ZEISS MICROSCOPES

CARL ZEISS
JENA

RESEARCH
4 MAY 1936
DEPARTMENT.

ZEISS

MICROSCOPES
AND ACCESSORIES

1934 EDITION

CABLE ADDRESS: ZEISSWERK JENA



BERLIN NW7, Karlstraße 39 · HAMBURG, Alsterhaus, Alsterdamm 12/13 · COLOGNE, Apostelnkloster 27 · VIENNA IX/3, Ferstelgasse 1 · BRUSSELS, 45, Boulevard Bischoffsheim · BUENOS AIRES, Bernardo de Irigoyen 330 · RIO DE JANEIRO, Rua dos Benedictinos 21 · SÃO PAULO, Rua Barão de Itapetininga, 18 · TOKYO, Yusen Building 7th floor, Marunouchi
MADRID · MILAN · PARIS
LONDON W.1: Carl Zeiss (London) Ltd., Mortimer House, 37—41, Mortimer Street
NEW YORK: Carl Zeiss, Inc., 485 Fifth Avenue and at Los Angeles, Cal., 728 So. Hill Street

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CONTENTS

	Page
Foreword	5
I. General	7
II. Completely Equipped Microscopes	18
a) Medium Stand E	18
b) Medium Stand U	27
c) Large Stands F and G	30
d) Large Stand H	38
e) Stand L	43
f) Large Stand S	47
g) Travelling Microscopes	49
III. Objectives and Eyepieces	
a) General	50
b) Achromatic Objectives	56
c) Fluorite Objectives	58
d) Apochromatic Objectives	59
e) Objectives in Short Mounts	60
f) Eyepieces	62
IV. Stereoscopic Dissecting Microscopes	
A. Stands X (Greenough Microscope)	65
a) General	65
b) Paired Objectives and Eyepieces	69
c) Stand XA	71
d) Stands XB and XC	73
e) Accessories	76
f) Zeissler Plate Culture Microscope	79
B. Binocular Stand Magnifier XII	80
V. Magnifiers	
a) Anastigmatic Magnifiers	83
b) Aplanatic Magnifiers	84
c) Magnifier and Dissecting Stands	87
VI. Illuminating Apparatus	90
a) for Bright Field Observation	91
b) for Dark Field Observation	97
c) for Observation in Incident Light	101
VII. Object Stages	103
VIII. Devices for Centring and Changing Objectives	107
IX. Drawing Apparatus	109
X. Measuring Devices	111
XI. Counting Devices, Haemacytometers	115
XII. Polarizing Attachments	120
XIII. Micro-Spectroscopic Apparatus	122
XIV. Special Eyepieces	124
XV. Inclined Eyepiece Attachments	127
XVI. Miscellaneous Accessories and Auxiliaries	129
XVII. Microscope Lamps and Accessories for Artificial Illumination	136
XVIII. Equipments for Special Purposes	141
XIX. Microscopes by R. Winkel G. m. b. H., Göttingen	145
XX. Alphabetical Index	151
XXI. Index of Order Numbers	156

FOREWORD

For some time past, microscope design has been strongly influenced by new wishes and suggestions. This has resulted in substantial changes in microscope stands, and the creation of some entirely new models. The present catalogue accordingly lists a number of new stands all having in common the location of the slow motion in the tilting axis. This feature supplies a further refinement for observation of difficult objects, and constitutes an added convenience for the user. Among the new types are stands U and H, of which the first is a medium and the second a large stand. A totally new departure is represented by Model L, which has both the slow and the coarse motion below the level of the stage, and, by the elimination of the customary tube, provides a low structure even when used in combination with inclined eyepiece tubes. The insistence on oblique observation, and the easy attitude rendered possible thereby without the need of tilting the instrument, has become a dominant factor in the design of the microscope upper parts. The new inclined tubes for monocular and binocular observation are expressly designed to meet this demand. These are tubes made for the reception of the standard eyepieces, and are adapted also for use with the older types of stands. Their design is, moreover, such as to admit of especially easy and rapid change from monocular to binocular observation and vice versa without the need of separating the objectives and nosepieces from the lower section of the tube.

