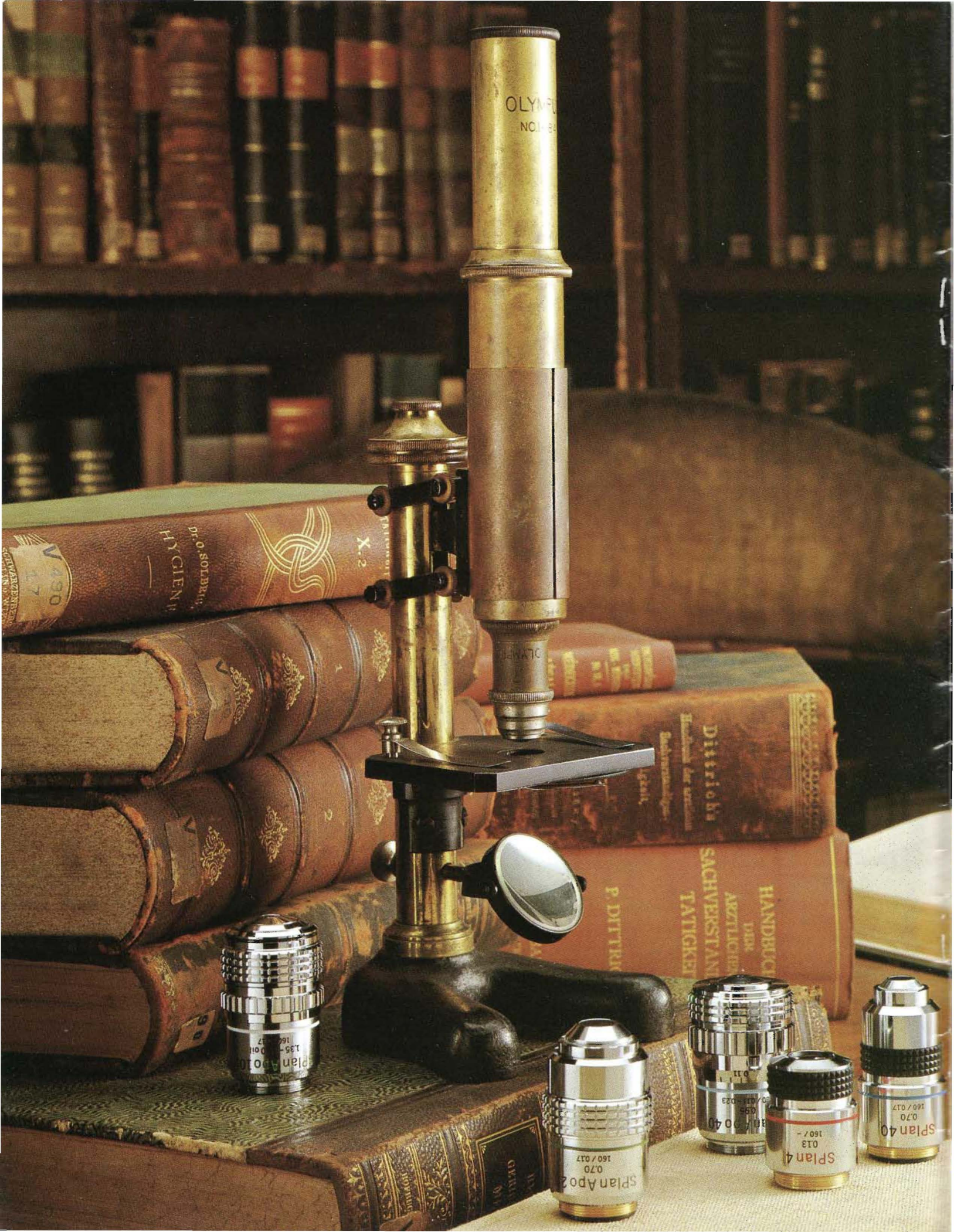
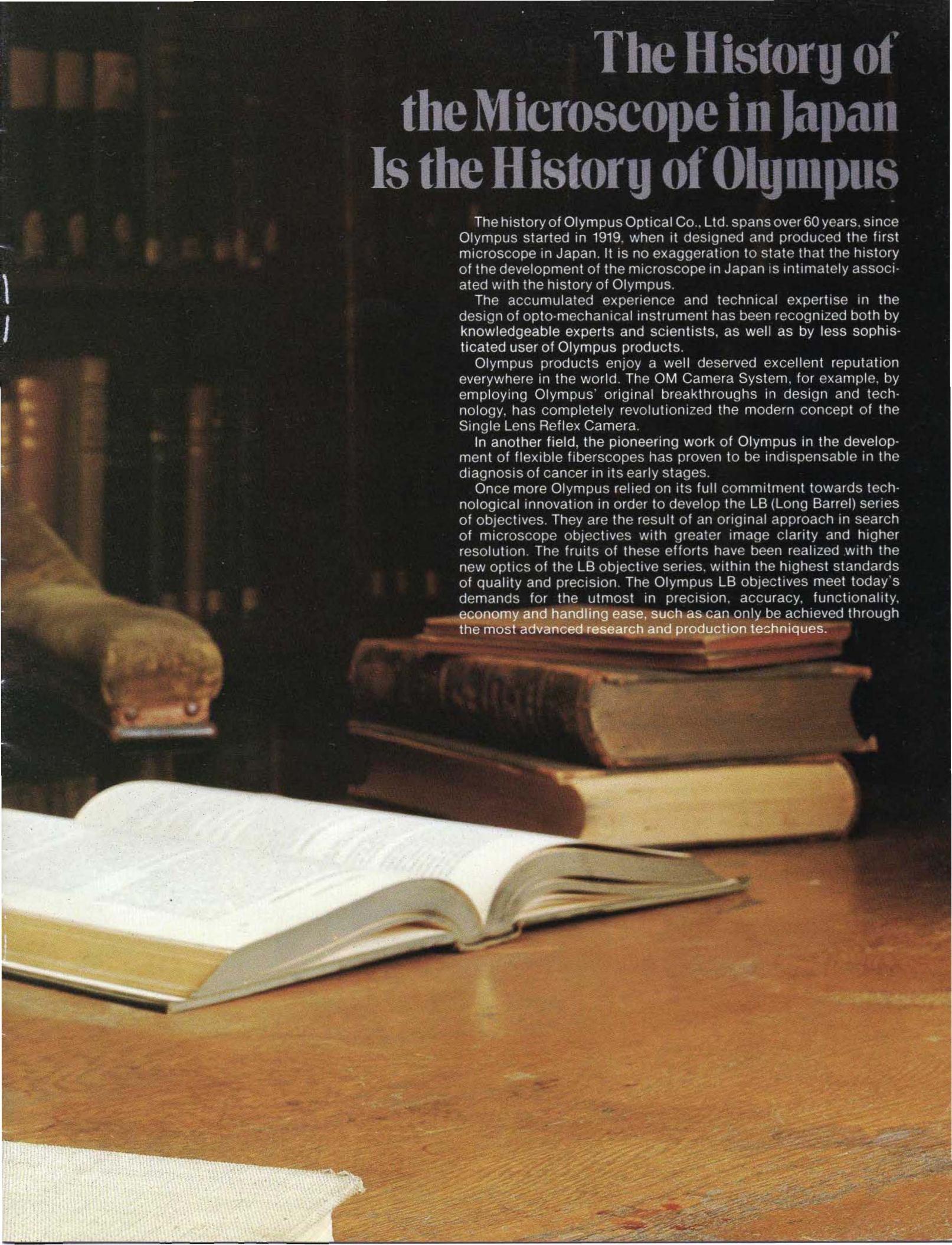
OLYMPUS®

LB-OBJECTIVES




Dr. O. SOLBRIG
HYGIENE
Dittrich's
HANDBUCH
DER
ARZTLICHEN
SACHVERSTAN
TATIGKEI
SPlan Apo 2
0.70
160 / 0.17
SPlan 4
0.13
160 / -
SPlan 40
0.70
160 / 0.17



The History of the Microscope in Japan Is the History of Olympus

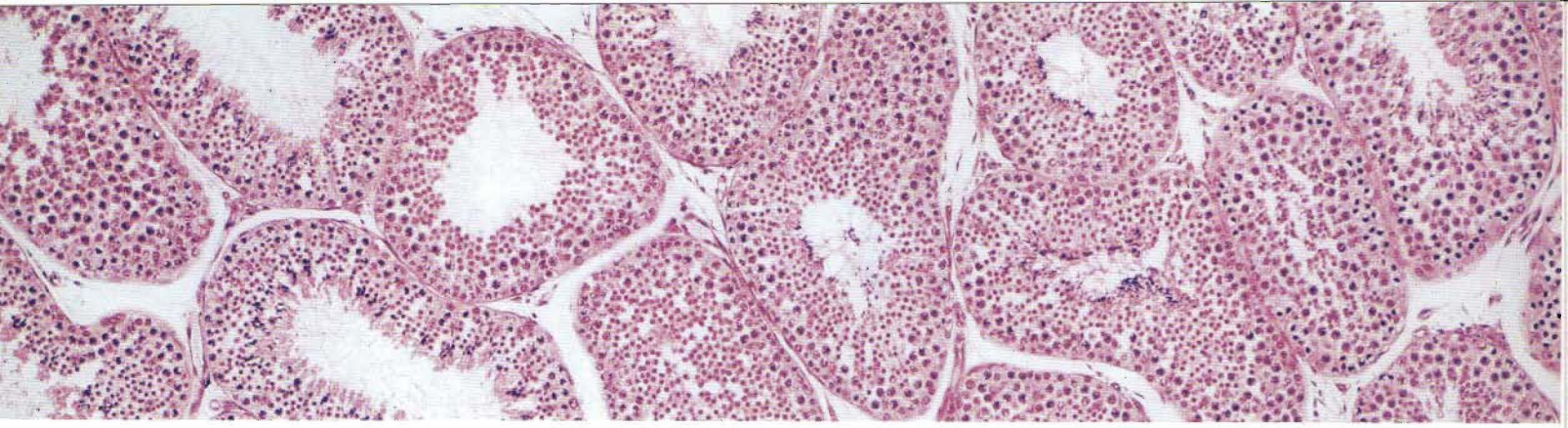
The history of Olympus Optical Co., Ltd. spans over 60 years, since Olympus started in 1919, when it designed and produced the first microscope in Japan. It is no exaggeration to state that the history of the development of the microscope in Japan is intimately associated with the history of Olympus.

