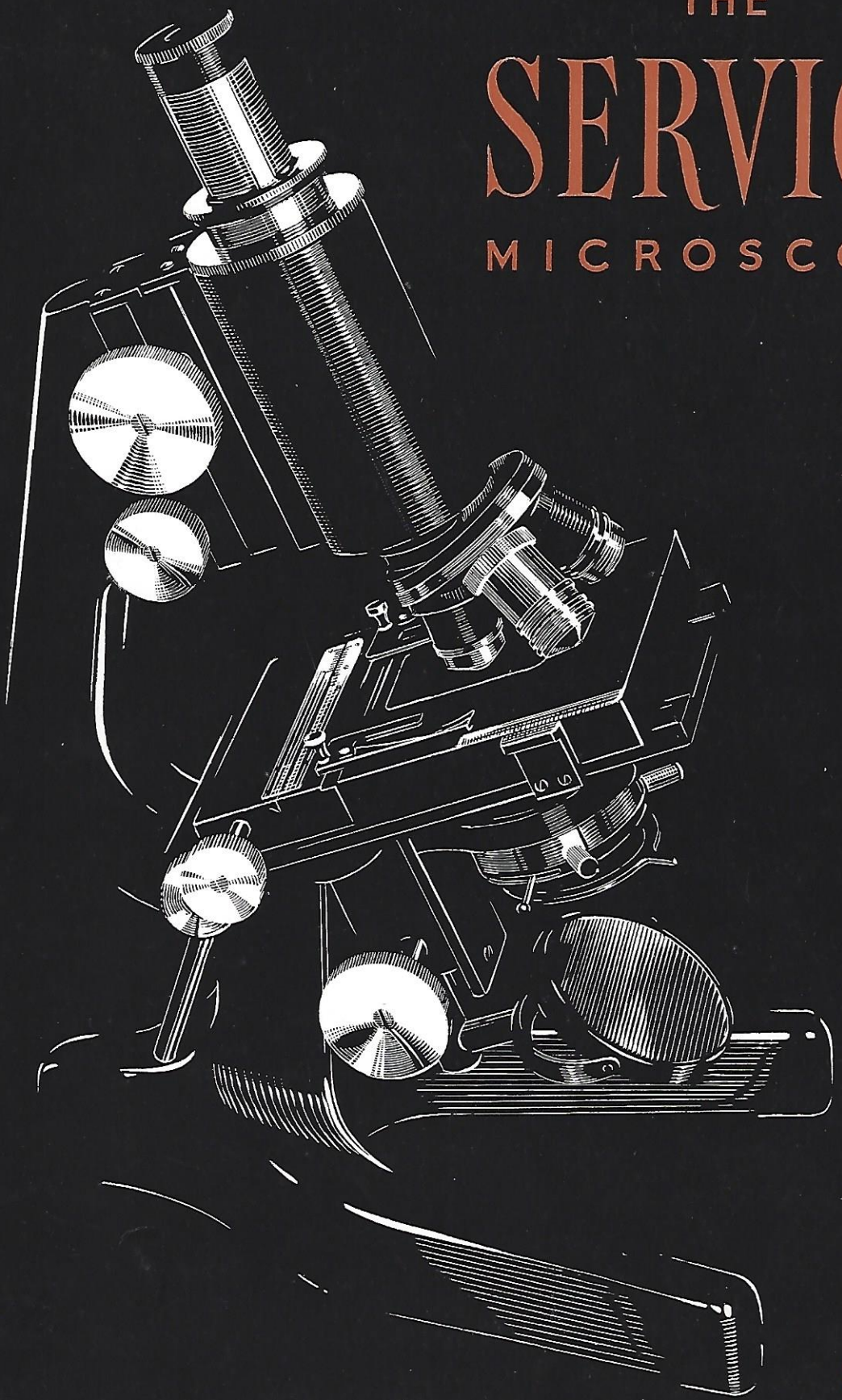
THE SERVICE MICROSCOPE



W. WATSON & SONS

SERVICE I

Over the years since Watsons were founded in 1837 they have built up a reputation for design and performance in Scientific Instruments. The pride they have in this reputation is shared alike by the oldest employee and the most recent worker in the company.

The instruments described in this publication are a typical example from a complete range of microscopes designed by experts and assembled by craftsmen.

All Watson products are designed and built to give a lifetime of efficient work, combining ease of manipulation with precision of movement and absolute rigidity.

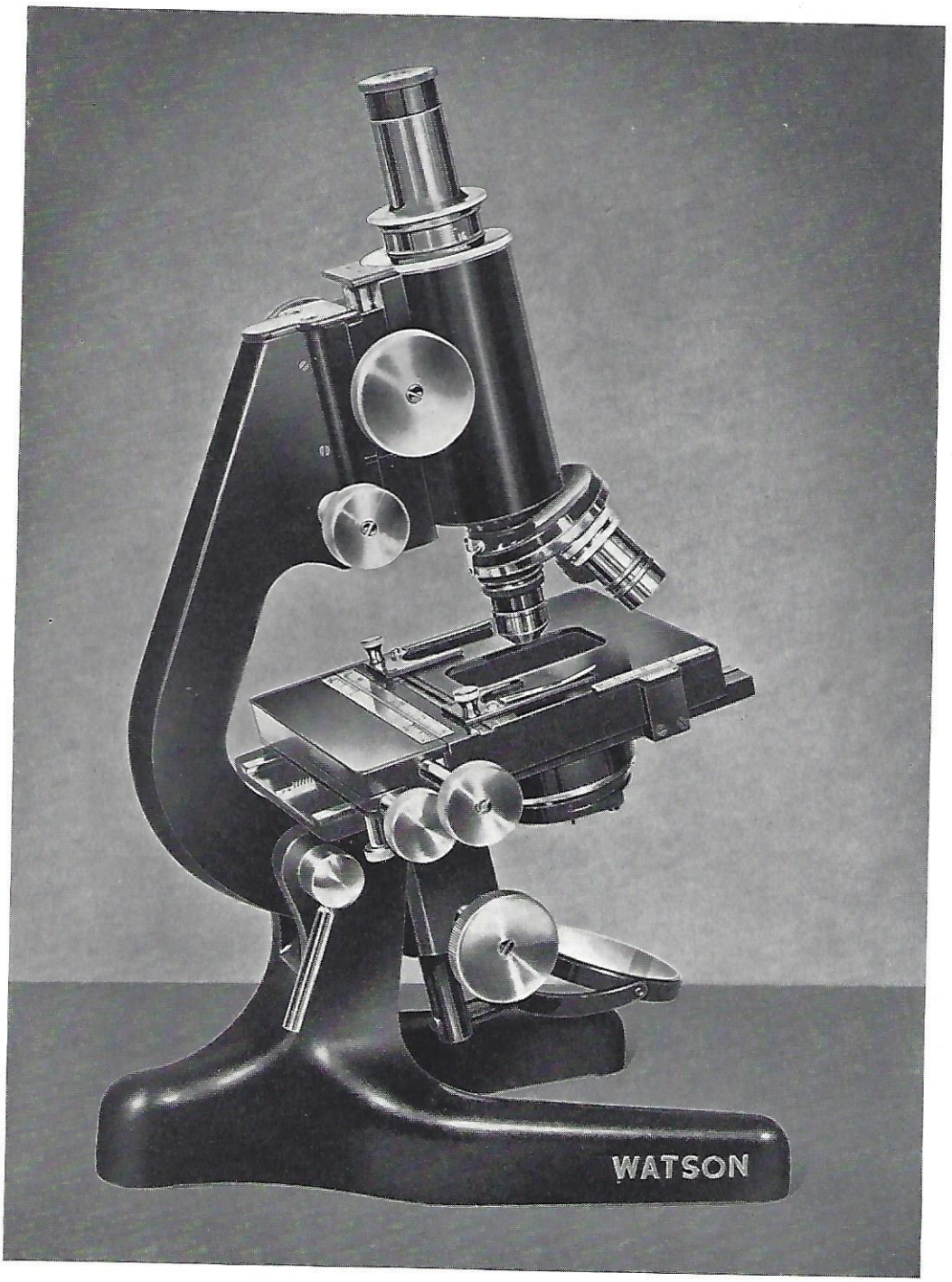
If this particular model does not meet your needs, we shall be pleased to send on request details of our other microscopes.