While following the previous general arrangement, some sections of this catalogue have been rewritten and thereby, as we hope, rendered more striking. Wholly new items are the instruments brought out since the last edition, as for instance Binocular Stand Magnifier XII. In other, previously existing instruments, the changes made within the last few years have been specified. An expansion has also occurred in that some older accessories and auxiliaries

still in demand are again shown without, however, listing every special design. On the contrary, a large number of special instruments and devices have not been considered. In the event that special parts not mentioned in this catalogue should be required, we shall be glad to submit information upon receipt of enquiry.

In general, the text is concise, and the catalogue therefore does not give a detailed description of the instruments. This information is contained in special folders, to which reference will be found in each case and which we shall gladly forward free of charge.

From its very inception, our firm has been guided by the aim of turning out instruments of the very first order only. The greatest care is expended upon the manufacture of every instrument. In the course of decades, we have been perfecting an extensive system of detailed inspection based on scientific principles, which applies to every phase of manufacture and positively ensures a uniform product of the highest quality. Contrary to a widely prevalent erroneous impression, it will be found, wherever instruments can at all be compared, that our prices are relatively but slightly higher than those of other makes. Any such difference as may exist will be amply justified by the superior quality of our products.

GENERAL

The microscope is an instrument capable of being *equipped in a great variety of ways* by the interchangeable use of numerous optical and mechanical parts. This capacity for combination is necessary in order to adapt the microscope to the many special purposes for which it is used. Microscope equipments accordingly differ not only in the maximum obtainable total magnification —which, in fact, is by no means always decisive—but also by the nature of the illuminating apparatus, the stage, the number of objectives and eyepieces and their fitness for the work to be done. The remarks to follow are intended to call attention to the chief *points requiring consideration in the choice of a microscope and equipment.* Additional suggestions will be found under the various instrument heads.

The microscope consists of the stand with the illuminating apparatus, the stage, the observation tube, an objective changing device, and the optical parts comprising the condenser, objectives, and eyepieces. The diagram of Fig. 1 on the next page shows the general design of the instrument. In the lower portion of the stand is seen the *ABBE illuminating apparatus* (see folder "Mikro 15e" and Fig. 16, p. 36) with the commonly used two-lens condenser N.A. 1.2. Upon swinging out the diaphragm carrier, the condenser may be withdrawn from the sliding sleeve of the illuminating apparatus and replaced as needed either by a cylinder diaphragm, or by some other device for illuminating the object under examination, as for instance by a swing-out condenser, a dark field condenser, or a spectroscopic condenser. For this reason, all of these devices are mounted in cylindrical fittings of a diameter of 36.8 mm. agreeing with the internal diameter of the sliding sleeve of the illuminating apparatus. It is not absolutely necessary to use the ABBE illuminating apparatus, however, and in many cases a simplified illuminating arrangement, Fig. 2, p. 13, will suffice. On the other hand, ever higher demands are being made upon the illumination particularly by way of close regulation of the path of light. We have met this requirement by bringing out a universally movable rectangular prism with accurately plane sides, which is used in the microscope in the place of the customary mirror and will be found described on page 90.

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Path of Light through Microscope

