Mr. T. Barkley

WATS ON

SEPTEMBER
J32/964
C.

WANTED - MORE ORDERS.

Despite one or two difficult bottlenecks, Production of instruments is rapidly overhauling the order book. There has been a steady decline in sales of Stereoscopic models, the Eyepiece Camera, Land Camera, Unisects and Konimeter. A special effort is required to obtain increased numbers of orders for these products and every effort should be made to follow up potential business that may have been outstanding for some time in your own area. If your area includes educational establishments, it should be noted that the new year is about to commence, and this should give you an opportunity of chasing up all those Zoom Stereos which you have reported will be ordered in the Autumn.

On the subject of Zoom Stereo - how many of you have pushed this microscope to Hospitals and Hospital Medical Schools - if not, why not?

This months special offer: Unisects - 20% discount for any quantity.

Dozens in stock.

WATS ON

J33/964
C

ZOOM STEREO

EYEPIECES.

It was recently agreed to go ahead with the production of x15 eyepiece and also x15 micrometer eyepieces. The standard eyepiece, Code 511, will be priced at £15.0s.0d. per pair and the micrometer eyepieces, Code 514 (a), (b), and (c) at £15.0s.0d. each, including graticule. The date for first production is mid-November, 1964, and you should recently have received details of the coding through your Products List.

LONG ARM STAND.

The special long arm stand (Code 512) designed for the Zoom Stereo is expected to become available early in November. It will be approximately £65.0s.0d. A vertical Zoom box may also be available by that time for demonstrations where the application demands other than an inclined Zoom Box.

POLARISING ACCESSORIES

A compromise of the specification for these accessories has been agreed with the Technical Department so that design and prototype manufacture can proceed as so n as possible. Basically the equipment will be very similar to that offered with the Research Stereo. Prototype polariser and analyser will be ready early November.

VERTICAL ILLUMINATOR

This is in design at the moment - Prototype expected to be available early in November.

AUXILIARY LENS x0.4

Prototype ready in four weeks.

AUXILIARY LENS x2

Prototype available soon. If subsequent manufacture is agreed, this lens will only be available to special order as it is necessary to modify existing stand design to allow lens to focus at stage level.

PHOTOGRAPHIC OUTFIT

Camera prototype being designed - working model expected December.

WATS ON

J34/964
C

ZOOM STEREO COMPARISON

Bausch and Lomb have announced new prices (upwards, fortunately) as from September 1st, 1964. A new comparison sheet is attached. This also includes the Nikon (Japan) 5:1 Zoom Stereo.

It has been reported to the Editor that Zeiss propose to drop their Stereomicroscope II (Magnification changer) - can anyone confirm this?

ZOOM STEREO EQUIVALENT OUTFITS

WATSON		BAUSCH AND LOMB			ZEISS		
	LIST PRICE		DUTY PAID	DUTY FREE		DUTY PAID	DUTY FREE
Code 521 Mags. x 10 - x 50	199.10.0.	2 + 3 + 9 7 - 30	166.16.0.	119.19.6.	2 + 3 + 9 10 - 40	239. 6. 0.	158.14. 0
Code 522 Mags. 10-50, 15-75, 22.5-112.5	240.10.0.	2 + 3 + 9 + 10 + 13 + 14 7-30,10.5-45, 21-90	212.14.6.	154.13.0.	2 + 3 + 9 + 11 + 13 + 14 10-40, 15-60, 20-80	324. 0. 5.	215.16. 1.
Code 523 Mags. 7-35,10-50,14-70,20-100,30-150	249. 0.0.	2 + 3 + 9 + 11 + 12 + 13 + 14 3.5-15, 7-30, 14-60,28-120	225. 2.0.	164. 6.6.	2 + 3 + 9 + 11 + 12 +13+14 5-20,10-40,12.5-50,20-80, 25-100, 50-200	343.13. 5.	228.16. 1.
Code 525 Mags. 10 - 50	224. 0.0.	2 + 3 + 9 + 6 7 - 30	200. 1.0.	189. 8.6.	2 + 3 + 9 + 6 10 - 40	333.13.11.	222.11.11.
Code 526 Mags. 10-50,15-75,22.5-112.5	247.10.0.	2 + 3 + 9 + 10 + 13 + 6 7-30, 10.5-45, 21-90	228.17.0.	211. 4.6.	2+ 3 + 9 + 11 + 13 + 6 10-40, 15-60, 20-80	374. 2.11.	249. 9.11.
Code 527 Mags. 7-35,10-50,14-70,20-100,30-150	262.10.0.	2 + 3 + 9 + 11 + 12 + 13 + 6 3.5-15,7-30, 14-60, 28-120	241. 4.6.	220.18.0.	2 +3 + 9 + 11 + 12 + 13+6 +18 5-20,10-40,12.5-50,20-80, 25-100, 50-200	405.10.11.	266. 7.11.
Code 529 Mags. 10-50	240. 0.0.	2+3 + 9 + 6 + 14 7-30	217. 3.6.	202. 6.0.	2 + 3 + 9 + 6 + 14 10-40	377.19. 4.	252.16. 0.
Code 530 Mags. 10-50,15-75, 22.5-112.5	270. 0.0.	2 + 3 + 9 + 6 +10 +13 + 14 7-30, 10.5-45, 21-90	245.19.6.	224. 2.0.	2 + 3 +9 +6+ 11 +13+14+18 10-40,15-60, 20-80	430. 3. 4.	282.12. 0.
Code 531 Mags. 7-35, 10-50,14-70,20-100,30-150	278.10.0.	2 + 3 + 9+6 +11+12 + 13 + 14 3.5-15, 7-30, 14-60, 28-120	258. 7.0.	233.15.6.	2+3+9+6+11+12+13+14+18 5-20,10-40,12.5-50,20-80, 25-100, 50-200	449.16. 4.	296.12. 0