W. WATSON & SONS, LTD.,
313, HIGH HOLBORN, LONDON, W.C.1. HOLborn 2767

SERVICE I MICROSCOPE

The Service I Microscope is a model designed to meet the demand for a robust monocular microscope incorporating those features required by the research worker. It is of solid construction and the large limb and foot ensure balance and stability at any angle of inclination. The mechanical movements, in the Watson tradition, are of the highest standard of precision and are designed to withstand arduous conditions of general laboratory work and climatic rigours. The mechanical stage, which can be selected from three different types is built in to the instrument, forming an integral part of the microscope. A choice of two different forms of substage fitting is also available and attention is drawn to the Research Substage with condenser changers allowing easy and rapid exchange of condensers. The design of this instrument makes it an ideal choice for photomicrography.





THE SERVICE I MICROSCOPE WITH
BUILT IN FLAT TOP MECHANICAL STAGE

SPECIFICATION

Limb. The limb is new in design and conforms with modern ideas of simplicity in profile while retaining the necessary strength and stability. It still retains the original Watson feature of having the bearings for the fine adjustment and substage machined in the same operation. This ensures a basic alignment both optically and mechanically.

Foot. This is an improved horseshoe pattern, designed and proportioned to ensure perfect stability and balance for the microscope when inclined at any angle from vertical to horizontal.

Body. This is 50 mm. in diameter and is machined from a solid billet of metal, so that the body and the dovetail slides of the focusing movement are in one integral unit. This ensures complete rigidity throughout and perfect alignment.

The body of the Service I with inclined eyepiece has a tube length corrector lens incorporated in the optical system, the introduction of which increases the magnification by x 1.5.

Drawtube. This is large in diameter (35 mm.) minimising internal reflections and so adding to the contrast of the optical image. It is engraved with tube lengths up to 200 mm. with a bold indication at 160 mm.

No drawtube is fitted to the Service I with inclined eyepiece (illustrated on page 8).

Coarse Adjustment. This adjustment is by a diagonally cut rack and pinion and the slides have the maximum bearing with the dovetails when the parfocalled objectives are in focus.

Fine Adjustment. The operation of this is by a vertical lever moved by a micrometer screw which is controlled by milled heads placed on both sides of the limb. These controls are engraved in divisions 0-50, one complete rotation moves the objective 0.127 mm. or 0.005".

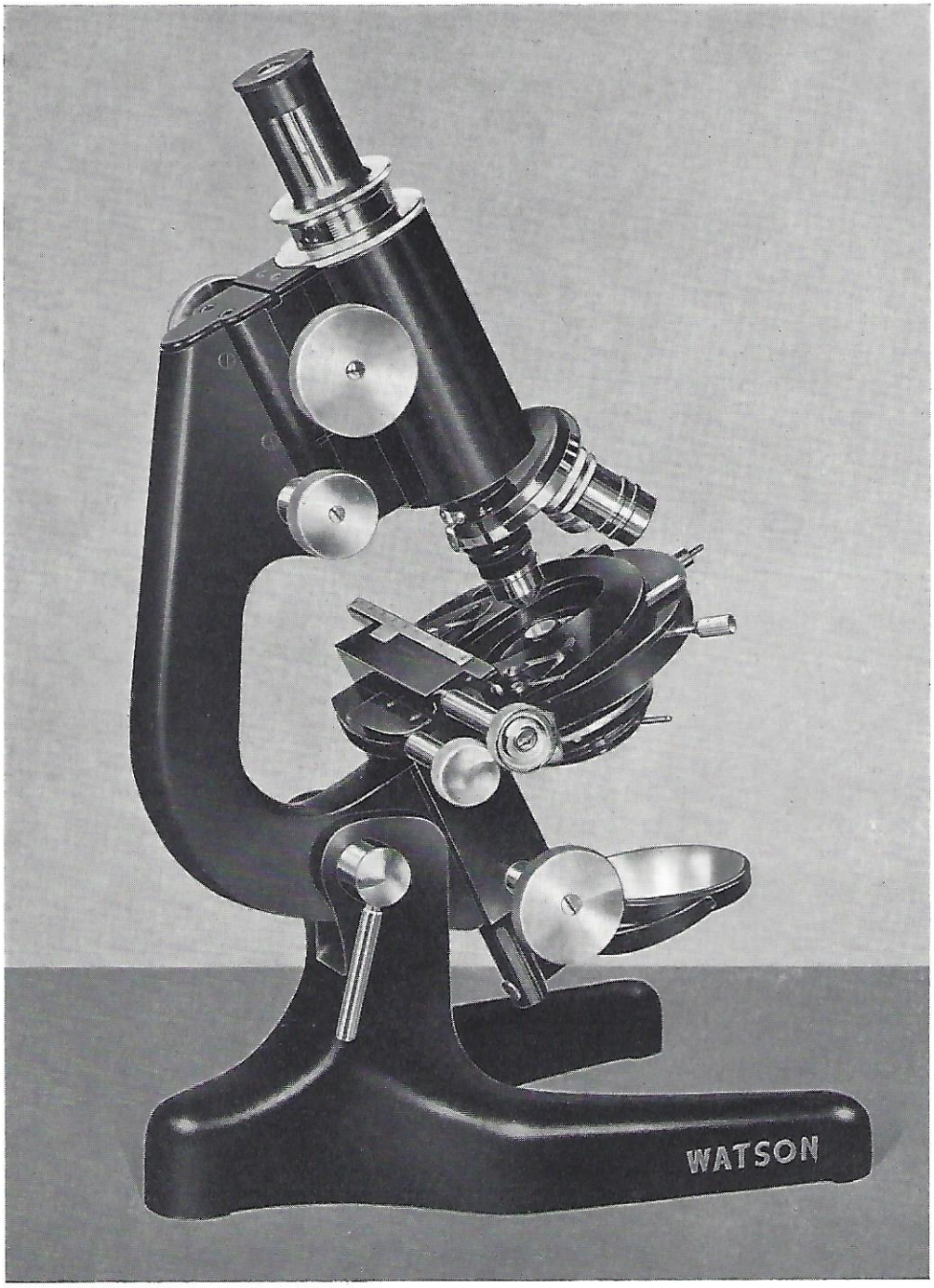
Mechanical Stage. Built in to the microscope with a choice from the three types described and illustrated on page 5.