The accumulated experience and technical expertise in the design of opto-mechanical instrument has been recognized both by knowledgeable experts and scientists, as well as by less sophisticated user of Olympus products.

Olympus products enjoy a well deserved excellent reputation everywhere in the world. The OM Camera System, for example, by employing Olympus' original breakthroughs in design and technology, has completely revolutionized the modern concept of the Single Lens Reflex Camera.

In another field, the pioneering work of Olympus in the development of flexible fiberscopes has proven to be indispensable in the diagnosis of cancer in its early stages.

Once more Olympus relied on its full commitment towards technological innovation in order to develop the LB (Long Barrel) series of objectives. They are the result of an original approach in search of microscope objectives with greater image clarity and higher resolution. The fruits of these efforts have been realized with the new optics of the LB objective series, within the highest standards of quality and precision. The Olympus LB objectives meet today's demands for the utmost in precision, accuracy, functionality, economy and handling ease, such as can only be achieved through the most advanced research and production techniques.



Characteristics of the new LB Objectives

1 Excellent resolution

The resolving power is the reciprocal of the resolution, and refers to the minimum distance at which two minute dots in a specimen can clearly be distinguished. This is expressed by the following formula in which λ is the

$$\text{Resolution: } \delta = 0.61 \times \frac{\lambda}{\text{N.A.}}$$

wavelength, and N.A. is the numerical aperture of the objective.

The above fomula was first suggested by Lord Rayleigh. As shown in the formula, it is necessary to increase the N.A. (numerical aperture) in order to increase the resolving power. Olympus went back to this theory in designing the new LB objectives and increased the numerical aperture, as shown in the table below.

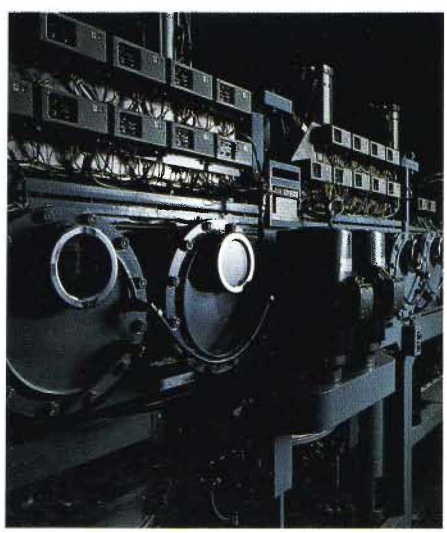
		Numerical aperture	
		LB objective	Conventional objective
S Plan Fl	1X	0.04	—
S plan Fl	2X	0.08	—
S Plan	4X	0.13	0.10
S Plan	10X	0.30	0.25
S Plan	20X	0.46	0.40
S Plan	40X	0.70	0.65
S Plan	100X	1.25	1.25
S Plan Apo	4X	0.16	0.16
S Plan Apo	10X	0.40	0.32
S Plan Apo	20X	0.70	0.65
S Plan Apo	40X	0.95	0.95
S Plan Apo	100X	1.35	1.30

2 Good contrast

Even if definition is good, it is not possible to see well if image contrast is insufficient. It is important to eliminate one by one those factors which exert a detrimental influence upon the image, such as flare.

During the various objective design stages, the lens construction, the different lens radii of the curvature, and the quality of optical glasses, etc., are very carefully weighed. Extensive use of computers is made in calculating the various possibilities.

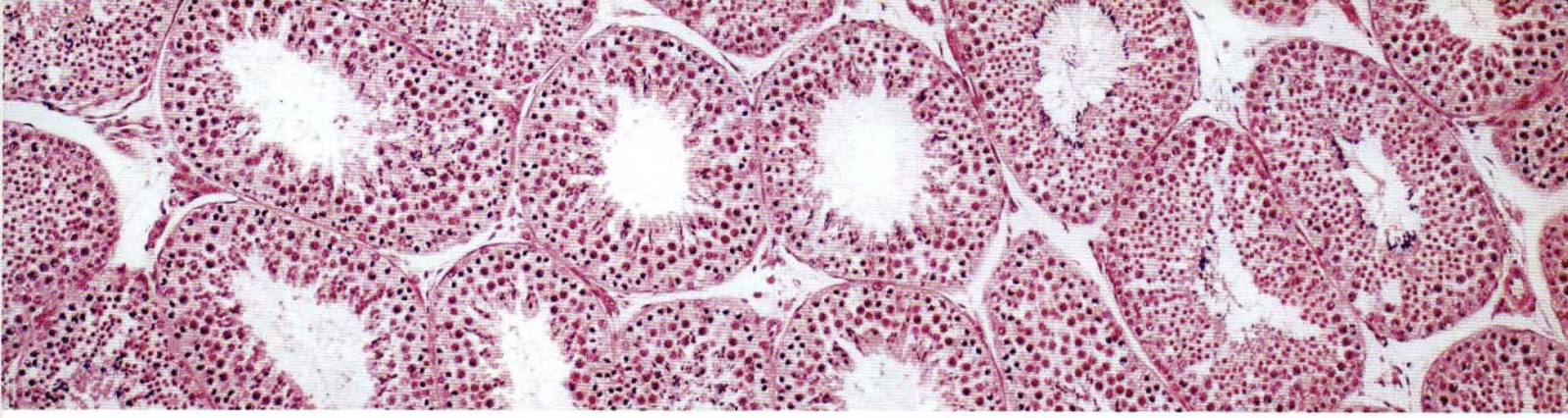
In objective manufacture, a special machine for coating lenses is employed. Multilayer coatings are applied utilizing the latest technology, and lens surface reflections are brought down to a minimum. These are some examples of the efforts which Olympus devoted to the improvement of contrast in the Olympus LB series.



Lens coating machine

3 Outstanding field flatness

The demand for efficiency in photomicrography is growing stricter from day to day, and so is the importance of being able to obtain a clear image throughout the visual field. One of the typical aberrations which exert a detrimental influence upon the image quality is field curvature, which has been thoroughly compensated. Olympus has available the NFK eyepiece series for taking photomicrographs (new photocompensation type), which project a real image on the film.



4

Increased working distance

By increasing the objective working distances, many advantages are obtained, such as the fact that oil in an oil-immersion system does not easily adhere to the dry objective, the ability to mark a specimen detail, and many more.

The increase in objective working distances with the new LB objective series can be seen in the following table.

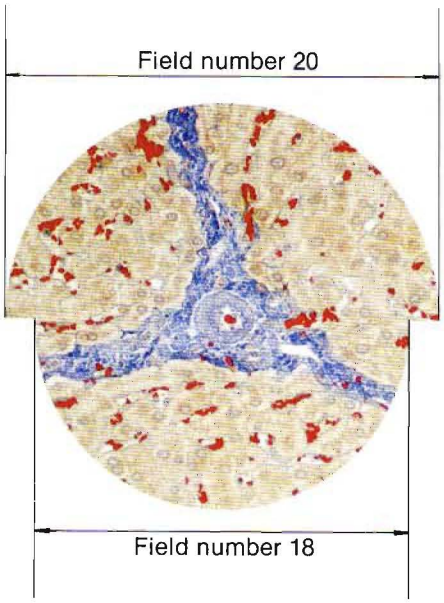
		Working distance	
		LB objective	Conventional objective
S Plan Fl	1X	2.20mm.	—
S Plan Fl	2X	5.50	—
S Plan	4X	15.50	5.50
S Plan	10X	7.50	7.20
S Plan	20X	1.50	0.70
S Plan	40X	0.50	0.22
S Plan	100X	0.17	0.08
S Plan Apo	4X	9.83	4.40
S Plan Apo	10X	2.03	0.20
S Plan Apo	20X	0.55	0.14
S Plan Apo	40X	0.13	0.10
S Plan Apo	100X	0.15	0.08

5

The visual field was increased by 23%

(in conjunction with a WHK10X eyepiece)

With the standard eyepiece WHK10X, ease of operation has been greatly improved. Its field number of 20 yields a visual field 23% larger than the one obtained with conventional systems.



6

The parfocal distance of an extremely low power objective

A conventional objective of extremely low magnification (e.g. 1X, 2X) has a drawback in that, because of its extremely long working distance, it cannot be made parfocal with higher magnification objectives. In order to respond fully to the needs of the market, this problem was solved in the new optical system of LB objectives, because the object distance of the objectives was increased to 45 mm (compared to the conventional object distance of 36.65 mm.)

Olympus Confirms the Advantages of the Compensation Type.