WATSON	Prices dated 1.2.64.	BAUSCH AND LOMB	1.9.64. DUTY PAID	1.9.64. DUTY FREE	ZEISS	1.5.64. DUTY PAID	1.5.64. DUTY FREE
1)No Equivalent	-	2:1 Power Pod 31.26.93	93. 0.0.	68. 5.0.	No Equivalent	-	-
2)5:1 Zoom Box 501	150. 0.0.	4:1 Power Pod 31.26.94	129. 5.0.	94.15.0.	4:1 Zoom head 47.50.20	169. 9.0.	112. 0.0.
3)Stand with fitted cabinet 502	34.10.0.	Stand with fitted cabinet 31.26.88+31.40.11.12	37.15.0.	27.11.0.	Stand F with cabinet 47.52+47.52.20+47.94.70	52. 3.0.	34.16.0.
4)Rackwork long arm stand 484	42. 0.0.	Long arm stand (no rackwork) 31.26.96.85+31.26.59	53.13.0.	39. 8.0.	Long arm stand (no rackwork) 47.52.10+47.52.05	67.14.0.	45. 4.0.
5)Special rackwork long arm stand 512	-	Long arm stand with vertical and horizontal rackwork. 31.26.97+31.26.59	145. 5.0.	106. 8.6.	Long arm stand (vertical and horizontal rackwork) 47.52.10+47.52.02	247.12.0.	165. 3.0.
6)Transmitted light base with built-in illuminator and control unit 503	24.10.0.	Transmitted light base with Nicolas Illuminator (plugged-in) and separate control unit 31.26.84.86+31.33.53	34. 2.6.	25. 0.6.	Transmitted light base with twin lamps and control unit 49.50.55	94. 7.11	63.17.11.
7)No Equivalent	-	Transmitted light base with mirror only 31.28.84.86	16.10.0.	12. 2.0.	Transmitted light stage and mirror base unit 47.52.30+47.52.20+47.52.60	28.14.0.	19. 4.0.
8)No Equivalent	-	No Equivalent	-	-	Pair x4 eyepieces and cups 46.36.01+46.49.00(2)	16. 8.0.	11. 0.0.
9)Pair x10 eyepieces and eyeguards 504	15. 0.0.	Pair x10 eyepieces and eyeguards 31.05.61.02+31.50.68	17. 3.0.	12.11.0.	Pair x10 eyepieces and cups 46.40.01+46.49.00	17.14.0.	11.18.0.
10)Pair x15 eyepieces and eyeguards 511	15. 0.0.	Pair x15 eyepieces and eyeguards 31.05.62.02+31.50.64	17. 3.0.	12.11.0.	No Equivalent	-	-
11)Pair x20 eyepieces and eyeguards 505	15. 0.0.	Pair x20 eyepieces and eyeguards 31.05.63.02+31.50.64	17. 3.0.	12.11.0.	Pair x25 eyepieces and cups 46.44.01+46.49.00(2)	20.16.0.	13.18.0.

Continued/.........................

WATSON	Prices dated 1.2.64.	BAUSCH AND LOMB	1.9.64. DUTY PAID	1.9.64. DUTY FREE	ZEISS	1.5.64. DUTY PAID	1.5.64. DUTY FREE
12) Auxiliary front lens x0.7 506	8.10.0.	Auxiliary front lens x0.5 31.26.18	13. 6.0.	9.16.0.	Attachment lens x0.5 47.50.67	19.13.0.	13. 0.0.
13) Auxiliary front lens x1.5 507	8.10.0.	Auxiliary front lens x2 31.26.19	13. 6.0.	9.16.0.	Attachment lens x2.0 47.50.67	19.13.0.	13. 0.0.
14) Streamlite and control unit 276	17.10.0.	Nicolas Illuminator and control unit 31.33.53	17.12.6.	12.18.6.	Illuminator and control unit 49.50.54	44. 5.5.	30. 4.1.
15) Fluorescent Illuminator 499	14. 0.0.	Fluorescent Illuminator 31.33.36	20.16.0.	15. 6. 0.	No Equivalent	-	-
16) Movable stage 513	19. 0.0.	No Equivalent	-	-	Gliding stage 47.52.22.	24.14.0.	16.10.0.
17) No Equivalent	-	Graduated mechanical stage 31.59.53.	55.15.0.	41. 2.6.	Mechanical stage 47.33.22	41.16.0.	27.18.0.
18) Arm rests 509	6.10.0.	No Equivalent	-	-	Arm rests 47.52.68	11.15.0.	3.18.0.