Substage. This can be either of the two patterns offered for choice and described on pages 7 & 9. The plain substage for the centring condenser mounts. The research substage for the quick interchangeability of pre-centred condensers. The focusing adjustment in both cases is by rack and pinion controlled on either side of the limb.

The Finish of the microscope is semi-matt black enamel, providing a hard and durable surface. All control heads are chromium plated with a satin finish.

Measurements.

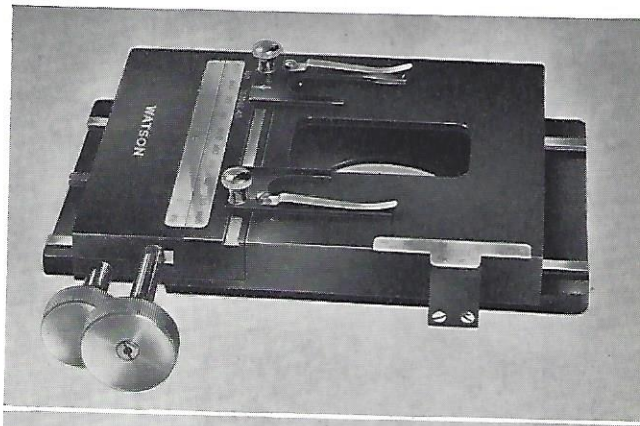
Height of Microscope	13½"	342 mm.
Length of foot	9"	228 mm.
Spread of foot	6"	152 mm.
Height to underside of stage	5"	127 mm.
Distance from optical centre to limb	4½"	115 mm.
Weight of Microscope	15 lbs. 10 ozs.	7 kilos
Weight of Microscope in case with average equipment	23 lbs.	10.4 kilos



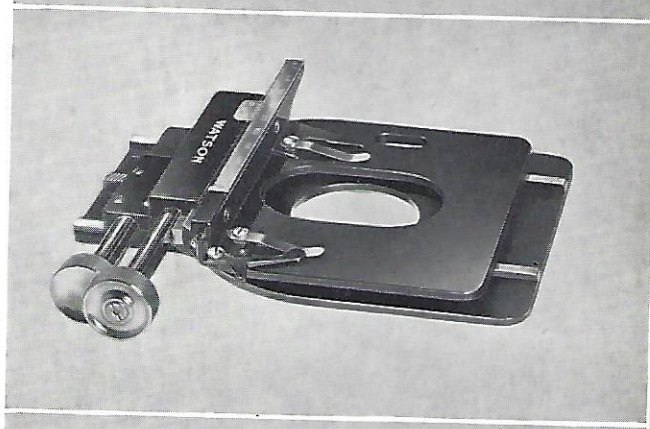
THE SERVICE I MICROSCOPE WITH BUILT IN ROTATING CENTRING MECHANICAL STAGE

MECHANICAL STAGES

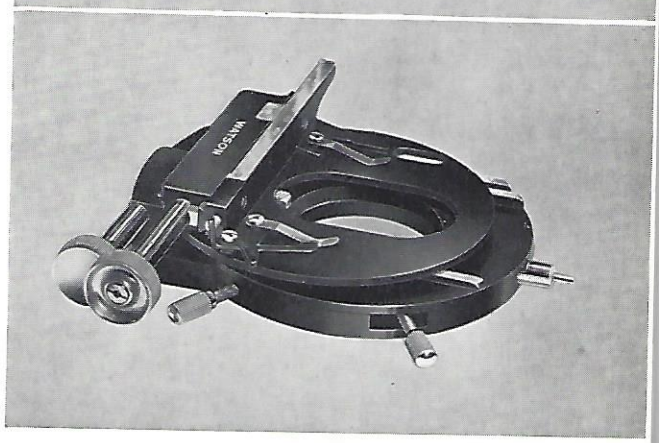
Flat Top Mechanical Stage with lateral movement of 76 mm. and transverse movement of 25 mm. both reading by verniers to 0.1 mm. The lateral millimetre scale is provided with two verniers to enable readings to be made from either side of the microscope limb. The adjustable stage clips can be moved to accommodate a slip from 48 mm. to 100 mm. in length.