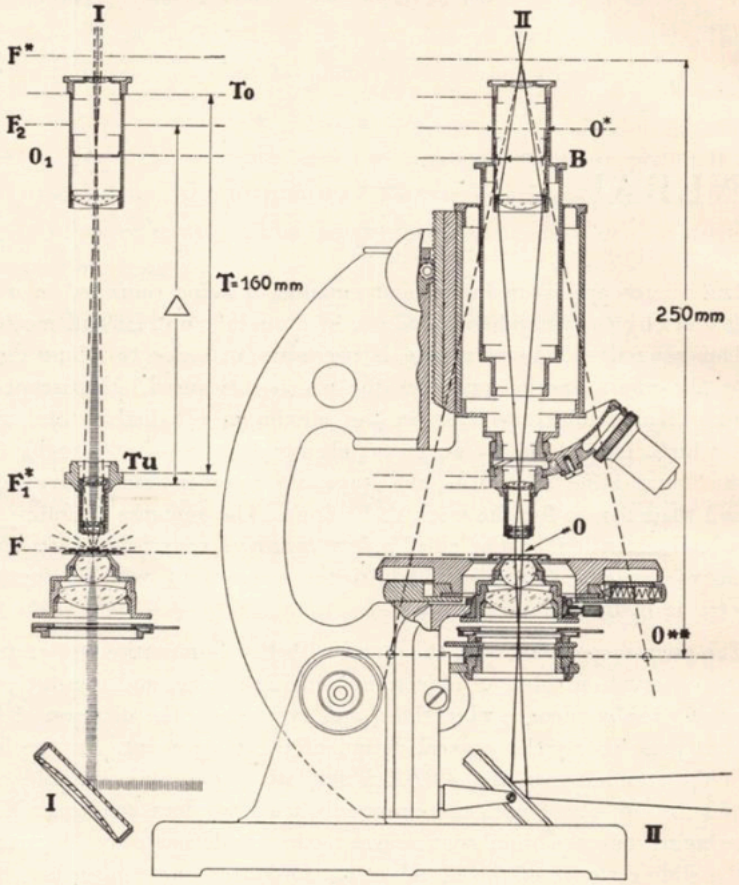


Fig. 1. 11549

I. Path of rays forming the image of a point on the object.
II. Path of rays determining limits of field of view.

F_1* Back focal plane of objective
F_2 Front focal plane of eyepiece = O*
F* Back focal plane of entire microscope
△ Optical length of tube
T Mechanical length of tube = 160 mm.
O Object at F, the front focal plane of the entire microscope
O* Plane in which the image would be formed by the objective in the absence of the eyepiece = F_2
O** Projection of microscopic image to the distance of distinct vision
B Eyepiece diaphragm and location of real intermediate image = O_1
O_1 Location of real intermediate image = B.

For class use, we shall be glad to supply a large wall diagram free of charge upon request.

a) The Illuminating Apparatus

The path of the rays I, Fig. 1, shows the illumination for projecting a point on the object, in the instance of the diagram the point in the centre of the field of view. The beam of light between the mirror and the condenser need not be parallel as indicated, and the illuminating rays may have other directions. It is not always necessary for the condenser to produce a sharp image of the source of light in the object plane, and this is not, indeed, always permissible, as for instance when the source of light shows a pronounced structure. Artificial sources of light should be provided with an iris diaphragm, which is projected into the object plane and is contracted until its image just fills the field of view and prevents interference with the microscope image by excess light. The distance between the surface of the condenser and the point where the rays issuing from the condenser are united is called the *focal intercept* of the condenser. This distance determines the thickness of the object slide to be employed wherever maximum light intensity in the plane of the object is essential, as for instance in dark field illumination. The limit stop for the vertical adjustment of the condenser is therefore designed to bring the surface of the condenser just, *i. e.*, about 0.1 mm., below the surface of the stage.

Diagram II shows the directions of the rays, which after deflection by the mirror, intersect in the centre of the iris diaphragm, and emerge parallel from the condenser. The rays indicated in this diagram, which just touch the edges of the field of view, are the principal rays of pencils of the kind I issuing from the marginal points of that part of the object embraced in the field. The aperture of the iris diaphragm operates like a source of light at a very great distance.

b) The Stage and the Object

The microscope stage is not as a rule adjustable in the direction of the optical axis. This adjustment becomes necessary, however, in metallographic work, and is accordingly arranged for in the Stand S described on page 47. In all cases, it is of great advantage to have the stage movable in the transverse plane. Fixed stages are circular or rectangular in shape. Movable stages are either of simplified type, with small range of adjustment, or are made with precision ways perpendicular to each other and allowing a wide range of motion. Simple fixed stages may be rendered equivalent to the movable types by the addition of the attachable mechanical stages described on page 105.