OLYMPUS 4:1 Zoom Stereomicroscope

Complete instrument with x10 eyepieces (x7.5 -x30 magnification range) - Price - £145. 0.0d.

Complete instrument with x20 eyepieces (x15-x60 magnification range) - Price £145. 0.0d.

x2 Auxiliary lens available.

Marketed by Gallenkamps.

NIKON 5:1 Zoom Stereomicroscope

Complete instrument with x10 eyepieces (x8.0 to x40 magnification range) Price unknown.

Complete instrument with x20 eyepieces (x16.0 to x80 magnification range) Price unknown

x0.5, x0.7 and x1.5 Auxiliary lenses available.
Working distance without auxiliary lenses 77.5mm.
Transmitted light base with mirror available
Long arm stand available
Vertical illuminator available
Polarising accessories available
Floating stage available

Marketed by R.B. Pullin & Co. Limited.

J.35/964
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DELIVERY SCHEDULE.

BACTIL-60 (Standard Optics)	4 weeks
BACTIL (Special Optics)	7 weeks
BACTIL	3 weeks
SERVICE 68	5 weeks
SERVICE 3 (292)	4 weeks
.. .. (293)	5 weeks
STEREOS: 850 range	3 weeks
1050 range	3 weeks
Box Foot	5 weeks
Research	5 weeks
L.A.S.	6 weeks
Zoom	8-10 weeks
METALLURGICAL	5-6 weeks
MICROPROJECTOR	6 Months
EYEPIECE CAMERA	2 weeks
LAND CAMERA	5-6 weeks
35mm. CAMERA ATTACHMENT	2-3 weeks
KONIMETER	2 weeks
W.I.S.E.	10 weeks
FLUORESCENT ILLUMINATOR	10 days
16mm. INTERFERENCE OBJECTIVE	14 weeks
8 mm. INTERFERENCE OBJECTIVE	12 weeks.

WATS ON

J36/964

U.C.

EXTRACT FROM SUNDAY TIMES COLOUR MAGAZINE.

UNIVERSITIES.

The variety of courses offered at the older established universities is greater than many people realise. At Southampton, for example, possible combinations include French with Music and Philosophy with Mathematics. Edinburgh offers Hebrew, Persian, Turkish, Arabic and Sanskrit. Leeds has honours courses in Textile Design, Colour Chemistry and Leather Science. These are in addition to the common combinations and subjects. Now the enormously increased demand for university places has led to the planning of these seven new universities.

THE UNIVERSITY OF SUSSEX.

Began two years ago at Brighton. There are four 'schools of studies' - English and American Studies, European Studies, Social Studies and Physical Sciences. There are also plans for schools of African and Asian Studies, Educational Studies, Applied Science, Biological Science and Engineering.

THE UNIVERSITY OF YORK.

Opened this Autumn. There are combined and single-subject degrees in Economics (including Statistics), English, History, Mathematics and Politics (including Sociology). A Department of Languages is planned for 1964 to investigate the concept of teachihg language and the relationship of language-teaching to cultural problems in under-developed countries. The only orthodox department will be Russian. York hopes to interview all candidates and admissions won't be wholly dependent on G.C.E. results.

THE UNIVERSITY OF EAST ANGLIA.

Opened this Autumn at Norwich. At present there are two schools only: English Studies (language, literature and history) and Biological Sciences (experimental Botany and Zoology, Biochemistry and Genetics). There are plans for European Studies, Social Studies, Chemistry, Maths and Physics, Overseas Studies(African and Indian) and Environmental Sciences (Geography, Geology, Geophysics and Meteorology).

Continued/.........

THE UNIVERSITY OF ESSEX

Opens next year at Colchester with about 100 students and a nucleus of three schools: School of Comparative Studies, with departments of Government and Literature (including studies in North American, South American and Russian Literature, along with English Literature). School of Physical Sciences, with department of Physics, Maths and Chemistry. A centre of Engineering Science will develop out of this. Essex, like East Anglia, plans to establish a few strong departments rather than numerous small ones.

THE UNIVERSITY OF LANCASTER.

Plans to open in October, 1964. Joint Honours will be taken in subjects such as Chemistry, Physics, Biology, Maths, Operational Research, Politics, and Economics, English, French Studies, German Studies, Russian Studies, Classics, History, Philosophy and Geography.

THE UNIVERSITIES OF KENT AND WARWICK.

Both plan to take their first 300 students in October, 1965. The University of Kent, at Canterbury, will have schools of Physical Sciences, Engineering Sciences, Arts and Social Sciences.

THE DIPLOMA IN TECHNOLOGY

Awarded by the National Council for Technological Awards and recognised by the Committee of Vice-Chancellors and Principals as of degree standard. The course is a four-year one in which full time study in college alternates with one or more periods of industrial training. By January, 1963, 2,000 Dip. Techs. had been awarded. At present it is the most popular full-time course in the CATs, where 5,650 students are taking it, out of a total of 10,300. There are four CATs near London: Battersea, Brunel (at Acton), Chelsea and Northampton. The remainder are: Birmingham, Bradford, Bristol, Cardiff, Loughborough and Salford. In addition 18 technical colleges have Dip. Tech. courses. Details can be obtained from the National Council for Technological Awards, 24, Park Crescent, London W.1.