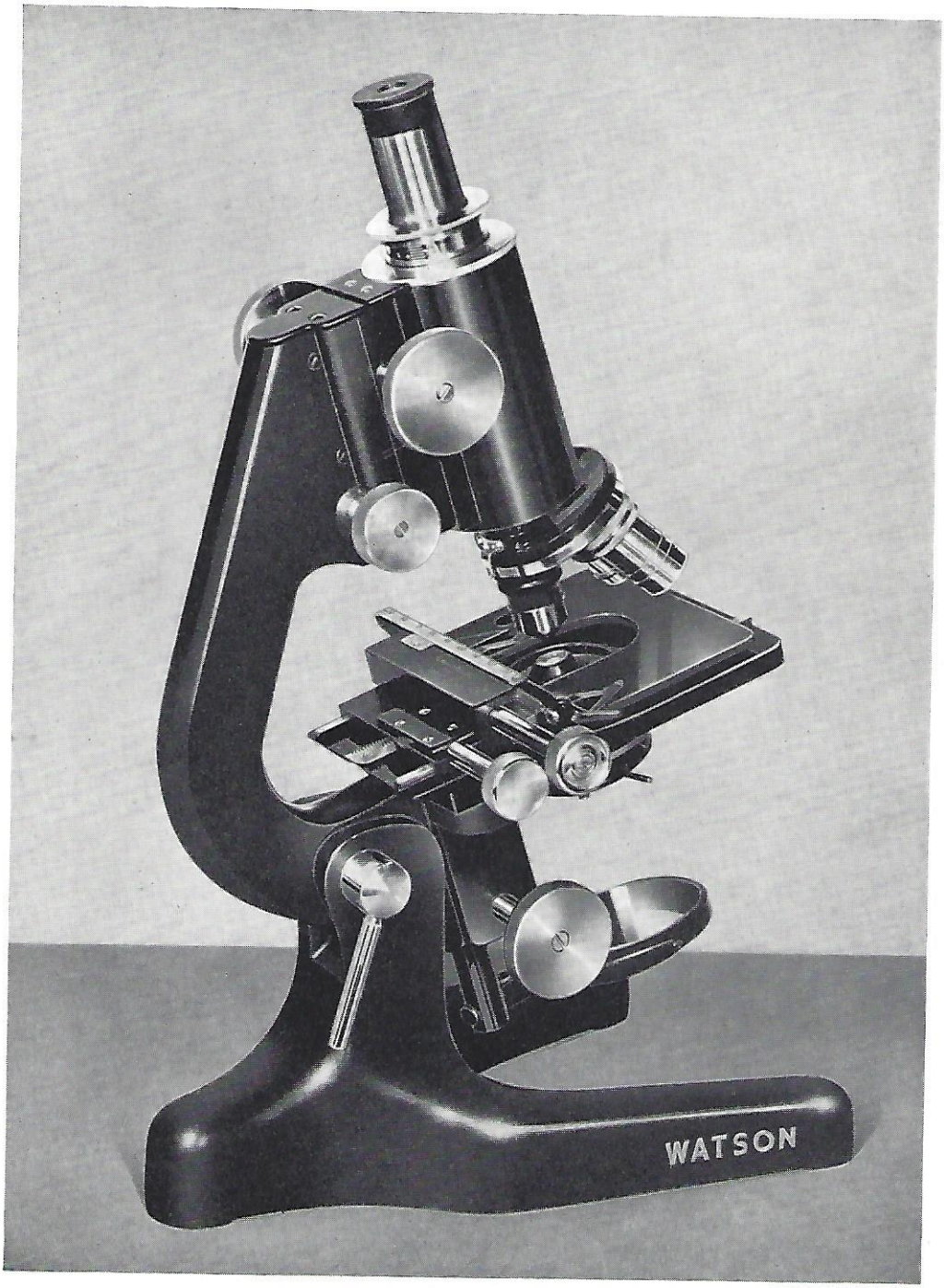


Interchangeable Mechanical and Plain Stage. The whole upper surface in which is built the mechanical motion of this stage can be racked off and replaced by a rigid plain plate 125 mm. square. The mechanical stage has a lateral movement of 76 mm. and a transverse movement of 37 mm. Millimetre scales, with verniers reading to 0.1 mm., are provided for each movement.



Circular Rotating Mechanical Stage has a concentric top rotating stage plate, 100 mm. diameter, with centring motion by means of adjusting screws. The mechanical movements are mounted on this stage and the range of travel is 75 mm. laterally and 25 mm. transversely with millimetre scales and verniers reading to 0.1 mm. A 125 mm. diameter plain stage is included and can be changed with the mechanical stage thus providing a rotating plain stage for rough work.





THE SERVICE I MICROSCOPE WITH BUILT IN INTERCHANGEABLE MECHANICAL AND PLAIN STAGE

SUBSTAGES, CONDENSER MOUNTS, POLAROID

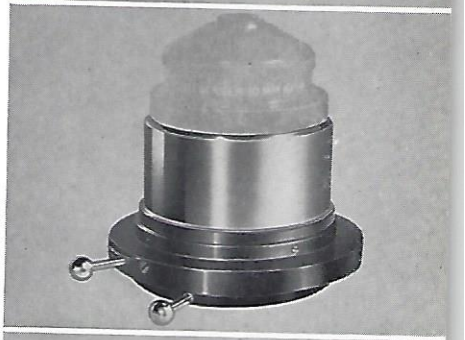
Focusing Substage. A solid metal bracket provided with rack-work focusing motion and a control head on each side of the limb. The extension of the bracket is circular and is fitted with a spring sleeve and a clamping screw (as illustrated). Into this will slide the sleeve of the plain condenser mount with precentred iris, or the centring condenser mount with precentred iris.



CONDENSER MOUNTS

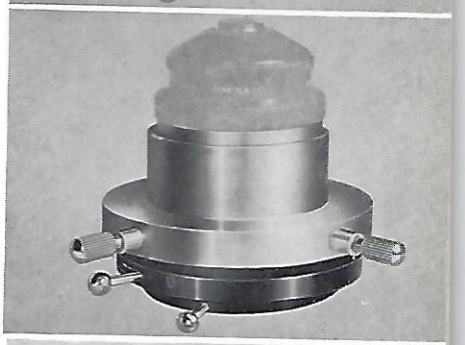
Plain Condenser Mount with precentred iris diaphragm and filter carrier. (Illustrated with condenser in position).

Code No.		£	s.	d.
2A158	Plain Condenser Mount - -	2	10	0



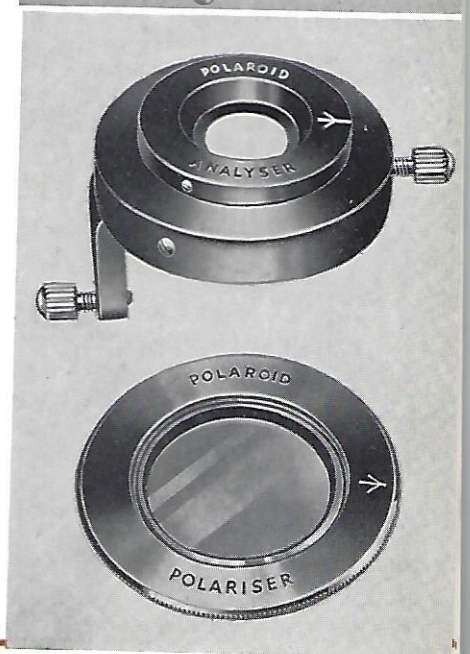
Centring Condenser Mount with tubular condenser sleeve, centring adjustment, precentred iris diaphragm and filter carrier. By adjusting the centring screws the condenser and the precentred iris diaphragm together can be axially aligned with the optical system. (Illustrated with condenser in position). When this mount is required to be used in a research substage, the addition of a condenser changer is necessary (as described on page 9).