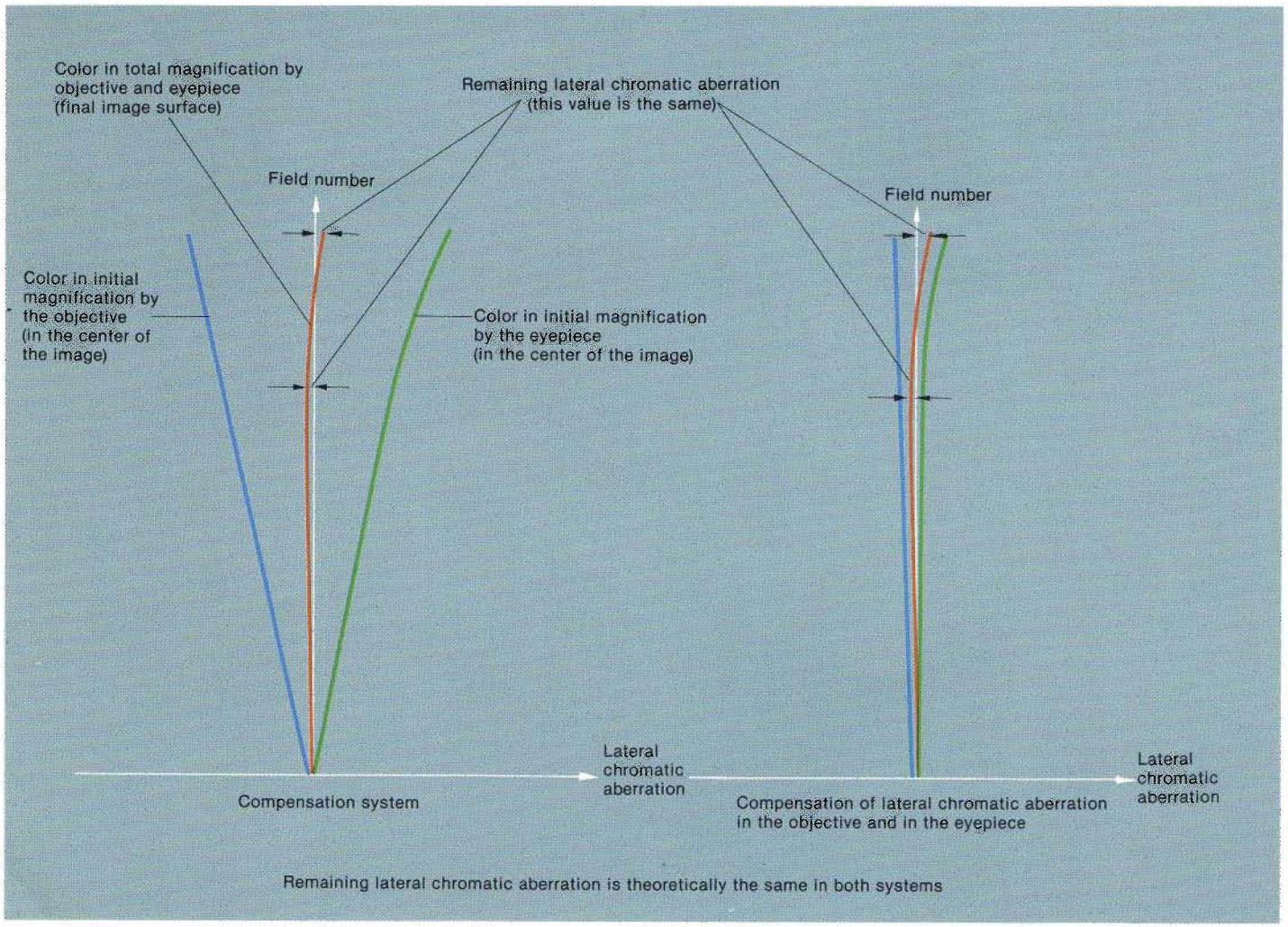
The compensation system VS. **the system of compensating lateral chromatic aberration by means of the objective alone**

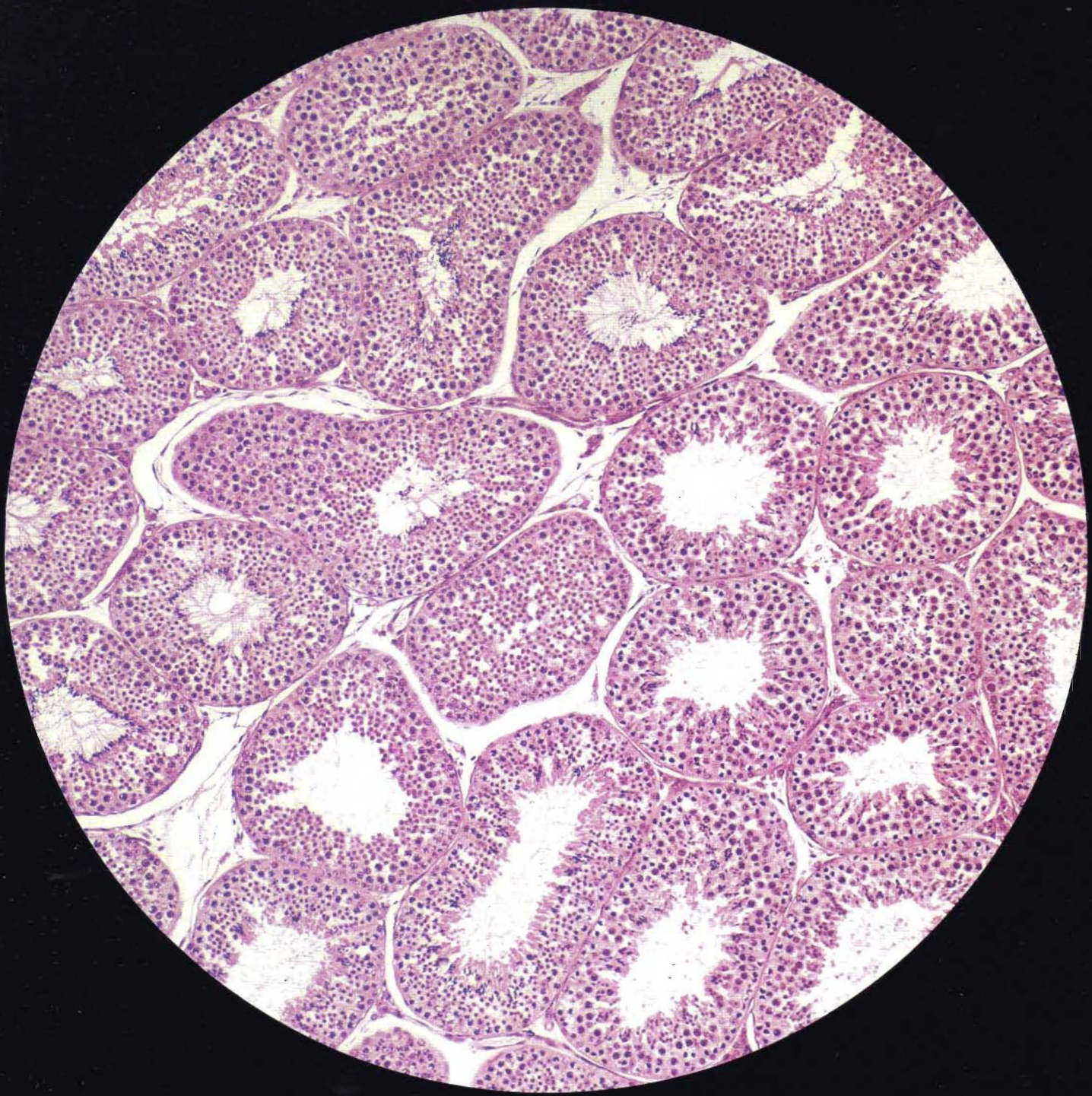
How to best compensate for lateral chromatic aberration has been a subject of discussion for a long time. After intensive investigation, the advantages of the compensation system were confirmed by Olympus in its LB series.

As opposed to the camera objective, the theory that the image magnified by the microscope objective lens is again magnified by the eyepiece has remained unchanged since the early days of the compound microscope in the 16th century.

The system of compensating lateral chromatic aberration in the objective alone has already been applied in some microscopes made in the United States. As shown in the illustration below, the remaining lateral chromatic aberration is theoretically the same as when the compensation system is applied. Only one difference is pointed out in that the field diaphragm of the eyepiece looks like a circle around the visual field, and a little color fringe appears on the periphery of the field diaphragm.

However,there are aberrations such as curvature of field, astigmatism, and others which exert an influence upon the image around the periphery of the visual field. Because the focal distance of the objective is short, its construction tends to cause lateral chromatic aberration, and compensation of other important aberration becomes difficult if the objective alone is compensated without taking all these factors into consideration. This is a very important point for microscopists. With Olympus LB objectives, it has been confirmed that the compensation system, which combines the objective and the eyepiece to compensate lateral chromatic aberration, is far superior, and presents no restrictions as to the compensation of other aberrations. Please note the color photograph on the right covering the entire field of view of a microscopic image.





The sharpness of the center of the image is at its best when resolving power, contrast and chromatic aberration compensation are obtained through a truly superior design. In addition to these factors, the effects of other aberrations such as curvature of field, coma, astigmatism, etc. must be taken into consideration, so that the compensation system can assure image sharpness from the center to the periphery of the visual field, as can be observed in this photomicrograph.

S Plan Achromatic Objectives

Plan achromatic objectives are mainly used in high quality microscopes for biological applications. Improvements in this kind of objective were of prime importance in order to set new standards in microscope performance. The emphasis placed on this aspect of our development activities has been met with widespread acceptance. The S Plan objectives opened the way to many new possibilities, with their larger numerical apertures and longer working distances.