NEW AND UNUSUAL COURSES.

Some colleges have begun quite new courses. Woolwich Polytechnic started this year a four-year course on overseas marketing, the third year being spent in a firm overseas. It leads to a college diploma and HND in business studies. Battersea College of Technology has started a three-year course which combines physical sciences with sociology, economics and law. An optional extra year can be spent abroad.

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The College of Aeronautics (Cranfield) and the six national colleges (agriculture, engineering, food, technology, heating, ventilating and refrigerating, foundry, leathersellers and rubber technology) also offer specialised courses.

TEACHER TRAINING COLLEGES

Most of these offer three-year initial training courses. Some specialise in certain subjects or age ranges, and intending students should look at the "Handbook on Training for Teaching" (published by Methuen at £2.2s.0d.). Some colleges offer four-year courses which include a general degree course together with professional training.

FOUR YEAR COURSES WHICH INCLUDE YEAR OF PROFESSIONAL TRAINING

Borough Road College, Isleworth Middlesex	-	Men
Goldsmith's Colleg, Lewisham Way, London S.E.4		Mixed.
College of St. Mark and St. John, Kings Road Chelsea, London S.W.10.	-	Men
St. Mary's College (R.C.) Strawberry Hill, Twickenham, Middlesex.	-	Mainly Men
College of the Venerable Bede, Durham.	-	Men.

J37/964
C.

SCHOOL OF APPLIED SCIENCES IN THE UNIVERSITY OF SUSSEX.

Prof. J. C. West.

Prof. J. C. West, at present Professor of Electrical Engineering in Queen's University of Belfast, has been appointed Professor of Engineering and Dean of the School of Applied Sciences in the University of Sussex. As Dean of the School of Applied Sciences in the new University of Sussex, Prof. West is eager to introduce undergraduate courses differing significantly from the traditional specialized subjects, and one of his first tasks is the specification of new buildings for Engineers, the third time he has performed this operation.

FIBRE SCIENCE IN THE UNIVERSITY OF LEEDS

Prof. A. Robson.

Dr. A. Robson has been appointed Professor of the Fibre Science in the Department of Textile Industries in the University of Leeds as from September 1st. He was awarded a Ph.D. degree in 1949, and in the Autumn of that year he joined the staff of the Wool Industries Research Association at Torridon, Leeds, as senior scientific officer; latterly he has been Head of the Fibre Chemistry Department. Dr. Robson will retain responsibility for the direction of a new research project on which he and his colleagues at the Wool Industries Research Association are at present engaged, and which is also sponsored by the United States Department of Agriculture.

MEDICAL BIOCHEMISTRY IN THE UNIVERSITY OF MANCHESTER

Prof. D. S. Jackson

Dr. D. S. Jackson has been appointed to be the first holder of the Chair of Medical Biochemistry in the University of Manchester.

EXPERIMENTAL PSYCHOLOGY IN THE UNIVERSITY OF SUSSEX.

Prof. N.S. Sutherland

The progress of the behavioural sciences in Britain will be natably furthered by the establishment of a Chair of Experimental Psychology at the University of Sussex and the appointment of Dr. N.S. Sutherland to it.

Continued/..........

UNIVERSITY NEWS

LEEDS

Dr. G. W. Johnson has been appointed lecturer in the Department of Metallurgy. Mrs. J. Tough has been appointed lecturer in the Institute of Education.

LONDON

The following titles have been conferred: Professor of Metallurgical Chemistry, on Dr. C. B. Alcock, in respect of his post at the Imperial College of Science and Technology; Professor of Rural Economy, on Dr. G.P. Wibberley, in respect of his post at Wye College; Professor of Histology, on Dr. F.R. Johnson, in respect of his post at the London Hospital Medical College; Professor of Embryology, on Dr. P.H. Spencer-Silver, in respect of his post at the Middlesex Hospital Medical School; Reader in Biophysics, on Mr. D.K. Hill, in respect of his post at the Post-Graduate Medical School of London; Reader in Haematology, on Mr. J.G. Humble, in respect of his post at Westminster Medical School.

SHEFFIELD

Professor R.S. Waters, Professor of Geography in the University of Canterbury, New Zealand, has been appointed to a Chair of Geology.

BATTERSEA COLLEGE OF TECHNOLOGY

Battersea College of Technology, in anticipation of the granting of University status, has conferred the title of Professor on the following heads of Departments: Dr. F.M. Arscott (mathematics); Dr. L.R.B. Elton (physics); Dr. V.S. Griffiths (spectroscopy and chemical physics); Dr. Z.S. Makowski (civil engineering); Dr. J.E. Salmon (chemistry); Dr. S.R. Tailby (chemical engineering). A petition is in preparation for presentation to H.M. The Queen in Council for a royal charter incorporating the University, which it is hoped may be entitled the University of Surrey.

PHYSICAL CHEMISTRY IN THE UNIVERSITY OF OXFORD

Prof. R.E. Richards, F.R.S.