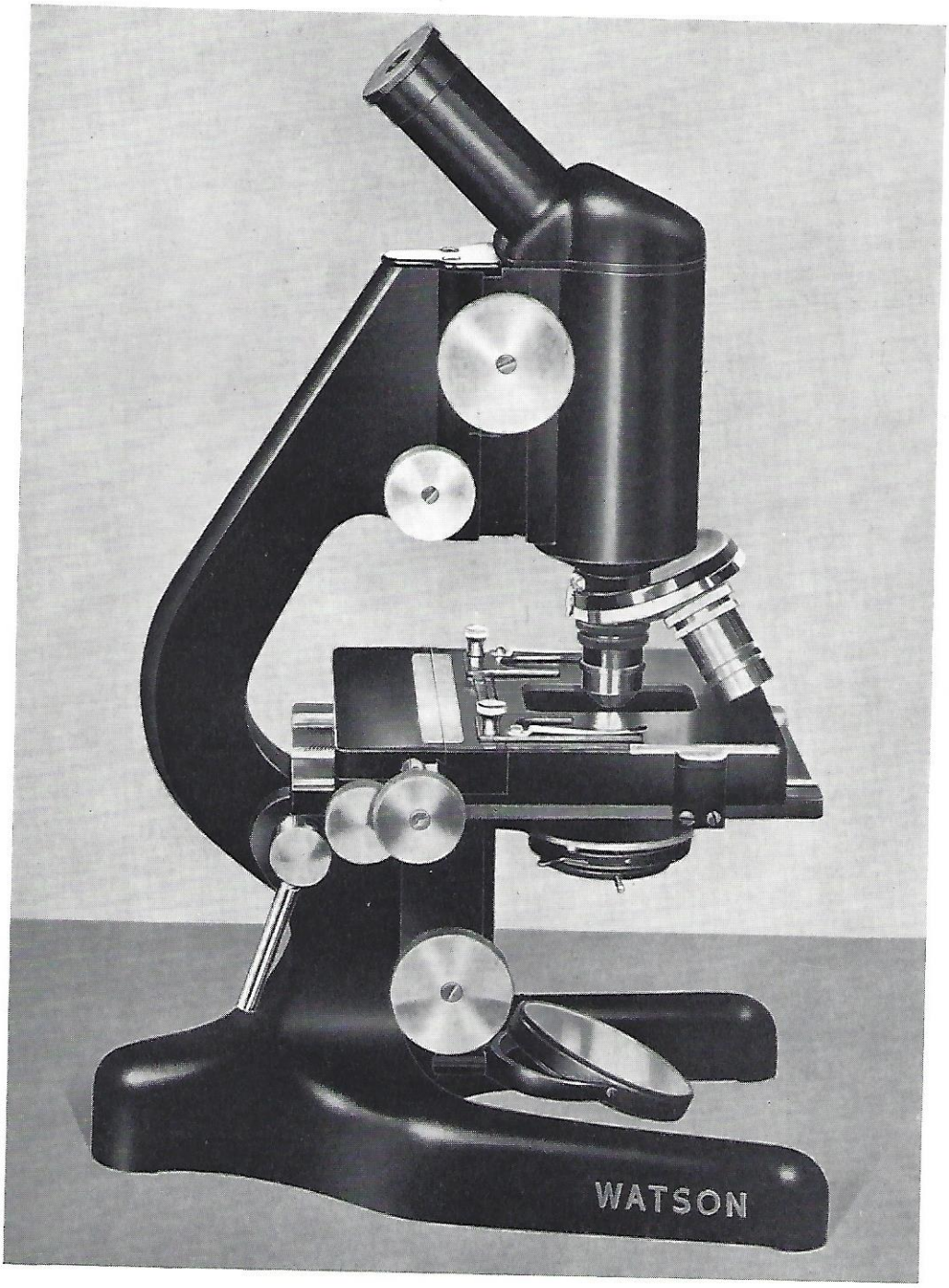
Code No.		£	s.	d.
2A159	Centring Condenser Mount - -	4	10	0



Polaroid Analyser and Polariser. Polaroid material is an excellent substitute for the Nicol prisms formerly used for polarising light. It is a prepared film which is cemented between optical glass discs. Two such plates are fitted into two suitable mounts, one fitting over the eyepiece with polaroid close to the eyelens and the other into the filter carrier beneath the substage.

Code No.		£	s.	d.
2A50	Polaroid Analyser - - - -	4	0	0
2A51	Polaroid Polariser - - - -	3	10	0

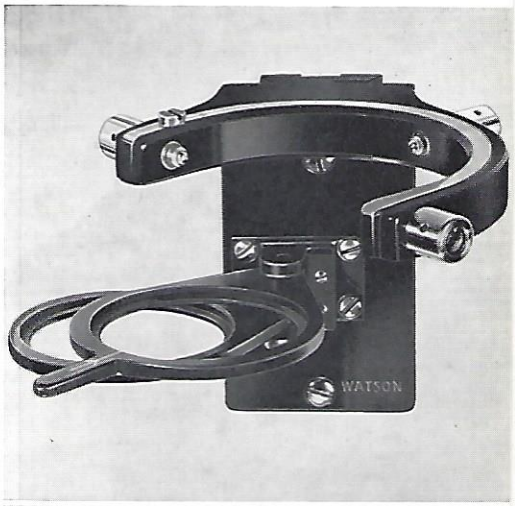




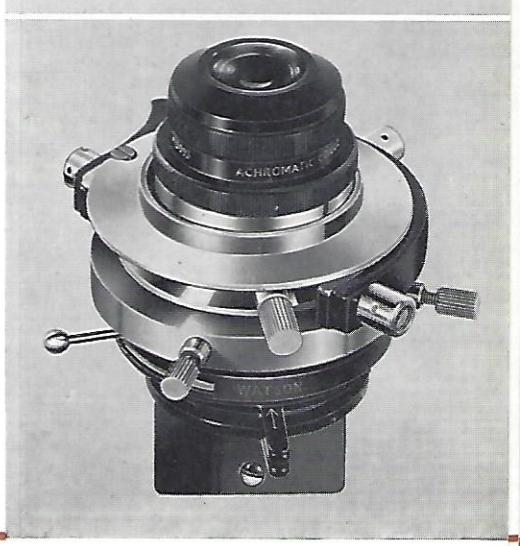
THE SERVICE I MICROSCOPE WITH INCLINED EYEPIECE AND FLAT TOP MECHANICAL STAGE

SUBSTAGES & CONDENSER MOUNTS

Research Focusing Substage. A solid cast metal bracket provided with rackwork focusing motion and with a control head on each side of the limb. The bracket is fitted with a double filter carrier and the extension is U shape in pattern (as illustrated). This is fitted with three steel bearing points, one of which is spring loaded, and on the top face of the bracket is fitted a locating screw or key pin. Two condenser changers are normally supplied with this type of substage. These changers are in the form of a V collar with a key slot cut in the top rim to engage with the locating screw on the bracket. The changers fit over the sleeves of the condensers which are supplied with individual centring mounts and precentred iris diaphragms (as illustrated). The changer is locked by means of a clamping screw and the whole condenser assembly is then pressed home into the U fitting as illustrated. The spring bearing point, opposite the locating screw, locks the condenser into place when it is in position against the remaining two fixed bearing points. This type of mounting is recommended where interchangeability of precentred condensers is required.







Code No.			£	s.	d.
2A157	Extra Research Condenser Changers	Each	1	4	0

OBJECTIVES

Apochromatic Series. When objectives are required for very critical work, an objective from this series should be selected. We recommend them because both visually and photographically they are truly apochromatic. Fluorite, in combination with selected optical glasses, is used in their optical construction, making it possible to unite the red, green and blue rays at the focus. This eliminates the secondary spectrum and the image produced by these objectives is of a very high standard, free from colour and of perfect definition. These objectives are particularly suitable for use with stained preparations and for photomicrography, and no refocusing is needed when using a variety of colour filters.