1. Rectal cancer. S Plan 4X, NFK 3.3X

2. The small intestine of a bullfrog. S Plan 10X, NFK 2.5X

3. Human adrenal gland. S Plan 20X, NFK 3.3X

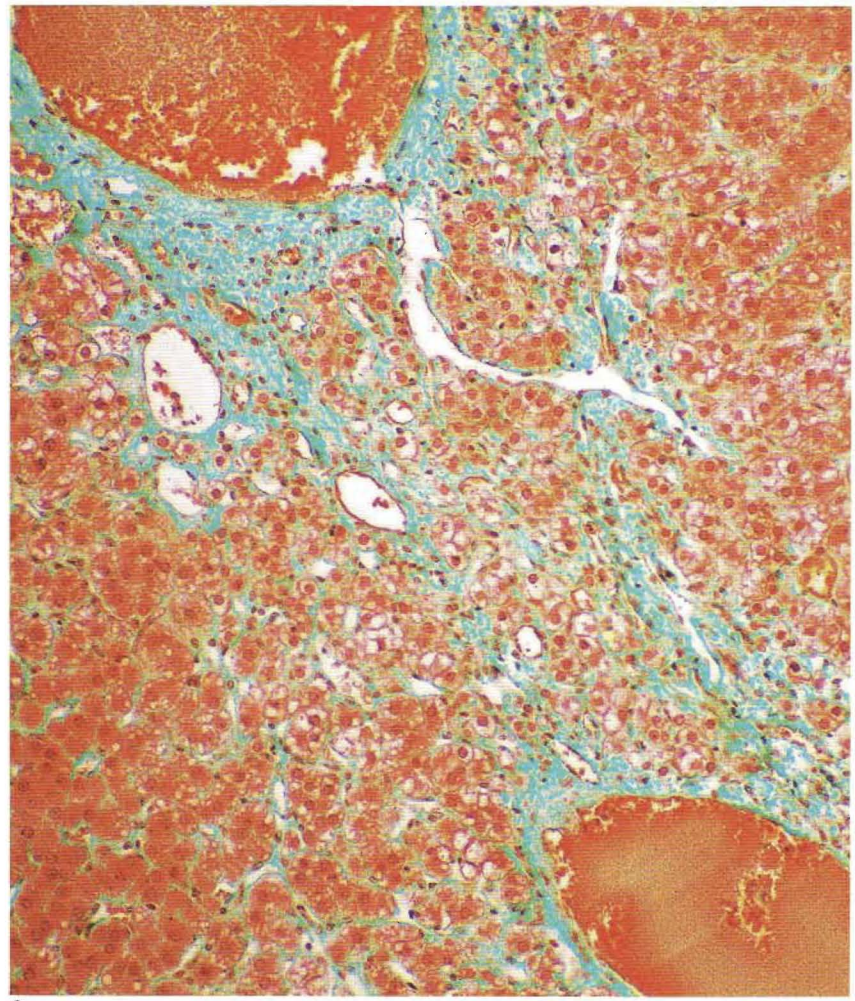
4. Cancer cell in culture medium. S Plan 40X, NFK 3.3X (Differential Interference Contrast Microscopy.)

5. Blood. S Plan 100X, NFK 2.5X





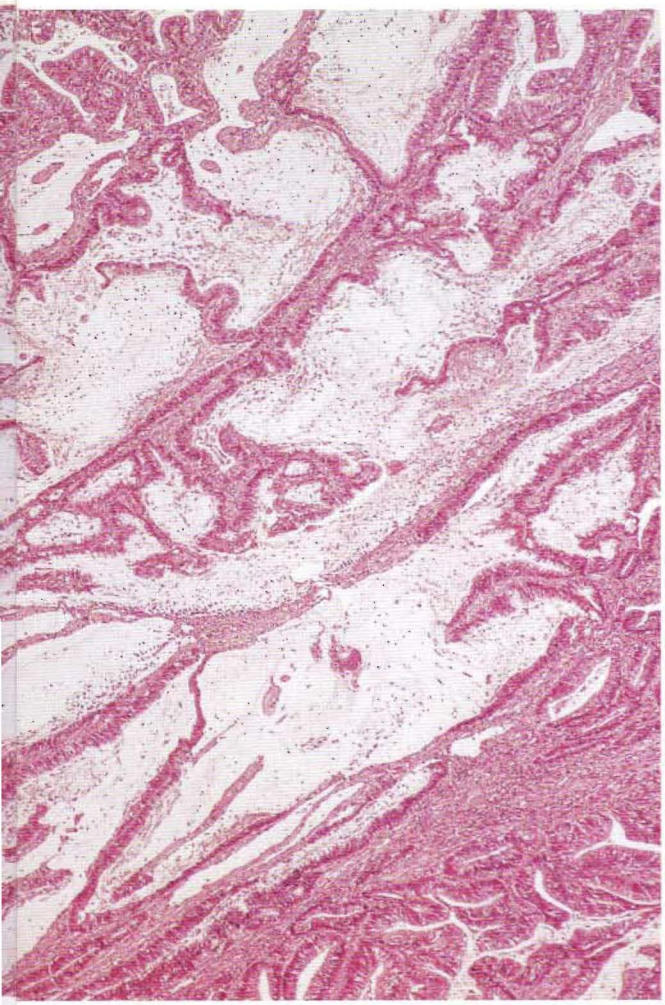
1



3

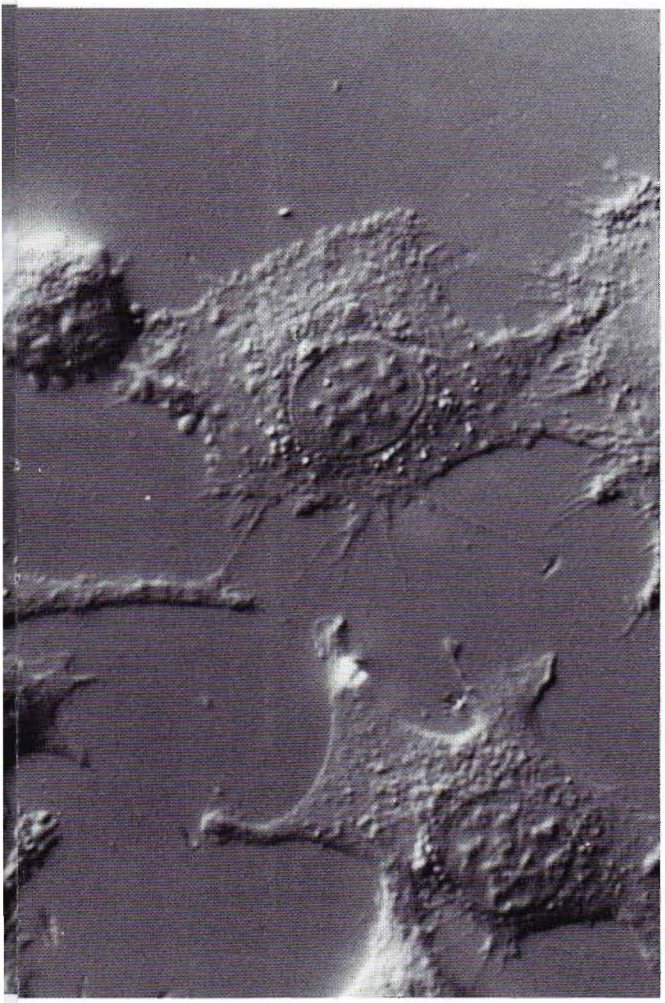


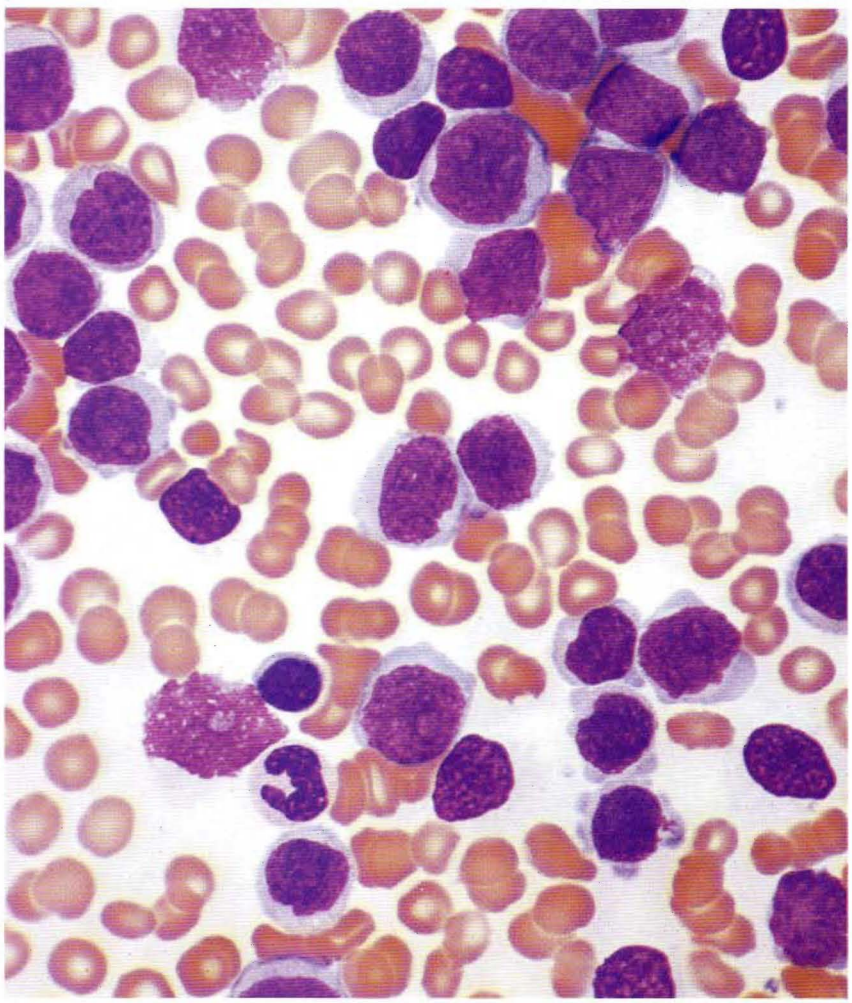
4





2





5

S Plan Apochromatic Objectives

The plan apochromatic objectives compensate for three kinds of chromatic aberration throughout the range of visible wavelengths so that superior resolution and image sharpness can be achieved from the center to the periphery of the visual field. These objectives are of particular importance in photomicrography. These superior quality plan apochromatic objectives were developed by Olympus engineers on the basis of the latest design and production technology, by 60 years of tradition in making the finest optical microscopes.