On October 1st, Dr. R.E. Richards will succeed Sir Cyril Hinshelwood as Dr. Lee's Professor of Chemistry at Oxford.

Continued/.............

UNIVERSITY NEWS

LONDON

Dr. A. Betts, University lecturer at the School of Veterinary Medicine, Cambridge, has been appointed to the Chair of Veterinary Microbiology and Parasitology at the Royal Veterinary College. Dr. J. Edelman, Reader in Enzymology at the Imperial College of Science and Technology, has been appointed to the Chair of Botany at Queen Elizabeth College. Dr. W.W. Schwabe, a member of the staff of the Agricultural Research Council Unit of Plant Morphogenesis and Nutrition at Wye College, has been appointed to the Chair of Horticulture at that College from October 1st, 1965.

WATS ON

SEPTEMBER, 1964.

T.S.M. No. 18

R.

LOW POWER MICROSCOPY

(Some notes on the instrumental aspects of non-stereoscopic low power microscopy and on the merits of special purpose equipment)

1) For many years high power microscopes have been available with very low power objectives to extend their range. Until recently these have been of two kinds,

a) simple doublet or triplet Achromats.

b) 'thick' lens arrangements with higher apertures typified by the WATSON Holoscopic range.

Type (a) objectives are inexpensive and quite satisfactory as searching objectives only.

Type (b) objectives have very high aperture and tend to have excessive field curvature. Their usefulness was doubtful as similar results could be obtained with shorter focal length Achromats and lower power eyepieces. With both types the lowest power that can be parfocalled with higher power objectives is about x 4 (x 3 with new 45mm. parfocal distance) and about 2.5 with the usual 1" of focusing movement. The range of focusing movement required increases rapidly as the magnification is reduced.

2) The recent rapid growth of the Stereo market is meeting the demand for low power microscopy of three dimensional objects but these instruments are not suitable for the critical examination or photography of flat specimens in the magnification range (x5 to x 50), mainly because of inadequate aperture and illumination difficulties.

3) The important applications are:-

a) the examination and photography of large microtome sections (Pathology, Histology, Vetinary Science etc.)

b) industrial applications (by transmitted and incident light) including micro circuitry - planar silicon technology - micro printing and surface finish of flat specimens.

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4) There appear to be two different solutions to this requirement; one can either make a more serious attempt to extend the range of standard microscopes downward in magnification by developing suitable objectives and illuminating systems as accessories or one can develop a new instrument for low power work only. Zeiss (Western Germany) have tackled the first solution and now offer objectives for their photomicroscopes down to x 1. Flat field Achromatic objectives have been developed (x 1, x 2.5, x 4, x 6.3, x 10) with built-in transverse colour so that they can be used with the standard (Compensating) eyepieces and the lower powers are telephoto lenses so that they are parfocalled. The method of illuminating the lowest powers is not described in the literature. Reasonable photographs can be taken except that the telephoto objectives cannot be used with vertical illumination.

5) The alternative solution should be seriously considered. The following considerations lend support to the concept of a separate instrument for low power work.

a) by departing from the standard eyepiece tube diameter a larger field lens can be used enabling an objective lens with any given focal length to be used to cover a larger field.

b) Compensating eyepieces need not be used.

c) the stage requirements are quite different from those of the high power microscope - faster movements and longer travels are required.

d) by using a longer parfocal distance the necessity to employ telephoto objectives might be removed.

e) the requirements of the illuminating systems are quite different:-

Illuminator requirements	High power microscope (x 50 to x 1000)	Low power microscope (x 5 to x 50)
Range of field diameters.	2.5mm. to 0.1mm.	25mm. to 2.5mm.
Range of apertures (for 2/3 cone illum.)	0.1 to 0.85 N.A.	0.02 to 0.15 N.A.

6) It has been suggested (by Dr. H.H. Hopkins) that a low power microscope could be based on a zoom lens system. The main function of this microscope would be to give top quality photomicrographs without field curvature or distortion. The zoom is attractive but we should not compromise the performance in order to have zooming.

7) Comments are invited on the market and application of such an instrument from the Sales Department and on the feasibility from the Technical Department.

WATS ON

SEPTEMBER, 1964.

T.S.M. No. 19

U.C.

THE STAR TEST FOR MICROSCOPIC OBJECTIVES

By A.C. Coles, M.D., M.R.C.P., D.Sc., F.R.S. Edin.

Reprinted from the "Microscope Record"
January, 1926 No. 7.

The ordinary method of testing Objectives adopted by most amateurs is to compare the image given by one lens with that given by another, on some object known to the observer, usually a Diatom or Bacteria being used as the Test Object.

In skilled hands this gives a good general idea of the quality of the object glass, but with unskilled workers there are many pitfalls. To my mind the greatest difficulty is in determining the correct tube length at which each Objective must be worked.

When an Objective is made, it is corrected for a special tube length, which is usually engraved on the mount, but that tube length is only correct for the special object and cover glass thickness which the manufacturer uses, and speaking generally, it will be found that that particular tube length will not be precisely the same for another object which may be examined.