APOCHROMATIC SERIES

Code No.	*Focal Length*	*Primary Mag. at 160 mm. t.l.*	*N.A.*	*Free Working Distance mm.*	£	*s.*	*d.*
2A228	16 mm. $\frac{2}{3}$″	× 9	0.30	7	12	10	0
2A229	8 mm. $\frac{1}{3}$″	× 20	0.65	0.56	15	0	0
2A230	4 mm. $\frac{1}{6}$″	× 40	0.85	0.18	19	10	0
2A231 O.I.	2 mm $\frac{1}{12}$″	× 90	1.37	0.19	32	0	0
*2A232 ,,	2 mm. $\frac{1}{12}$″	× 90	1.37	0.19	34	10	0

*With Iris Diaphragm incorporated in mount for use in dark ground illumination. O.I. = oil immersion.

All objectives in this series are parfocal.

Fluorite Series. 3.6 mm.—$\frac{1}{7}$″ Oil Immersion Objective. This is a new addition to the already comprehensive range of Watson Microscope Objectives. It has a long working distance, 0.4 mm., and its numerical aperture of 0.95 ensures a brilliant field. The magnification is × 50. The colour and spherical corrections approach those of an apochromat. There is a surprising depth of focus and it is very convenient for dark ground observation since no funnel stop is required. The outstanding performance of this lens makes it useful for searching and its inclusion whenever possible in the optical outfit for the Service I microscope, is strongly recommended. To obtain the full advantage from this lens, it should be used in conjunction with the compensating eyepieces described on page 12.

16 mm.—$\frac{2}{3}$″ Semi-Apochromatic Objective. This lens, although not having any fluorite components is equal in performance to a true fluorite objective, except for a very slight increase in secondary colour. It is designed as a low power lens for the fluorite series and is to be used with the same compensating eyepieces with which it yields a perfectly flat field. It has a primary magnification of x 10, a numerical aperture of 0.30, and an effective working distance of 7.7 mm.

Code No.			£	*s.*	*d.*
2A233	16 mm.—$\frac{2}{3}$″ Semi-Apochromatic Objective - -	N.A. 0.30	5	0	0
2A234	3.6 mm.—$\frac{1}{7}$″ Fluorite Oil Imm. Objective - -	N.A. 0.95	17	10	0
	ADDITIONS IN COURSE OF PREPARATION				
2A235	4 mm.— $\frac{1}{6}$″ Fluorite (Dry) Objective - -				
2A236	2 mm.—$\frac{1}{12}$″ ,, (O.I.) ,, - -				

OBJECTIVES

Parachromatic Series. The objectives of this series incorporate features which make them unequalled for general work. The spherical and chromatic corrections are the best obtainable with this achromatic type of objective and the residual aberrations are reduced to negligible proportions. The very flat field is an outstanding feature of the low powers, whilst the higher powers have a relatively flat field and a long working distance.

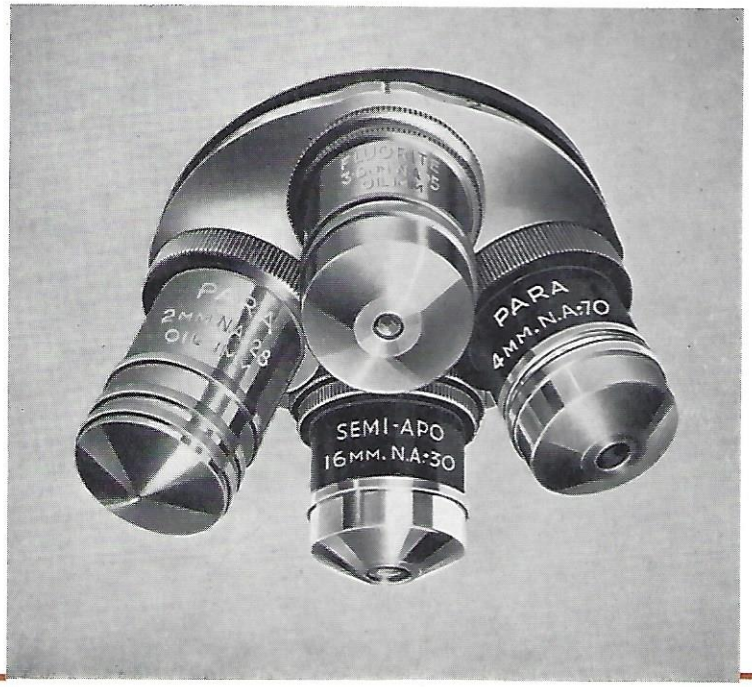
PARACHROMATIC SERIES

Code No.	Focal Length	Primary Mag. at 160 mm. t.l.	N.A.	Free Working Distance mm.	£	s.	d.
†2A200	100 mm. 4″	× 0.7	0.08	170	3	18	0
†2A201	75 mm. 3″	× 1.25	0.09	92	3	18	0
2A202	50 mm. 2″	× 2.75	0.15	45	4	2	0
2A203	40 mm. 1½″	× 4	0.13	18	2	10	0
2A204	25 mm. 1″	× 6	0.21	14	3	8	0
2A205	16 mm. ⅔″	× 10	0.28	7	3	0	0
2A206	12 mm. ½″	× 15	0.34	3.5	4	4	0
2A207	6 mm. ¼″	× 30	0.50	1.2	5	0	0
2A208	4 mm. ⅙″	× 50	0.70	0.6	5	10	0
2A210 O.I.	3.6 mm. 1/7″	× 45	0.94	0.7	9	0	0
2A211 ,,	2 mm. 1/12″	× 100	1.25	0.23	9	0	0
2A212 ,,	2 mm. 1/12″	× 100	1.28	0.23	11	10	0
* 2A215 ,,	2 mm. 1/12″	× 100	1.28	0.23	14	0	0
2A214 W.I.	3.6 mm. 1/7″	× 40	0.84	0.4	9	0	0

*With Iris Diaphragm in mount for use in dark ground illumination. O.I. = oil immersion. W.I. = water immersion.
†These magnifications are calculated when the objectives are screwed in to the bottom of the drawtube.
All objectives, with the exception of 4″, 3″ and 2″ Parachromatic series, are parfocal.

Rotating Nosepiece. These revolving objective changers are made to carry either three or four objectives. They are made with high precision from solid metal and are designed for accurate centration of parfocalled objectives. The nosepiece apertures are engraved 1, 2, 3, or 1, 2, 3, 4, the objective of lowest power being fitted into No. 1 and the next highest in No. 2 and so on.