The objects to be examined are as a rule mounted on thin glass plates, termed object slides (page 135). The most commonly used sizes are the English

pattern (76 × 26 mm.) and the 45 × 26 mm. pattern. The thickness of the object slides varies between 0.9 and 2 mm., and must suit the focal intercept of the condenser. The objects are imbedded in a suitable medium on the object slide and protected by means of cover glasses. These are very thin foils of glass, square or circular in shape, and from 0.1 to 0.2 mm. thick by 18 or 20 mm. in length or diameter. The *thickness* of the cover glass is largely *governed by the objective used.*

c) Image Forming System and Magnification

The image forming system of the microscope consists of two principal elements, the objective and the eyepiece. Of these, the objective is the nearer to the object. The diagram of the path of the rays in Fig. 1 shows an achromatic objective 10, N.A. 0.3 (p. 56). The distance between the bottom edge of the objective mount, which slightly projects beyond the front surface of the lower lens, and the upper surface of the cover glass, is termed the *free object* or *working distance.* In all numerical statements of working distances in this catalogue, it is assumed that the cover glass has a thickness of 0.17 mm. Achromatic objective 10 consists of two two-lens components and a front lens. The lower or front principal focus of the combination is therefore situated just above the object. The upper or back principal focus lies in the upper double lens of the objective. The principal focal plane is indicated by the line F_1^*.

Like all our HUYGENS eyepieces, the 5 × HUYGENS eyepiece consists of two unachromatized component lenses. The front principal focus of this eyepiece lies between the lenses in the plane F_2. The lower lens is called the field lens, and the upper the eye lens. The image 0* of the object 0 formed by the objective would be projected into the plane F_2, if the field lens did not intervene. The image O_1 formed by the objective and the field lens lies in a lower plane, namely the plane of eyepiece diaphragm B. This image O_1 is viewed by the observer through the eye lens of the eyepiece. The plane of diaphragm B lies in the front focal plane of the eye lens, it being generally assumed that the eye of the observer is completely relaxed for infinity during observation, either normally or by the aid of his distance spectacles. The rays passing through the various points of the real image O_1, diagram I, become parallel above the eyepiece. To the eye, they appear therefore to proceed from corresponding points of an image situated at an infinite distance below the microscope — the virtual image of the object formed by the microscope as a whole.

The two principal rays corresponding to the marginal points of the field of view shown in diagram II are paralleled before they enter the objective and therefore meet at the back principal focus of the objective in plane F_1^* and, after passing

through the field lens, impinge upon the margin of the eyepiece diaphragm. The eyepiece diaphragm operates as a *field diaphragm*. After traversing the eye lens, these rays meet in the back focal plane F* of the microscope as a whole, and determine the angle which the image formed by the microscope appears to the observer to subtend. This image may thus be situated at infinity to an unaccommodated eye, or at any finite distance from F* to an accommodated eye.

The linear magnitude of this image varies exactly in proportion to its distance from F*. Hence the angle at which it appears to the eye, or apparent or angular magnitude, and with it also the size of the image on the retina, remains unchanged. Since it is not practicable to measure the magnification in terms of visual angles and in order to obtain a basis for comparison, the image is supposed to be shifted to a distance S=10 inches, which is generally considered as the distance at which a normal-sighted person would view the object in order to see it distinctly. The magnification will then be expressed by the ratio of the imaginary image to the object itself. In diagram II, this imaginary image at the conventional distance of distinct vision is denoted by O**. It should be understood that this is not the actual image.

d) Numerical Aperture and Magnification

The condition represented in diagram I is that of a divergent pencil of rays proceeding from the axial point of the object. The pencils coming from other points of the field of view would have to be similarly drawn. Upon attentively pursuing the course of the rays, it will be seen that the pencils are bounded by the mount of the objective upper lens, since this is traversed by rays throughout its opening. This opening therefore governs the angular aperture of the beam issuing from the object and passing through the objective, and is called the *aperture stop* or *aperture diaphragm* because the ratio between the linear magnitude of this opening and the focal length of the objective determines its aperture. This ratio is not, however, directly represented by the aperture angle, but equals the product of the sine of half the aperture angle and the refractive index n of the medium between the objective and the preparation:

$$n \times \sin \varphi = a.$$

ABBE has called this quantity a the *numerical aperture* (N. A.). The numerical aperture provides a decisive criterion of all essential qualities of an objective (see ABBE's "Gesammelte Abhandlungen," I, pp. 267, 354, 365, 366, Jena, 1904, and CZAPSKI-EPPENSTEIN, "Grundzüge der Theorie der optischen Instrumente," 3rd Edition, pp. 480 et seq., Leipzig, 1924). For any magnification, other things being equal, *the intensity of the image is proportional*

to the square of the numerical aperture; the resolving power is directly proportional to it; and the power of penetration (depth of focus) *for a given medium is inversely proportional to the numerical aperture.*