Now the question of correct tube length is the most important point in the whole of Microscopy, and it is absolutely essential to have learnt that before any lens can be tested, or before the best can be got out of any Objective.

Give me two Objectives, say a 1/6-inch, one a superb Apochromatic, the other a very inferior Achromat, of the same power, and I will show you, on the same object, with the same illumination, the same eyepiece, a better image with the inferior lens used at its correct tube length, than can be produced by the fine lens at a wrong tube length.

I have always maintained that it was not possible to properly test an object glass until one has mastered the determination of the tube length.

Another important point is that an Objective cannot be effectively tested unless it is illuminated with a Condenser of nearly the same Numerical Aperture as the Object Glass, and that means that for the examination of an Oil Immersion Lens it is necessary to use an Oil Immersion Condenser.

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But, after all, this method of testing is only a comparative one, it shows merely that under favourable conditions one lens gives a better picture than another, or the observer thinks it does. In other words, it is a subjective test, depending very largely on the skill, sensitiveness, or training of the observer's eye. What we want is an objective test, something tangible and definite, a test over which there can be no difference of opinion. The manufacturer uses such an objective test, and by this means ascertains precisely what error is present, and corrects it.

The Star Test.

This is the examination of a brilliant spot of light on a dark or black ground, and it has been in use for many years for testing the Object Glass of Astronomical Telescopes. (H. Dennis Taylor has written an excellent brochure on testing Telescopes, which contains a series of beautiful photographs showing the star rings. It is published by Cooke and Sons of York.)

Its application to the testing of Microscope lenses is somewhat new to me, but I find it by far the best method of examining Objectives, and not only is it a most fascinating study, but it is a fine education on the difficult question of determining the correct tube length which will prove of immense value in the ordinary work with the Microscope.

The only requisite is a slide with a silver film deposited either on the cover glass or slip, which can be obtained from W. Watson & Sons, Limited. The denser and more uniform the film, the more brilliant will be the image.

Place such a slide on the Stage of the Microscope, remove any colour screen, and after centreing the Condenser, focus the edge of the flame of an ordinary paraffin lamp.

Experience shows that a small difference of performance can be detected according to the illuminant used; difference in the tube length of the order of 5mm. being found to be necessary between an incandescent gas mantle and an ordinary electric lamp with obscured bulb. This is probably due to the colour of the light. If the Objective is computed for say, yellow green, the wave length .5555 μ, and used with a source of light which is, say, more towards the red end of the spectrum, there must be a slight error perceptible.

It is well, at first at least, to examine a dry lens, say a $\frac{1}{5}$-inch. With a low Eyepiece, hunt for a small round brilliant spot of light in the film, experience soon tells one the best size to pick for each Objective. Replace the low by a high Eyepiece.

1) Test for Tube Length and Spherical Aberration. - Examine the brilliant spot of light above and below the focus. If a series of beautiful rings are seen on focussing downwards which disappear or diminish

on focussing above the correct focus, this indicates there is Spherical Aberration present, in this case, the lens is under-corrected. Lengthen the tube of the Microscope until the rings above and below the exact focus are equal, and that point is the correct tube length for that Objective when used on that slide with that particular Eyepiece. The rule is: rings downwards, lengthen the tube; rings upwards, shorten the tube.

It is not always easy to get the exact distance where the rings within and without the focus are equal; as a matter of fact, they are seldom exactly alike, but the more nearly the rings are equal above and below the true focus the better is the Objective, so this is a very sensitive, very simple, and very certain test for Spherical Aberration, and will immediately show which is the better of two lenses, at least, from this, a very important, point of view.

If now a colour screen is used, it will be found that in all probability the tube length requires a little alteration, the less alteration necessary the better is the lens corrected for colour.

Having determined the correct tube length, examine very carefully the spot of light or "star." It should be surrounded by a clearly defined and perfect circle of light - the diffraction ring - at the exact focus and at the correct tube length. The more imperfect or irregular the ring the worse, other things being equal, the Objective.

Still keeping the correct tube length, focus the point of light very slowly downwards and upwards. The star is seen to be surrounded by a series of very beautiful rings, which increase in number, but diminish in intensity, the further from the corrected focus the Objective is placed. These rings should be perfectly circular, perfectly concentric, perfectly spaced, and of about the same brilliancy.

If the rings are not circular, but elliptical, the long axis changing through 90 degrees between the above and below focus position, this indicates that there is Astigmatism.

Putting this into other words; if, when focussing downwards, the rings are not properly circular, but have a bulging towards, say, three o'clock, it will be seen that the bulgin will be towards nine o'clock on focussing upwards.

This, to my mind, is one of the commonest faults, and I sometimes adopt a rather unorthodox method of showing it better, by putting the tube length at a decidedly wrong position, say, as far down as the tube will go, then, on focussing down, the rings are exaggerated and any defect will be more easily seen. If the rings at the correct tube length are circular, but not concentric, the cause is want of Centreing, and, in my opinion, errors in Centreing and Spherical Aberration are by far the most important points to determine in an Objective.

2) Zonal Aberrations, i.e., Spherical Aberration in the different zones or areas of an Objective may also be detected by the Star Test. At the correct tube length, want of zonal correction is shown by excessive inequality of the spacings in the expanded rings above and below the focus.