Code No.		£	s.	d.
2A261	Rotating Triple Nosepiece - - -	3	0	0
2A262	Rotating Quadruple Nosepiece - -	3	10	0



EYEPIECES

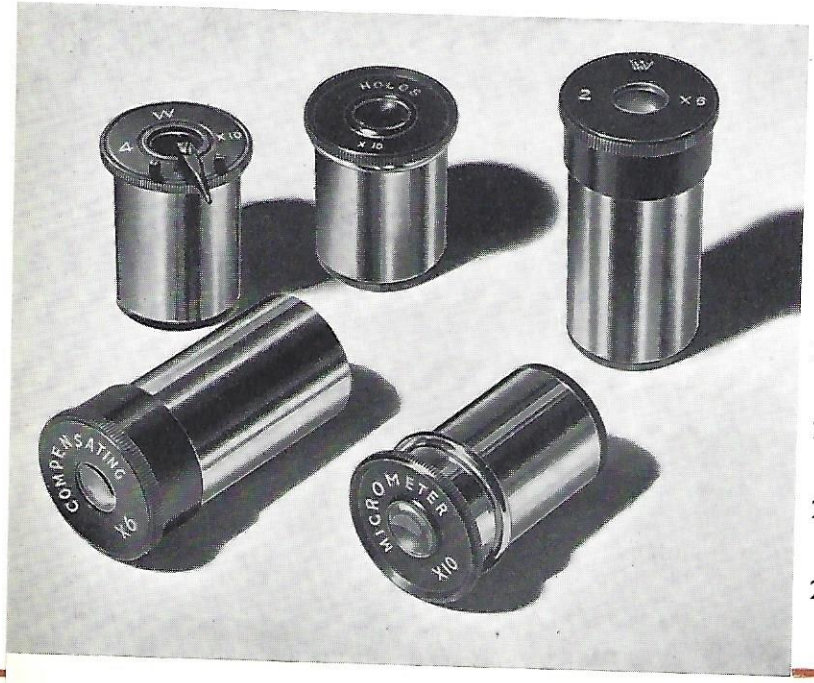
Huyghenian Series. These eyepieces are those most frequently used with achromatic objectives (Parachromatic series). They perform well with all powers in this series. Six magnifications are provided as shown below.

Holoscopic Series. The Holoscopic eyepieces are, fundamentally, compensating eyepieces in which the amount of compensation is continuously variable between wide limits. They are primarily for use with the Apochromatic series since with these objectives the degree of compensation required increases with the power. The eye lens is fitted with a sliding tube engraved in arbitrary divisions. Four magnifications are provided as shown below.

Compensating Series. This series has been computed especially for use with the Fluorite series of objectives. With these objectives, maximum field flatness and achromatism of magnification (compensation) are obtained. These eyepieces will also perform very satisfactory with the higher powers in the Parachromatic series.

Micrometer Series. The micrometer eyepieces are Huyghenian in type and each supplied with a focusing eye lens. In the x 15 eyepiece, a smaller graticule, 18 mm. diameter, is used.

All the Huyghenian, Compensating and Micrometer eyepieces (the latter when in normal adjustment and with the exception of x 15), are parfocal.



Code No.	Type	Power	£	s.	d.
2A300	Huyghenian	x 5	1	0	0
2A302	,,	x 6	1	0	0
2A304	,,	x 8	1	0	0
2A306	,,	x 10	1	0	0
2A308	,,	x 12	1	10	0
2A310	,,	x 15	1	10	0
2A312	Holoscopic	x 7	4	0	0
2A314	,,	x 10	4	0	0
2A316	,,	x 14	5	0	0
2A318	,,	x 20	5	0	0
2A320	Compensating	x 4	2	5	0
2A322	,,	x 6	2	5	0
2A324	,,	x 8	2	5	0
2A334	,,	x 10	2	5	0
2A326	Micrometer	x 6	1	14	0
2A327	,,	x 8	1	14	0
2A328	,,	x 10	1	14	0
2A330	,,	x 15	2	4	0
2A331	Extra for fitting pointer to eye-pieces at time of ordering eyepiece -		0	16	0
2A332	Eyepiece Micrometer. 1 cm. divided to 100 parts—scale type -		0	18	0
2A333	Eyepiece Micrometer. Patterson globe and circle type - -		1	10	0
2A100	Stage Micrometer. Divided 0.1 and 0.01 mm. - - - -		1	4	0
2A101	Stage Micrometer. Divided 0.01 and 0.001"		1	4	0

MAGNIFICATION TABLES

(Tube Length 160 mm.)

TABLE I. **PARACHROMATIC OBJECTIVES**—HUYGHENIAN EYEPIECES

Objective (mm.)	Primary Magnification	Total Magnification with Eyepiece					
		×5	×6	×8	×10	×12	×15
100	0.7	3.5	4.2	5.6	7.0	8.4	10.5
75	1.25	6.3	7.5	10.0	12.5	15.0	18.8
50	2.75	13.8	16.5	22.0	27.5	33.0	41.3
40	4	20	24	32	40	48	60
25	6	30	36	48	60	72	90
16	10	50	60	80	100	120	150
12	15	75	90	120	150	180	225
6	30	150	180	240	300	360	450
4	50	250	300	400	500	600	750
3.6 oil imm.	45	225	270	360	450	540	675
2 oil imm.	100	500	600	800	1000	1200	1500

TABLE 2. **FLUORITE (SEMI-APOCHROMATIC) OBJECTIVES**—COMPENSATING EYEPIECES

Objective (mm.)	Primary Magnification	Total Magnification with Eyepiece			
		×4	×6	×8	×10
16	10	40	60	80	100
3.6 oil imm	50	200	300	400	500

TABLE 3. **APOCHROMATIC OBJECTIVES**—HOLOSCOPIC EYEPIECES*

Objective (mm.)	Primary Magnification	Total Magnification with Eyepiece			
		×7	×10	×14	×20
16	9	55	75	95	135
8	20	120	165	205	300
4	40	220	315	390	580
2 oil imm	90	450	650	820	1220

* In the Holoscopic eyepieces the separation between the two components is variable to provide the degree of compensation required for each Apochromatic objective. This variation in component separation changes the eyepiece magnification so that the working magnification of any one eyepiece will vary according to the objective with which it is used, and also with the individual settings adopted by the user.

CONDENSERS

Universal No. 1 Achromatic Condenser. A triple back lens is used to obtain a high correction of spherical aberration and a large aplanatic aperture. It is corrected for slips of 1.2 mm. thickness but can be used with slips slightly less in thickness by partly unscrewing the front lens so that it touches the slip when in focus. The total aperture is 1.0, the aplanatic aperture complete is 1.0, and with the front lens removed 0.4. The focal length is 10.0 mm., and with the front lens removed 20 mm. The diameter of the back lens is 20 mm.

Code No.		£ s. d.
2A180	Universal Condenser No. 1, optical part only - - - - -	9 10 0

Universal No. 2 Achromatic Condenser (long focus). This condenser has been specially computed to meet the occasional demand for an Achromatic condenser with the maximum aperture of back lens. It is similar in design to the No. 1 Universal but by the use of special optical glasses the diameter of the back lens has been increased to 28 mm. Its focal length is 14 mm. and 28 mm. with the front lens removed. The remaining optical data are the same as for the No. 1.

Code No.		£ s. d.
2A176	Universal Condenser No. 2, optical part only - - - - -	12 10 0

Holoscopic Oil Immersion Condenser. The corrections for chromatic and spherical aberrations are effected by a triple cemented back combination. It can be used with slides up to 1.4 mm. in thickness and will give an aplanatic cone equal to its aperture. This condenser may be used dry (without immersion oil) or with the front lens removed for low power objectives. The focal length is 5.5 mm., and 12 mm. with the top lens removed. The full aperture is 1.30 N.A. when oil immersed, 1.0 when used dry and 0.60 with top lens removed. The aplanatic aperture when used dry is 0.92 N.A., and 0.55 N.A., with top lens removed.