The most important factor is the relation between the resolving power and the numerical aperture. This relation can be made visible by means of the diffraction apparatus illustrated on page 129, and is highly instructive in judging the microscope images.

The magnitude of the numerical aperture further determines the limits of *the effective or useful magnification* of the microscope. This is the least magnification which the instrument must be capable of affording in order to enable an observer endowed with normal vision to perceive all that the microscope brings into view by virtue of its aperture. This magnification may not be exceeded without the risk of introducing into the image purely optical diffraction and interference phenomena which, though inseparable from the image, are entirely foreign to the object. Stated in round figures, the lower limit is $N=500\times a$, the upper limit $N = 1000 \times a$, a being the numerical aperture of the objective.

e) Image and Exit Pupil of Microscope

The pencils transmitted through the aperture stop, having become convergent, tend towards the points of the image O*, but are intercepted and deflected by the field lens of the eyepiece, with the result that their apices produce the image O_1 in field stop B.

As diagram II shows, the principal rays of all pencils proceeding from the various points of the object meet above the microscope at its back principal focus in the plane F*. This is likewise that plane in the diagram where the image of the aperture stop of the objective is formed by the eyepiece. It appears as a bright circle above the eyepiece and is known as the *RAMSDEN circle* or, according to ABBE, as the *exit pupil* of the microscope. All pencils proceeding from the microscopic image have this circle for their common base. If, therefore, the observer's eye is placed in this plane and the circle is not larger than the pupil, all of the rays coming from the microscopic image will be received by the eye.

f) The Tube of the Microscope

At their upper ends, the objectives are provided with the English standard screw thread of about 20 mm. outside diameter. By this they are attached to the end of the tube—not directly, but by means of a changing device of a length of 15 mm. such as a revolving nosepiece or sliding objective changer, or

by an intermediate collar of the same length. The distance from the upper edge of the tube *To* to the thread shoulder *Tu*, *i. e.*, including the changing device or intermediate collar, is called *the mechanical tube length T*. Unless otherwise stated, this length is 160 mm. with our objectives, since they are ordinarily corrected for this 160 mm. length. Those of our stands having a variable tube

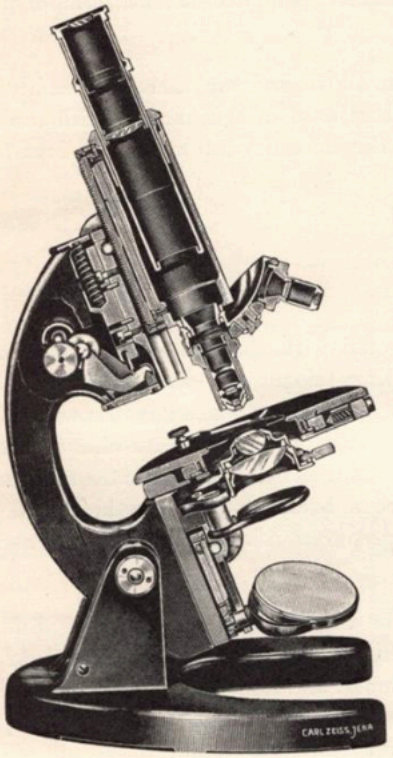


Fig. 2. 11527
Section through a microscope

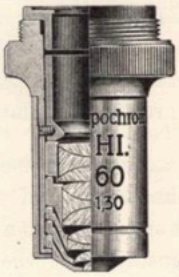


Fig. 3
Section through
an apochromatic objective

therefore have a scale engraved on the upper, narrower tube portion, the draw tube, for indicating the length. Under all ordinary conditions, the tube length should be set to 160.*)

*) In the older stands, the length of the changing devices is not taken into account on the scale. In their case, the draw tube should therefore be set to 145 when the revolving nosepieces are used, or to 145 or 138 as required, if a sliding objective changer is used. In doubtful cases, the tube length should be verified by measurement with a rule.