1. Human spleen. S Plan Apo 4X, NFK 3.3X

2. Mouse liver (leukemia). S Plan Apo 10X, NFK 3.3X

3. Section of human scalp. S Plan Apo 20X, NFK 3.3X

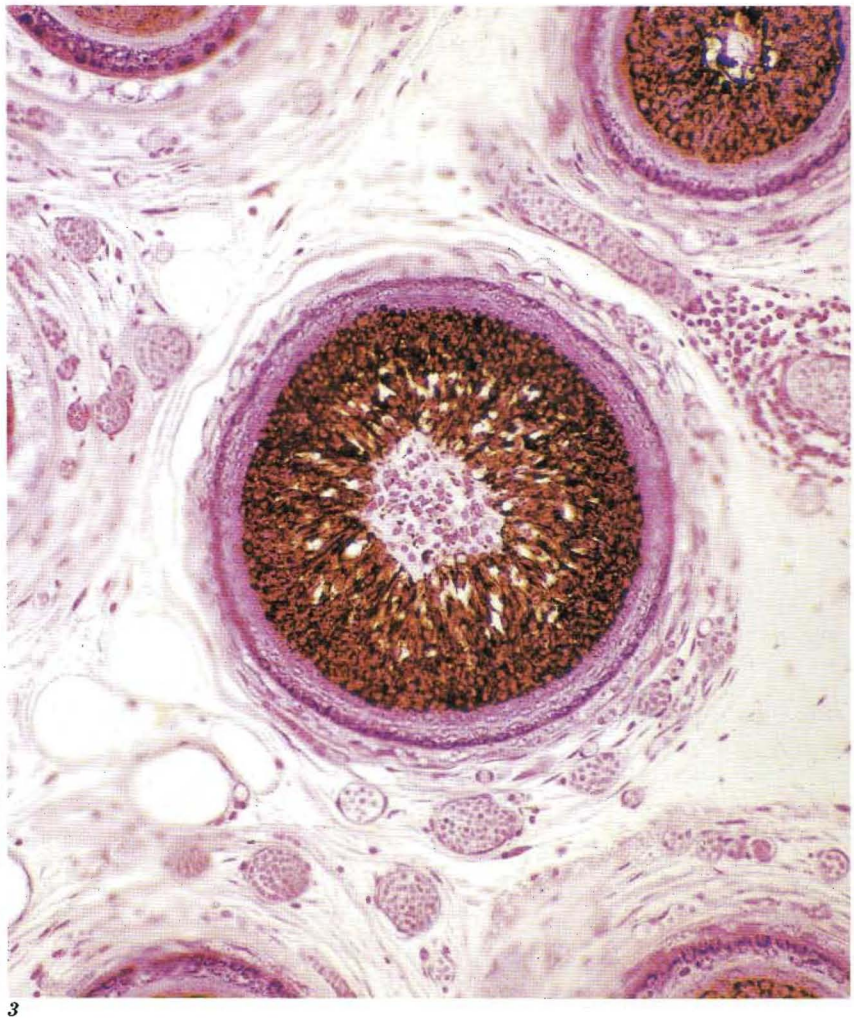
4. Mouse neural tube. S Plan Apo 40X, NFK 2.5X

5. Neutrophilic leucocyte. Human. S Plan Apo 100X, NFK 6.7X

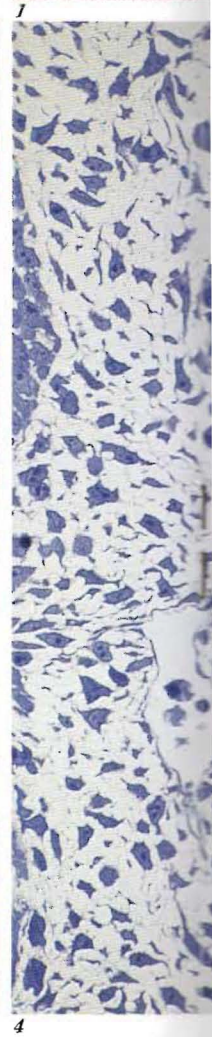




1

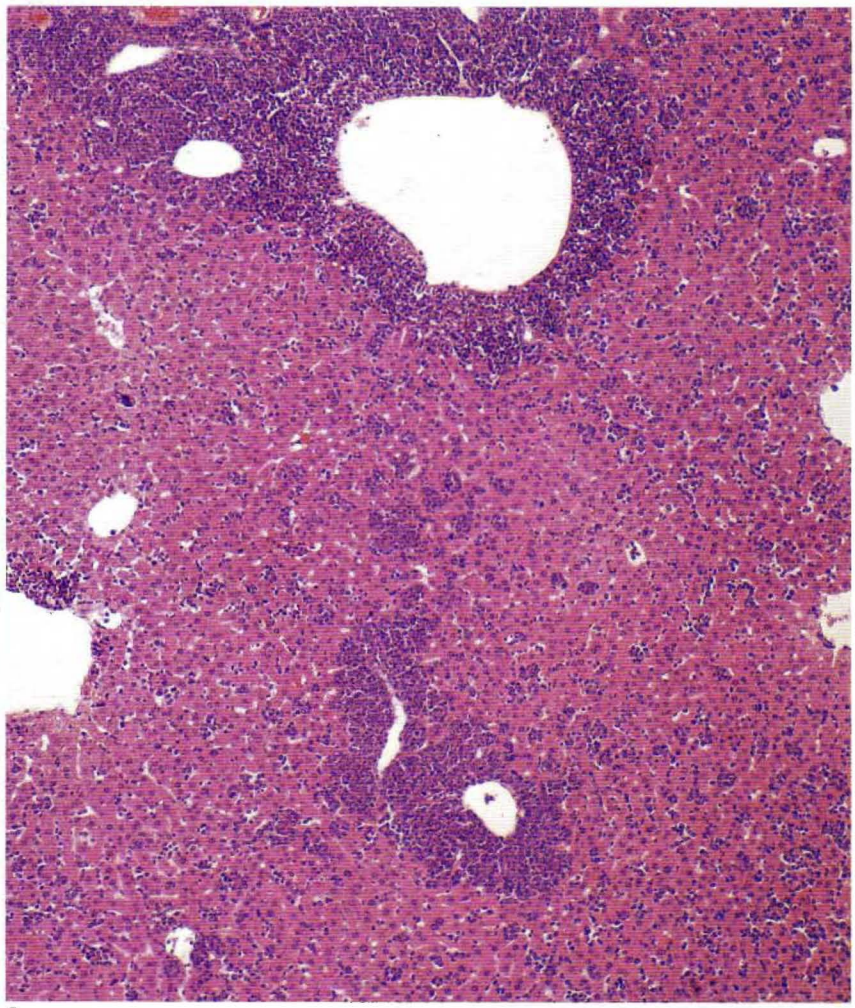


3

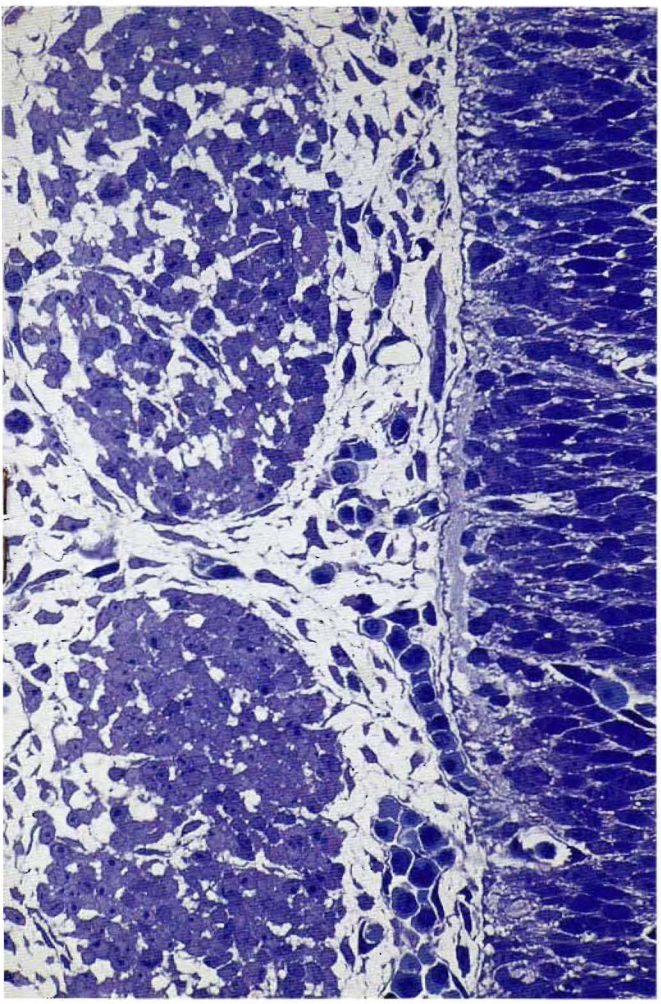


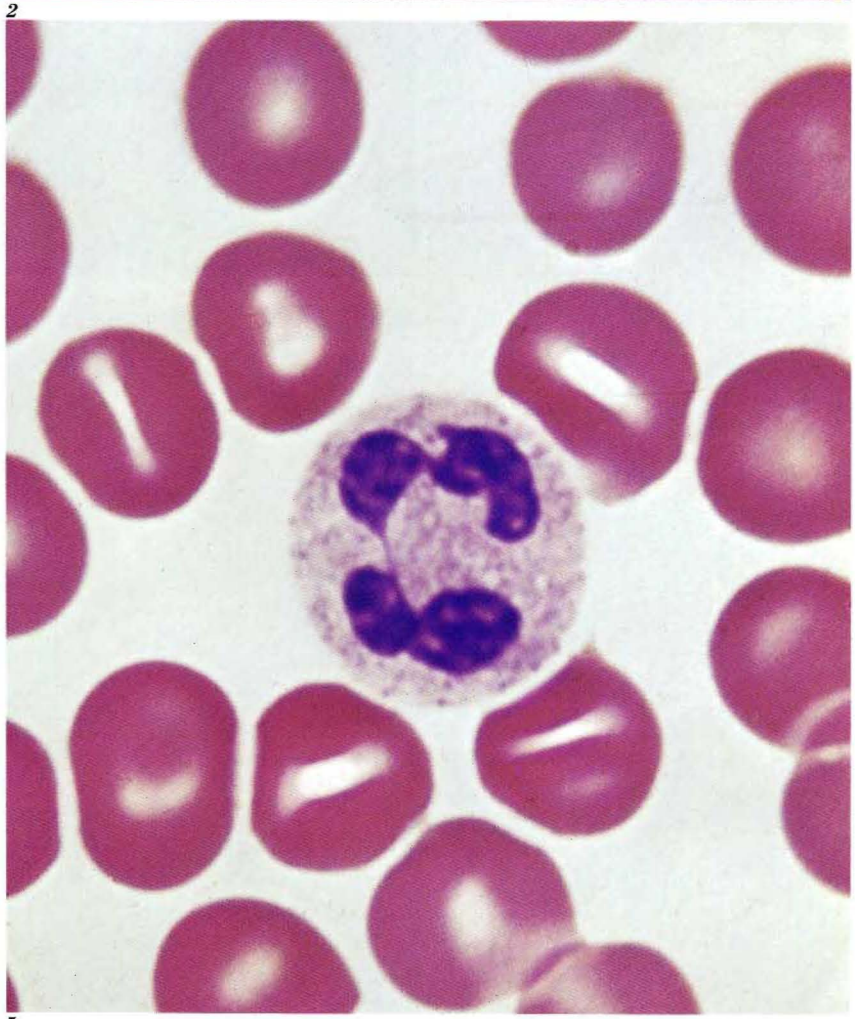
4





2





5

S Plan Fℓ Objectives 1X, 2X

The plan fluorite objectives, also called plan semi-apochromats, yield superior image flatness and excellent compensation for chromatic aberration.