Code No.		£ s. d.
2A184	Holoscopic Oil Condenser, optical part only - - - - -	14 10 0

Zonal Dark Ground Condenser. This condenser is catoptric and designed on the concentric principle. It is intended to work through a slip of 1.2 mm. thick and must be used in oil contact with the slide. The objective aperture needs to be reduced to a value of unity by means of a funnel stop or iris diaphragm within the objective and under these conditions an intense black background is obtained.

Code No.		£ s. d.
2A188	Zonal Dark Ground Condenser, optical part only - - - - -	9 0 0
2A155	Funnel Stop - - - - - - - - - - -	0 10 0

See pages 7 and 9 for Condenser Mounts.

CONDENSERS, FILTERS

Aplanatic Condenser. This is a three lens Abbe illuminator which is adequate for most routine work with all powers of Achromatic objectives. When used as an immersion condenser the numerical aperture is 1.40, or 1.0 if used dry ; the equivalent focus is 9.5 mm. With the top lens removed the aperture is reduced to 0.6 and the focal length is 14.5 mm.

Code No.		£	s.	d.
2A192	Aplanatic Condenser, optical part only - - - - - -	7	10	0

Abbe Illuminator. This is a two lens uncorrected illuminator the maximum numerical aperture of which is N.A. 1.20. It is useful for simple routine work with achromatic objectives and lower power dark ground illuminator.

Code No.		£	s.	d.
2A196	Abbe Illuminator, optical part only - - - - - -	1	16	0
2A156	Set of metal stops for dark ground, etc., illumination in brass box -	1	4	0

See pages 7 and 9 for Condenser Mounts.

A booklet on dark ground illumination technique is published separately. Copies will be sent gratis on application.

Filters. Chance-Watson. These filters are made from pot glass, so that the tint is permanent and evenly distributed throughout. A comprehensive range is available as follows :

1	Ruby	5	Yellow	9	Daylight Blue	13	Ultra Violet
2	Red	6	Light Green Ortho	10	Blue	14	Infra Red
3	Deep Orange	7	Green	11	Purple		
4	Orange	8	Blue Green	12	Neutral		

Code No.		£	s.	d.
2A52	Chance-Watson light filter 1⅜" diameter to fit substage filter holder - each	0	8	0



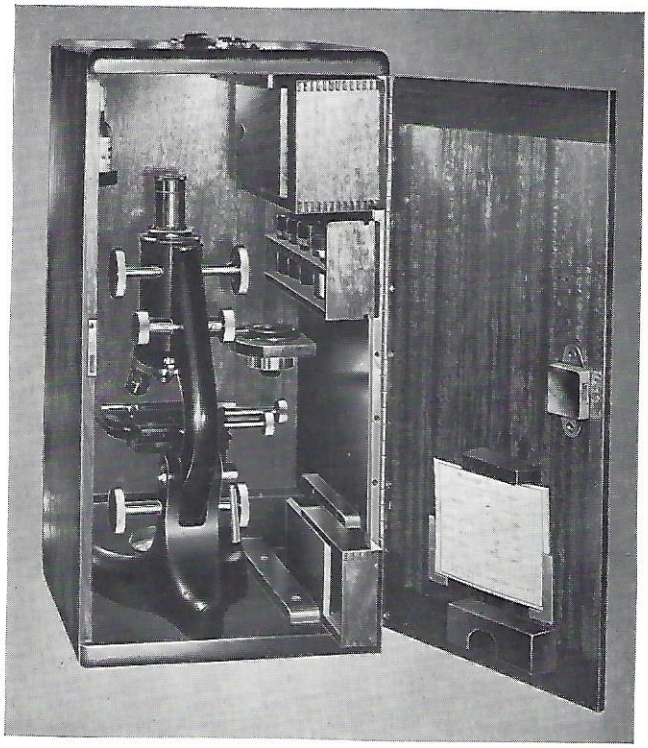
SUGGESTED OUTFITS AND PRICES

Prices of Microscope Stand without accessories but with fitted mahogany case.

Code No.		£ s. d.
2A24	Service I Microscope Stand only with built-in flat top mechanical stage and focusing substage	50 0 0
2A25	Service I Microscope Stand only with built-in interchangeable mechanical and plain stage and focusing substage	50 0 0
2A26	Service I Microscope Stand only with built-in rotating mechanical stage and focusing substage	55 0 0
2A27	Extra for built-in inclined eyepiece unit with bloomed prism, in place of drawtube and vertical eyepiece tube on any of the above models	6 6 0
2A14	Extra for research substage with 2 condenser changers in place of focusing substage	5 4 0

The following are suggested optical outfits for the Service I Microscope and are recommended for normal working requirements. A complete range of Objectives, Eyepieces and Condensers will be found on pages 10—15.

Code No.		£ s. d.
2A20	2 Huyghenian Eyepieces (at choice) x 5, x 6, x 8, x 10 Triple Rotating Nosepiece 16 mm.— $\frac{2}{3}$″ Parachromatic Objective N.A. 0.28 x 10 4.0 mm.— $\frac{1}{6}$″ ,, ,, ,, 0.70 x 50 2.0 mm.—$\frac{1}{12}$″ ,, ,, ,, 1.28 x 100 Aplanatic 3 Lens Condenser in centring mount ,, 1.40	37 0 0
2A21	2 Compensating Eyepieces (at choice) x 4, x 6, x 8, x 10 Quadruple Rotating Nosepiece 16 mm.— $\frac{2}{3}$″ Semi-Apochromatic Objective N.A. 0.30 x 10 4.0 mm.— $\frac{1}{6}$″ Parachromatic ,, ,, 0.70 x 50 3.6 mm.— $\frac{1}{7}$″ Fluorite ,, ,, 0.95 x 50 2.0 mm.— $\frac{1}{12}$″ Parachromatic ,, ,, 1.28 x 100 Aplanatic 3 Lens Condenser in centring mount ,, 1.40	59 10 0
2A17	*Extra* for Universal fully corrected Achromatic Condenser No. 1, N.A. 1.0 in place of Aplanatic 3 Lens Condenser	2 0 0
2A22	2 Holoscopic Eyepieces x 7, x 10 Quadruple Rotating Nosepiece 16 mm.— $\frac{2}{3}$″ Apochromatic Objective N.A. 0.30 x 9 8 mm.— $\frac{1}{3}$″ ,, ,, ,, 0.65 x 20 4 mm.— $\frac{1}{6}$″ ,, ,, ,, 0.85 x 40 2 mm.—$\frac{1}{12}$″ ,, ,, ,, 1.37 x 90 Holoscopic Oil Imm. Condenser in centring mount ,, 1.30	109 10 0



LIST 4502A. Improvements in design are introduced from time to time, so that illustrations and specifications used in this list may not be correct in every detail.

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