For ordinary work with the microscope it is not, however, necessary to use a draw tube. It is, in fact, an advantage of microscope stands having a non-extensible tube that they prevent a wrong tube length from being set. In regard to binocular bodies with single objective, there are technical reasons against the employment of an extensible tube. Unless otherwise ordered, we accordingly furnish the simple Stands EB and ES with a non-extensible single tube. The monocular tube of these stands is therefore supplied in the form of a draw tube only to special order.

The eyepieces slip into the tube from above and are therefore readily interchangeable. The objectives are as a rule used in conjunction with the above named changing devices, to obviate the necessity of having to screw them on and off.

g) The Focusing Motions

The most important elements connected with the observation tube are the focusing mechanisms. All stands in this catalogue not designated as dissecting microscopes are equipped with both coarse and fine focusing motions. The former are rack-and-pinion mechanisms having racks and pinions with oblique teeth cut with high precision on special machines of our own design. When the two parts are properly fitted together there is therefore no backlash, and even the highest power objectives can be easily focused on the preparation by a trained observer without recourse to the slow motion.

The action of the coarse motion can be regulated as desired. The differences in the weights of the tube occasioned by varying loads ranging from a few light objectives to a heavy tube attachment and four heavy objectives oblige us, when adjusting the microscopes in our shops, to impart a certain degree of stiffness to the motions. Where this movement is found to be unnecessarily heavy, it may be readily eased as desired. On the other hand, it may be stiffened if it works so freely that the tube descends of its own accord. This will be the case when the image is found to become blurred shortly after focusing although no change has been made in the fine adjustment. The requisite stiffness of movement may be established by holding the left motion head against rotation and at the same time turning the right-hand head from left to right as in tightening a screw. By turning the heads in the opposite sense, the motion may be eased as required. In either case, about a quarter of a turn of the motion head suffices. This simple mode of regulation has been rendered practicable by making the pinion spindles much heavier than they were before.

Over the usual method whereby a one-sided pressure is exerted upon the spindle by means of small screws, this design has the advantage that it does not cause the grease coating of the spindle to be squeezed out sideways. A uniform layer of heavy grease is, however, necessary for obtaining the smooth and uniform action of the coarse motion required for focusing high-power objectives upon the preparation with any degree of assurance.

Fine adjustment in our stands is effected by *the MEYER geared slow motion.* This is not a micrometer screw device, but a mechanism employing gears similar to those in a watch and requiring no lubrication. These gears are constantly maintained by a spring in a state of uni-directional thrust. Unlike a micrometer screw, this type of motion excludes all possibility of backlash. The terminal gear of the set acts upon the end of an angular lever of which the other end is supported on a knife edge fulcrum. The motion of this lever is transferred through a pressure pin to the movable tube carrier. The approximate value of the movement of the carrier is read from the graduated drum of the focusing head. Each interval equals approximately 0.002 mm., and a 0.001 mm. movement can still be easily estimated. One complete revolution of the fine adjustment milled head causes an up or down movement of the tube carrier of 0.1 mm. The slow-motion mechanism is sealed against the entry of dust. The design is seen from the sectional view of Fig. 2, p. 13. In the latest stands, the reduction ratio is doubled, so that one interval on the divided drum of the fine adjustment head corresponds to a vertical motion of the tube of about 0.001 mm.

The extent of the slow motion in either direction is limited by a stop. The advantage of our former slow motion, of showing by the direction of rotation of the focusing heads whether the tube is being raised or lowered, has been retained, as has also the agreement of the directions of rotation for ascending and descending movements in both motions. An *important improvement* is the *change in the location of the slow motion*, whereby the focusing head is either coaxial with the tilting axis of the instrument as in stand H, or is located directly above the foot at a height corresponding to the level of the tilting axis. Both motion heads contain safety ratchets, which act at the limits of movement to prevent forcible turning beyond the stops.