1. Human jejunum. S Plan Fℓ1X, NFK 3.3X

2. Human scalp. S Plan Fℓ2X, NFK 3.3X





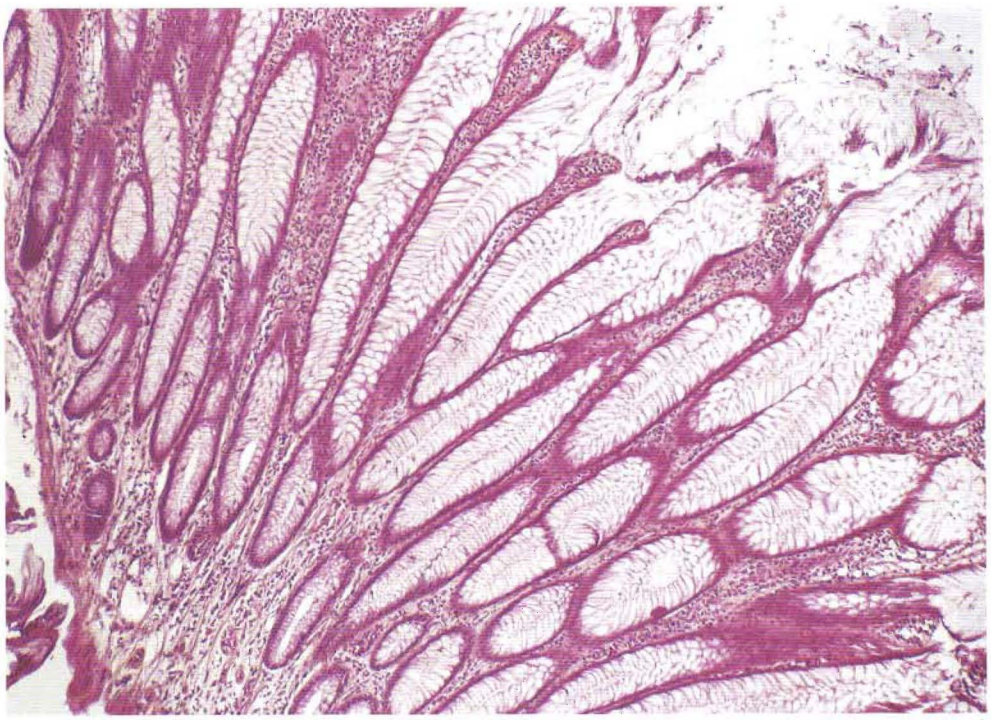
1



2







1

D Plan Achromatic & D Achromatic Objectives

The LB series includes high performance, yet extremely reasonably priced. D Plan Achromatic and D Achromatic objectives in addition to top performance S Plan Apochromatic and S Plan Achromatic objectives. The D series is ideally suited for routine work, especially in a clinical laboratory.

1. Human intestine. D Plan 20X, NFK 3.3X

Phase Contrast Objectives

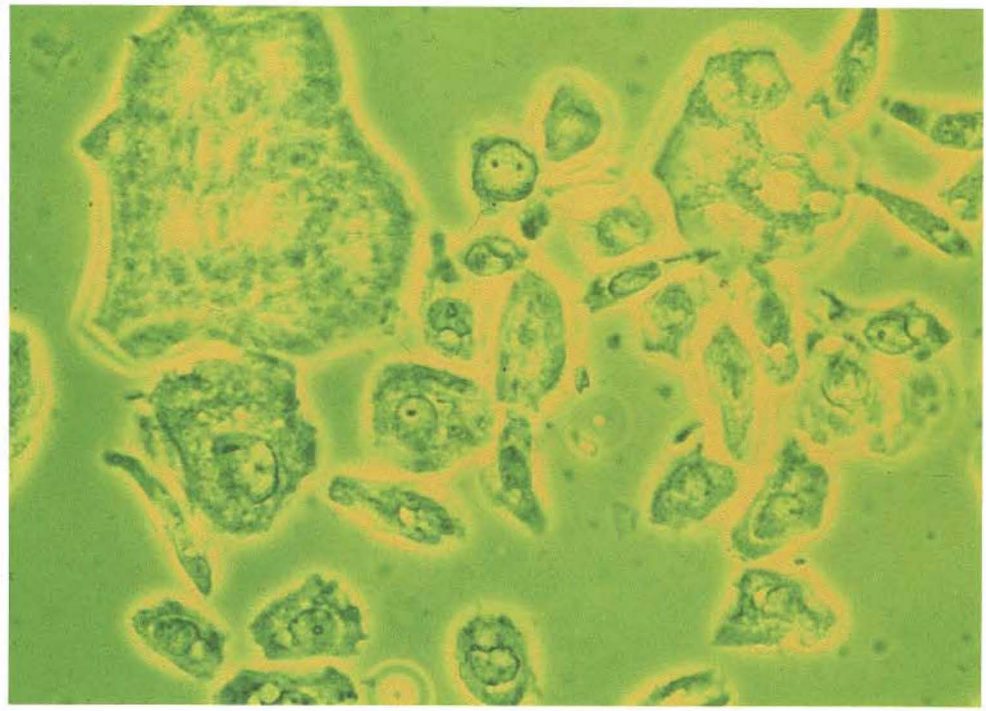
The PC S Plan series incorporates the characteristics of the S Plan objectives in addition to those inherent to the phase contrast objectives for observation in phase contrast within an extra wide visual field. Objectives are available in positive-low (PL) and negative-high (NH) contrasts.

There are also the PC D Ach series of phase contrast achromat objectives. Objectives are available in PL, positive low-low (PLL), NH and negative medium (NM) contrasts.

1. Epithelial cells of urinary bladder. Dog. S Plan 40XPL, NFK3.3X
2. Spermatozoa of newt. D Ach 40X NM, NFK 5X (right)
3. Spermatozoa of newt. D Ach 40X PLL, NFK 5X (left)





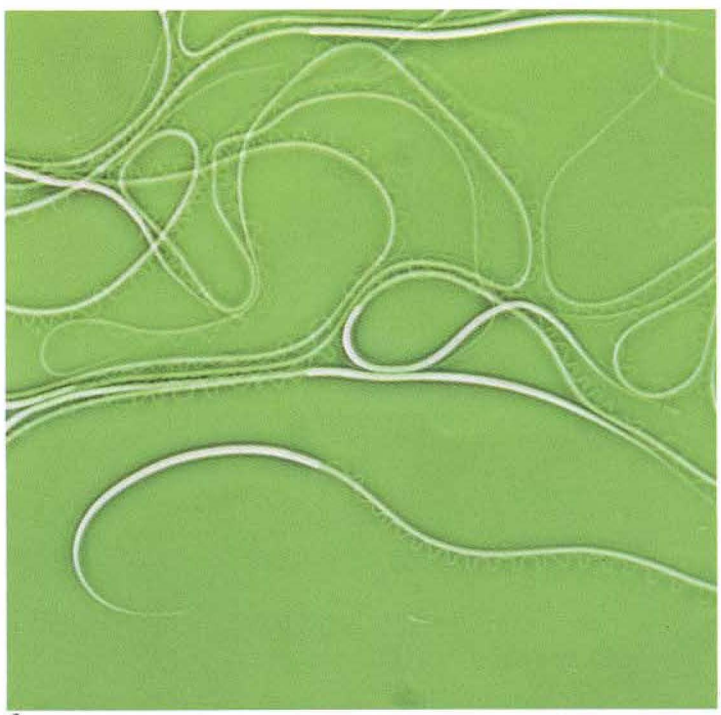


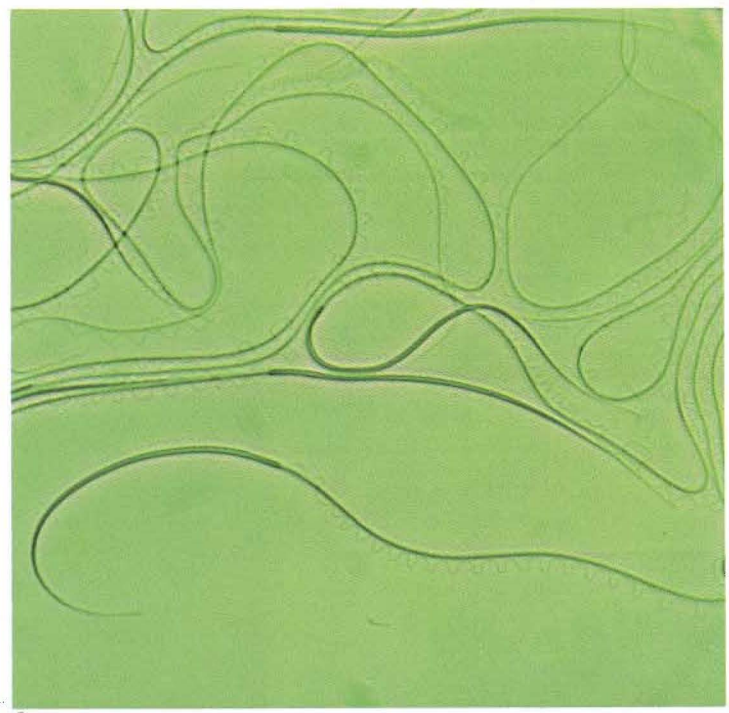

A 10PL
0.25
160 / 0.17
A 20PL
0.40
160 / 0.17
A 40PL
0.65
160 / 0.17
A 100PL
1.30 oil
160 / 0.17