When there is excessive Zonal Aberration the appearance would be, perhaps, fairly well defined rings on one side of the focus, whilst on the other side there might be a light patch surrounded by a darker band without well-defined boundaries, with two or three moderately-defined rings at the margin.

Another defect which should never be seen in a good Objective is the appearance of a very bright spot or pip in the centre of the expanded rings, for this indicates that one or the other of the surfaces is not truly spherical, or that the computation is at fault.

Defects in the glass of any of the lenses in the Objective, such as veins and striae, will be shown as a smear or streak breaking the continuity of the rings.

The Chromatic Corrections of a lens are not nearly as important as errors in the Spherical Aberrations or want of centreing, but they can be easily seen by the Star Test.

In detecting colour errors, it is well to pick a larger hole or break - "star" - in the silver film, and notice the colour or absence of colour at the exact focus within and without the focus.

With an Achromatic Lens the colour of the marginal fringes above and below focus would be somewhat blue and red. With a Fluorite or Semi-Apochromatic Lens there should be almost complete absence of colour in these fringes.

A Compensating Eyepiece should be used in conjunction with these tests.

It is probable that for a beginner a fine scratch made on the silver film would enable the chromatic correction to be more accurately tested.

There are two or three points which are of importance when examining an Objective by the Star Test.

1) The test is very exacting, which is just what we want, and many really good Objectives will show some slight error, so that one has to get considerable experience before condemning a lens.

2) The size of the brilliant spot or star should, I think, vary. I find it is easier to detect exact tube length when a very small spot is chosen; a somewhat larger star is better when examining the in and out of focus rings; whilst colour corrections are best seen on quite a large hole or break in the silver film, either circular or irregular in outline.

3) The lens which is found the best on the Star Test will prove the best lens on a Diatom or on bacteria, although it may be mentioned the latter is not so severe a test for an Objective as a suitable Diatom.

4) Dennis Taylor's description of a Perfect Astronomical Lens may apply to a Microscope Lens. He says: "Rings perfectly circular in outline, whilst the individual rings grow gradually and regularly stronger and further apart as the outside ring is approached, this outer ring running a little out of proportion, seemingly in its brightness and visibility. Above all, the appearance of the rings should be exactly the same on both sides of the focus."

To Silver a Slide or Cover-glass for Star Test.

1) Clean some slides or cover-glasses so carefully that a drop of water will spread over the surface. This can be done by placing them in strong nitric acid, and then thoroughly wash in running water. The easiest way is to rub the surfaces with whiting made into a paste with water, allowing them to dry, then cleaning with a perfectly clean cloth.

2) Make a 5 per cent solution of Silver Nitrate in distilled water. To part of this add strong ammonia, very carefully, drop by drop, till the precipitate which forms almost, but not quite, dissolves. If the solution is quite clear it shows that too much ammonia has been added, therefore add a few drops of the silver solution till it produces a faint turbidity, which does not disappear on shaking.

3) Make a solution of Rochelle Salt (sodium potassium tartrate) about 25 grains to 1 ounce of distilled water.

Take equal quantities of (a) the ammonio-silver solution, (b) the solution of Rochelle Salt, and (c) distilled water; mix thoroughly.

Pour this mixture over the clean slides, or if it is preferred, over the cover-glasses. As there may be some deposit, it is best to put this mixture into a plate or on a curved piece of glass, and place the slides on the surface of the solution. Allow them to stand for two or three hours, or overnight; the longer time gives a denser film.

Wash and allow to dry very thoroughly.

One surface of the slide should be coated with a beautiful film of silver, but for our purposes this will not give a suitable film for a star image. When the film is absolutely dry it should be polished with the dry finger or a clean piece of chamois leather, with or without a little rouge.

The film when now examined under the microscope may show several scratches, but in parts at least it should show minute holes of varying sizes. Choose the most opaque and clean part: place a drop of Canada Balsam on that, and cover with a clean cover-glass.

16th September, 1964.

REPORT ON WATS ON QUIZ NO. 1

We were disappointed that only one reader attempted this quiz but can understand that the representatives are very busy on more important matters at present. However, we would welcome any comments as to whether it was too easy, too difficult or just a downright waste of time.

The entry we did receive was a valiant attempt from one who is not in possession of the tables on the G.K.N. tester or as familiar with the W.I.S.E. as some of us. There was some disagreement about the Historical Section - our own answers are based on the authority of George Herbert Needham and were taken from his book "The Practical Use of the Microscope". In the Medical Section we allowed PNEUMOCONIOSIS which appears to be a perfectly correct alternative to PNEUMONOCONIOSIS. In Section V we gave the integrated transmission of the OGR1 filter as 22% in accordance with the published Chance figures but our entrant calculated the answer on the basis of a x 6 factor which is published in the Watson leaflet on the Weston Master Meter. We allowed this but are at present trying to discover which is correct. We certainly hope that our solution to the last question is comprehensible - please let us know if you can't understand it or disagree with it. The important point is that the large particles contribute far more to a weight distribution and that as only 8 particles were counted in group 2, each particle representing about half a percent of the total weight, there is room for considerable inaccuracy here.

