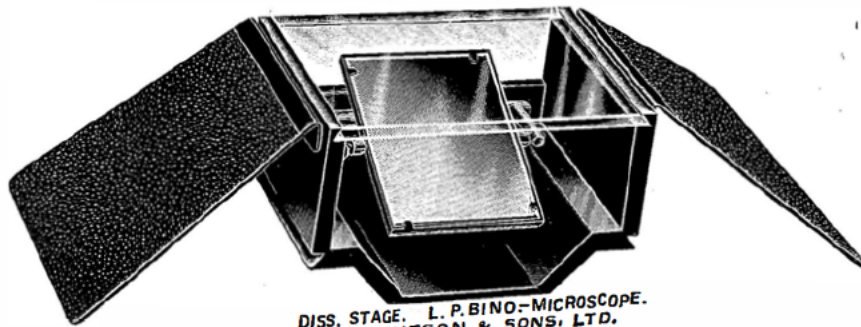
This mounting can be supplied for use with **Greenough Binocular Dissecting Microscopes** Nos. 3 4, see pages 108 and 109.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

LOW-POWER BINOCULAR MICROSCOPE ACCESSORY FITTING



DISS. STAGE. L. P. BINO-MICROSCOPE.
W. WATSON & SONS, LTD.
LONDON.

The Low-Power Dissecting Microscope is constructed primarily for the dissection of opaque objects, but it is sometimes necessary to be able to make use of transmitted light. This is particularly so where the new technique in demonstrating histological structure by means of thick sections approximately 40μ is employed. Binocular examination of such specimens permits the observer to follow the course of nerve fibrils, and capillaries, the position of muscles and of connective tissues, in a manner which conveys a true sense of their relationship to the surrounding tissues, in a way which is impossible when the ordinary thin sections are displayed for examination with the monocular microscope.

Therefore so that transmitted light can be used, a simple form of stage has been constructed. This stage is made in such a way that it can be slid into the dovetails provided for the glass stage ordinarily supplied with the microscope. The glass stage is pulled out, and the stage for transmitted light is put in its place. The stage is fitted with hand rests, as shown in the illustration. It is heavily constructed, thus rendering it very suitable for students' use. Dissection can be carried out on the glass of the stage itself, and then washed clean. This stage, in conjunction with the Low Power Binocular Microscope described on the preceding page, forms a useful adjunct to laboratory equipment.

Code Word No.

Makbu 11160 Price for stage, complete with hand rests and mirror £2 10 0

For other forms of cheap but effective dissecting microscopes, and for particulars of dissecting instruments, see Part 2 of this catalogue.

W. WATSON & SONS, LTD.



313 HIGH HOLBORN, W.C.

PRINTED IN GREAT BRITAIN BY ROBERT MACLEHOSE AND CO. LTD.
THE UNIVERSITY PRESS, GLASGOW

INDEX—Part I

[illegible]