A 10PLL
0.25
160 / 0.17
A 20PLL
0.40
160 / 0.17
A 40PL
0.65
160 / 0.17
A 100PLL
1.30 oil
160 / 0.17


A 10NM
0.25
160 / 0.17
A 20NM
0.40
160 / 0.17
A 40NM
0.65
160 / 0.17
A 100NM
1.30 oil
160 / 0.17


A 10NH
0.25
160 / 0.17
A 20NH
0.40
160 / 0.17
A 40NH
0.65
160 / 0.17
A 100NH
1.30 oil
160 / 0.17





UVFL Non-fluorescing Objectives

The UVFL objectives are designed for vertical fluorescence observation. The lenses are completely free of auto fluorescence and therefore, even with powerful fluorescent light excitation, a remarkably sharp and bright image can be obtained, with excellent background extinction. The UVFL objective series consists of 10X, 20X and 40X dry, as well as 40X and 100X immersion objectives. The advantage of having both dry and immersion 40X objectives is that if examination is performed at magnifications of 40X or less, all observation can be performed with dry objectives. On the other hand, for primarily high magnification examinations, 40X observation is also possible without having to remove the immersion liquid. By providing a significant increase in the objective N.A., we have overcome the major drawback of vertical fluorescence microscopy that image intensity is decreased at low magnifications. Not only is the image brighter at low mangifications, but it has greatly increased resolution.

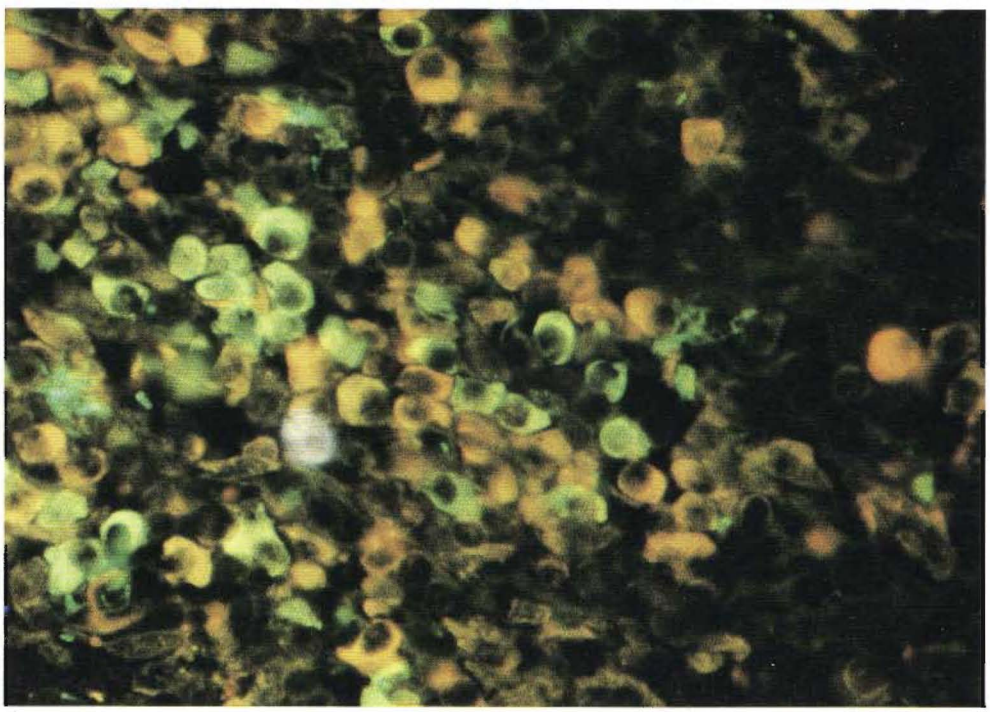


No Cover Objectives

Some specimens and most smears are observed on specimen slides without cover glass. For these applications No-cover objectives are required. Most objectives are designed to compensate for refraction, not only of the object slide, but also of the 0.17 mm cover glass. Thus, when specimens are examined without a cover glass, the performance of the objective suffers. This is especially true of high N.A. immersion objectives and dry objectives with magnifications of 20X or higher.



1. Immunofluorescent demonstration of the immunoglobulin light chains in the plasma cells by double staining method. Green color indicates the K-chain, and yellow-orange color the λ-chain. UVFL 100X, NFK 3.3X
Courtesy: Professor Y. HAMAJIMA. Kyoto Univ.



1



Strain-free Objectives

Polarized light microscopy, in addition to its traditional role in the study of minerals and crystals, is enjoying increased use in oil-related industries and pharmacology. Olympus objectives are completely strain free, an essential requirement in polarized light microscopy. Two series of strain-free objectives for transmitted light microscopy are available, D Ach PO with excellent resolution and D Plan PO, with excellent resolution and field flatness.

Eyepieces

Olympus eyepieces have been newly designed in perfect conformity with the objectives, and their visual fields are wider than ever before. The standard visual eyepiece is the WHK 10X, with a field number of 20.



[Reference]

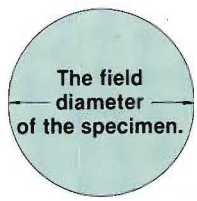
The diameter of the visual field of the microsocpe (mm).

$$\fallingdotseq \frac{\text{eyepiece visual field number}}{\text{objective magnification}}$$

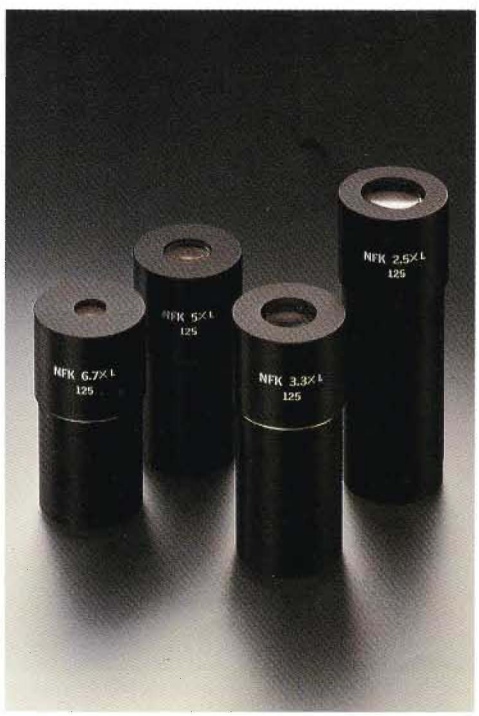
[Example]

In the case of observation with the WHK 10X eyepiece and the S Plan 40X objective, the diameter of the visual

$$= \frac{20}{40} = 0.5 \text{ mm.}$$







NFK Photo Eyepiece Series

These eyepieces are specially computed to complement the new LB objective series for photomicrography because of their correction for field flatness and aberrations. Magnifications available are 2.5X, 3.3X, 5X and 6.7X. Each eyepiece is designed to focus at a projection length 125 mm, which equals the film plane distance of the 35 mm camera back of the Models PM-10 and PM-10AD photomicrographic camera attachments. Magnifications for large format cameras are three times greater than for 35 mm cameras, i.e., in this case, NFK 2.5X becomes 7.5X, NFK 3.3X becomes 10X, NFK 5X becomes 15X and NFK 6.7X becomes 20X.