Congratulations to Mr. Casartelli who will receive a book token for 15/-.

16th September, 1964.

WATS ON - QUIZ NO. 1

ANSWERS

SECTION 1 (HISTORICAL)

	Dates	Inventors	Inventions
1)	1782	J. RAMSDEN	Eyepiece with flat field.
2)	1829	J.J. LISTER	Crown & Flint Achromats.
3)	1851	C.A. SPENCER	Fluorite objectives.
4)	1886	E. ABBE	Apochromatic objectives, with Comp. eyepieces.
5)	1932	F. ZERNIKE	Phase Contrast.

SECTION 11 (MEDICAL)

1) CYTOLYSIS
2) PATHOLOGY
3) HISTOLOGY
4) PNEUMONOCONIOSIS
5) LEUKOCITE

SECTION 111 (FOREIGN MANUFACTURERS)

1) Carl Zeiss Instruments
2) Degenhart Limited
3) ASeQ or Negretti & Zambra or D.R. Grey.
4) Light Filters Limited.
5) Shandon Scientific Co. Ltd.

/Contd ...

SECTION IV

1) WATSON
2) BECK
3) ZEISS (Western Germany)
4) LEITZ
5) LEITZ
6) BECK
7) WATSON

SECTION V

1) Answer : N.A. = .09

let d = diameter of lens

let F = its focal length

now the f: number is defined as F ÷ d

and for small apertures the N.A. is approximately equal to $\frac{d}{2} \div F = \frac{1}{2 \times f\text{: number}}$

2) Answer : 1 second.

To allow for the slower film we must extend the exposure in the ratio 3000 : 200 i.e. x 15. To allow for the green filter we would extend the exposure by 100 : 22, i.e. x 4.5, but the polaroid film is insensitive to the red so the exposure is probably reduced by less than x 4.5, say 3.5.

$$\text{required exposure} = \frac{1}{50} \times 15 \times 3.5 \simeq 1 \text{ second.}$$

3) Answer : 2.4 microns

Magnification at negative was 90 x 20 x $\frac{1}{3}$ = x 600

10" = 254 mm.

The long side of the 35mm. frame = 36mm.

The magnification of the enlarger = 254 ÷ 36 = x 7

Overall magnification was 600 x 7 =x4,200

$$\text{Bacterium was } \frac{10}{4,200} \text{ mm.} = \frac{100}{42} \text{ microns} = 2.4 \text{ microns.}$$

4) Answer : D.P.N. = 25

The diagonals of the image measured 5.52 - 4.17 = 1.35 mm.
and 5.19 - 3.82 = 1.37 mm.
'mean' = 1.36 mm.

Primary magnification was x 50

So that the diagonal of the indent was 1.36 ÷ 50 mm.
= 27.2 microns

From the D.P.N. Tables enter page for 10 g. loading for 27.2 microns D.P.N. = 25.1.

(If no Tables were available the result could have been calculated from the definition of D.P.N., which is,

$$D.P.N. = \frac{2\ P \sin \theta}{D^2}$$

where θ is the half angle of the diamond = 68°

P is the load in Kilograms

D is the diagonal in mm.)

5) The calculation has been performed and laid out in tabular form below - the quantities tabulated in each column are as follows:-

COL.		SYMBOL
1.	The objective used for each class	
2.	The critical size to which the W.I.S.E. was set for each class. This is the smallest diameter of each class.	d min.
3.	The total number of particles counted with diameter greater than d min.	N
4.	The area of the counting square.	Δ A
5.	The number of fields (squares) counted.	n
6.	The total area counted for each class = Δ A x n	A
7.	The number density (No. per mm^2) with greater diameter than d min = N ÷ A	$\frac{N}{A}$
8.	The number density in class. This figure is obtained by subtracting from each value in Col. 7 the previous value.	

9. The weight factor (proportional to cube of diameter). Starting from the smallest class the diameters double for each class so the weights can be assumed to increase 8 times for each class. We therefore use factors 1, 8, 64, 512.

10. Weight distribution - the number distribution is multiplied by the appropriate weight factors to give a weight distribution.

Finally we can express the weight in group d min = 5 microns as a proportion of the total.

1 Objective	2 d min (microns)	3 N particles	4 ΔA mm^2	5 n fields	6 $A = n\Delta A$ mm^2	7 N/A	8 Number Distribution in class	9 WT. factor $\propto d^3$	10 Weight Distribution
16 mm.	40	0	.0484	20	0.968	0	0	-	0
"	20	8	.0484	20	0.968	8.26	8.26	512	4,240
"	10	356	.0484	30	1.45	246	238	64	15,400
4mm.	5	284	.001024	30	.0307	9,260	9,015	8	72,120
4mm.	2.5	398	.001024	30	.0307	12,950	3,690	1	3,690
								TOTAL :	95,450

$$\text{proportion in 5 - 10 micron class} = \frac{72{,}120}{95{,}450}$$

$$= 75.7\%$$

<u>Answer:-</u> Insufficient evidence to reject specimen.

To improve accuracy, more fields must be counted in group 2 (critical size 20 microns).