LB Objective Series for Biological Use

	Magnification	Numerical Aperture	Working Distance mm	Focal Length mm	Cover Glass Thickness mm	Remarks	Order Designation
S Plan Apochromatic Objectives							
S Plan Apo	4X, dry	0.16	9.83	36.71	—	S.W.	SPLAPO 4X
	10X, dry	0.40	2.03	18.34	0.17	S.W., Spring-loaded.	SPLAPO 10X
	20X, dry	0.70	0.55	7.68	0.17	S.W., Spring-loaded.	SPLAPO 20X
	40X, dry	0.95	0.13	4.18	0.17	S.W., Correction collar (0.11 ~ 0.23), Spring-loaded.	SPLAPO 40X
	100X, oil	1.35	0.15	1.62	0.17	S.W., Iris diaphragm, Spring-loaded.	SPLAPO 100X
S Plan Fluorite Objectives							
S Plan Fl	1X, dry	0.04	2.2	137.86	—		SPLFL 1X
	2X, dry	0.08	5.5	73.42	—	S.W.	SPLFL 2X
S Plan Achromatic Objectives							
S Plan	4X, dry	0.13	15.50	35.99	—	S.W.	SPL 4X
	10X, dry	0.30	7.50	18.98	0.17	S.W., D.I.C.	SPL 10X
	20X, dry	0.46	1.50	8.03	0.17	S.W., D.I.C., Spring-loaded.	SPL 20X
	40X, dry	0.70	0.50	4.13	0.17	S.W., D.I.C., Spring-loaded.	SPL 40X
	100X, oil	1.25	0.17	1.69	0.17	S.W., D.I.C., Spring-loaded.	SPL 100X
D Plan Achromatic Objectives							
D Plan	4X, dry	0.1	7.02	34.23	—		DPL 4X
	10X, dry	0.25	7.40	17.50	0.17		DPL 10X
	20X, dry	0.4	0.83	8.99	0.17	Spring-loaded.	DPL 20X
	40X, dry	0.65	0.23	4.67	0.17	Spring-loaded.	DPL 40X
	100X, oil	1.25	0.17	1.75	0.17	Spring-loaded.	DPL 100X
D Achromatic Objectives							
D Ach	4X, dry	0.10	18.23	30.03	—		DA 4X
	10X, dry	0.25	7.18	16.90	0.17		DA 10X
	20X, dry	0.40	1.63	8.63	0.17	Spring-loaded.	DA 20X
	40X, dry	0.65	0.60	4.57	0.17	Spring-loaded.	DA 40X
	60X, dry	0.80	0.23	3.14	0.17	Spring-loaded	DA 60X
	100X, oil	1.30	0.20	1.90	0.17	Spring-loaded.	DA 100X
Phase Contrast Objectives							
S Plan	10X, dry PL NH	0.30	7.50	18.98	0.17	S.W.,	PCSPL 10XPL PCSPL 10XNH
	20X, dry PL NH	0.46	1.50	8.03	0.17	S.W., Spring-loaded.	PCSPL 20XPL PCSPL 20XNH
	40X, dry PL NH	0.70	0.50	4.13	0.17	S.W., Spring-loaded.	PCSPL 40XPL PCSPL 40XNH
	100X, oil PL NH	1.25	0.17	1.69	0.17	S.W., Spring-loaded.	PCSPL 100XPL PCSPL 100XNH
D Ach	10X, dry PL PLL NH NM	0.25	7.18	16.90	0.17		PCDA 10XPL PCDA 10XPLL PCDA 10XNH PCDA 10XNM
	20X, dry PL PLL NH NM	0.40	1.63	8.63	0.17	Spring-loaded.	PCDA 20XPL PCDA 20XPLL PCDA 20XNH PCDA 20XNM
	40X, dry PL PLL NH NM	0.65	0.60	4.58	0.17	Spring-loaded.	PCDA 40XPL PCDA 40XPLL PCDA 40XNH PCDA 40XNM
	100X, oil PL PLL NH NM	1.30	0.20	1.90	0.17	Spring-loaded.	PCDA 100XPL PCDA 100XPLL PCDA 100XNH PCDA 100XNM
Non-fluorescing Objectives (for reflected light fluorescence)							
UVFL	10X, dry	0.40	1.16	15.84	0.17	Spring-loaded.	UVFL 10X
	20X, dry	0.65	1.03	8.11	0.17	Spring-loaded.	UVFL 20X
	40X, dry	0.85	0.25	4.59	0.17	Correction collar (0.11 ~ 0.23), Spring-loaded.	UVFL 40X (D)
	40X, oil	1.30	0.11	4.56	0.17	Iris diaphragm, Spring-loaded.	UVFL 40X (O)
	100X, oil	1.30	0.14	1.91	0.17	Iris diaphragm, Spring-loaded.	UVFL 100X
No Cover Objectives							
S Plan	40X, dry	0.70	0.45	4.19	—	S.W., Spring-loaded.	NCSPL 40X
D Plan F	60X, dry	0.95	0.14	3.05	—	Spring-loaded.	NCDPL 60X
S Plan Apo	100X, oil	1.40	0.31	1.63	—	S.W., Iris diaphragm, Spring-loaded.	NCSPLAPO 100X
Strain-free Objectives (for transmitted polarized light)							
D Plan	4X, dry	0.10	7.02	34.23	—		PODPL 4X
	10X, dry	0.25	7.40	17.50	0.17		PODPL 10X
	20X, dry	0.40	0.83	8.99	0.17	Spring-loaded.	PODPL 20X
	40X, dry	0.65	0.23	4.67	0.17	Spring-loaded.	PODPL 40X
	100X, oil	1.25	0.17	1.75	0.17	Spring-loaded.	PODPL 100X
D Ach	4X, dry	0.10	18.23	30.03	—		PODA 4X
	10X, dry	0.25	7.23	16.90	0.17		PODA 10X
	20X, dry	0.40	1.63	8.63	0.17	Spring-loaded.	PODA 20X
	40x, dry	0.65	0.60	4.58	0.17	Spring-loaded.	PODA 40X
	100X, oil	1.30	0.20	1.90	0.17	Spring-loaded.	PODA 100X

Denote: S.W. = *Super Widefield*, PL = *Positive Low Contrast*, PLL = *Positive Low-Low Contrast*, NH = *Negative High Contrast*, NM = *Negative Medium Contrast*, D.I.C. = *Nomarski Differential Interference Contrast.*

LB Eyepiece Series

	Field Number mmϕ	Focal Length mm	Remarks	
Widefield Eyepieces				
WHK 8X	20	18.7		
WHK 10X	20	18.7		
WHK 10X-H	20	18.7	Diopter adjustment −8 ~ +5	
WK 10X	20	16.0		
WK 10X-H	20	16.0	Diopter adjustment −8 ~ +5	
WHK 15X	14	15.5		
Micro-WHK 10X	20	18.7	Built-in 10/100 micrometer disc.	
Cross-WHK 10X	20	18.7	Built-in cross micrometer disc.	
Micro-WK 10X	20	16.0	Built-in 10/100 micrometer disc.	
Cross-WK 10X	20	16.0	Built-in cross micrometer disc.	
Compensation Eyepieces				
NK 5X	21	16.4		
NK 20X	10	10.6		
Cross-NK 5X	21	16.4	Built-in cross micrometer disc.	
Super Widefield Eyepiece				
SWK 10X	26.5	15.6		
Finder Eyepieces				
35-WHK 10X	20	18.7	With built-in 35mm mask	
P-WHK 10X	20	18.7	With built-in 3¼" × 4¼" mask	to be matched with WHK 10X-H
4 × 5-WHK 10X	20	18.7	With built-in 4" × 5" mask	
MH-WHK 10X	20	18.7	With built-in 16mm cime mask	
35-WK 10X	20	16.0	With built-in 35mm mask	
P-WK 10X	20	16.0	With built-in 3¼" × 4¼" mask	to be matched with WK 10X-H
4 × 5-WK 10X	20	16.0	With built-in 4" × 5" mask	
35-SWK 10X	26.5	15.6	With built-in 35mm mask	
P-SWK 10X	26.5	15.6	With built-in 3¼" × 4¼" mask	to be matched with SWK 10X-H
4 × 5-SWK 10X	26.5	15.6	With built-in 4" × 5" mask	
MH-SWK 10X	26.5	15.6	With built-in 16mm cine mask	
Photo Eyepieces				
NFK 2.5X	23.0	—		
NFK 3.3X	18.4	—		
NFK 5X	12.4	—		
NFK 6.7X	8.8	—		

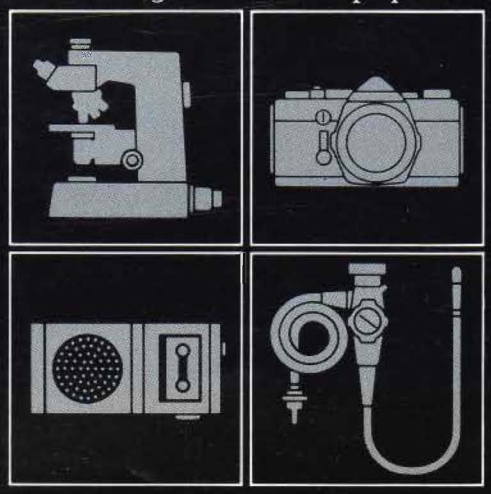
Condensers

	Numerical Aperture	Focal Length mm	Aperture Iris Diaphragm	Remarks
Achromatic/Aplanatic Condenser				
BH2-AAC	1.40	9.0	●	10X ~ 100X, S.W. (10X ~ 100X)
Swing-out Condenser				
BH2-SC	0.90 (top element in) 0.16 (top element out)	12 220	●	2X ~ 100X, S.W. (2X ~ 100X)
Abbe Condenser				
BH2-CD	1.25	13.4	●	4X ~ 100X, S.W. (10X ~ 100X)
Ultra-low Condenser				
BH2-ULC	0.16	67.4	●	1X ~ 4X, S.W. (2X ~ 4X)
Phase Contrast Condenser				
BH2-PC	1.25	13.4	●	10X ~ 100X S.W. (10X ~ 100X)
Nomarski D.I.C. Condenser				
BH2-NC	1.40	10.0	●	10X ~ 100X S.W. (10X ~ 100X) Phase annuli for 10X and 40X incorporated
Polarizing Condenser				
BH2-POC	0.90 (top element in) 0.25 (top element out)	7.2 28.8	●	4X ~ 100X
Darkfield Condenser				
BH2-DCD, dry	0.92 ~ 0.8	11.8	—	10X ~ 40X
BH2-DCW, oil	1.4 ~ 1.2	7.65	—	10X ~ 100X

An unwavering will to remain
at the forefront of scientific discovery,
and an uncompromising commitment
to quality have made the name
of Olympus a synonym of high performance
and reliability all over the world.
From cameras and microcassette recorders,
to microscopes for various applications,
fiberscopes, and facsimiles,
Olympus has kept abreast
of the most advanced technologies
and discoveries, constantly striving
to develop products which meet the new
and more complex needs
of our rapidly changing society.
Precision engineering,
long experience
and R&D activities tuned to the requirements
of man in his search for a better life,
have earned Olympus its unparalleled position
in the medical profession, in the photographic industry,
in the laboratory and the classroom,
and in the eyes of all those who benefit
from the functionality, accuracy,
versatility and economy of its products.

Progress through Precision

Photographic,
Medical,
Microscopic,
Measuring & Audio Equipment



OLYMPUS

OLYMPUS OPTICAL CO.,LTD.
San-Ei Building, 22-2, Nishi Shinjuku 1-chome, Shinjuku-ku, Tokyo Japan
OLYMPUS OPTICAL CO.(EUROPA) GMBH.
2 Hamburg 1, Steindamm 105, West Germany
OLYMPUS CORPORATION OF AMERICA
4 Nevada Drive, New Hyde Park, N.Y. 11042, U.S.A.

As we are continually improving and developing our products, the equipment supplied may not agree in all details with the descriptions and/or illustrations shown in this catalog.

Printed in Japan M28E-1080B