The limit stop for the downward slow motion may be made to serve as a means of safeguarding the preparation. To this end all that is necessary, in the case of an object which is not easily found, is to set the slow motion to its lower limit before attempting to focus, and then to lower the tube with the aid of the rack and pinion until the lower edge of the objective mount is nearly but not quite in contact with the cover glass. The object may then be focused by raising the tube with the slow motion only. Damage to the preparation or the front lens of the objective cannot then occur, even if the tube is again lowered, so long as the coarse motion is undisturbed.

h) Objectives

All of our objectives have inscribed upon their mounts the name of our firm and, below, the serial factory number. In addition, they bear their new denomination in terms of their component magnification, their numerical aperture where the latter exceeds 0.15 (p. 56), and where necessary, the size of the required cover-glass thickness or the special tube length. The objectives in fixed mounts for general use are *corrected for a cover-glass thickness of 0.16 to 0.17 mm.* It is assumed that the object will be in immediate contact with the lower surface of the cover glass. Where the object and the cover glass are separated by a stratum of an appreciable thickness, the latter will operate like a departure from the prescribed cover-glass thickness. In the case of objectives of a numerical aperture less than 0.65, the thickness of the cover glass may depart from the above values; in fact, these objectives may be used without a cover glass. Homogeneous immersion lenses likewise are independent of the cover-glass thickness within wide limits. With the higher power "dry" lenses, however, of numerical apertures from 0.65 upwards, and with water immersion objectives departures from the prescribed thickness have a more or less marked detrimental effect upon the spherical correction of the objective, and hence upon the quality of the image. A cover glass of incorrect thickness,

if too thin, causes spherical under-correction,
if too thick, causes spherical over-correction.

While, in the case of objectives of a numerical aperture of 0.65 and under, it is sufficient to keep to a mean estimated thickness, it is necessary to select cover glasses for objectives of higher aperture and therefore also for 40, N.A. 0.85 and 60, N.A. 0.9, with the aid of a cover glass gauge (p. 52).

Substances of a refractive index differing from that of glass, such as film, must not be used instead of a cover glass with these objectives. When preparations with cover glasses of a thickness not conforming to the prescribed limits must be viewed with existing objectives, the influence of a departure from the prescribed thickness may within certain limits be neutralized by varying the tube length. This may be effected by

extending the tube if the cover glass is too thin,
shortening the tube if the cover glass is too thick.

If the thickness of the cover glass is known, then the most favourable extension should be ascertained with the aid of a test plate (p. 52).

In cases of this kind, it is much more convenient to work with objectives provided with *correction mounts* (p. 58). In the case of objective 90, N.A. 0.9 (F) (p. 58), water immersion objective 90, N.A. 1.18 (J) (p. 57), and of stands without draw tube, large deviations in the cover glass thickness can be

neutralized only with the aid of a correction mount. In these objectives with correction mount, one of the components of the combination is movable relative to the other. (Fig. 27, p. 54.) A scale on the movable correction collar, read with the aid of a fixed index, shows the cover glass thickness in hundredths of a millimeter for which the objective is corrected at the corresponding position of the collar and with standard tube length.

As an *immersion fluid* for the objectives of the homogeneous immersion series, none but thickened cedar wood oil of a refractive index of 1.515 should be employed. We caution against the use, with our objectives, of immersion fluids not of our manufacture, since any discrepancy in the refractive and dispersive properties of the fluid is liable to cause a serious falling off in the performance of the objective. For testing the refractive power of the immersion oil, we supply a special device described on page 54.

i) Design of Stands

All of our stands are of substantial design and correspond to modern requirements as to form and style. Resting on a broad brass foot with elliptically curved sicks is the one-piece limb for carrying the illuminating apparatus, the stage, and the tube. The limb is in the form of a segment of a circle with a wide central recess. This recess enables the body to be used as *a handle* and provides an *ample radial range* for the stage and object, so that comparatively large dishes, plates, and the like may be accommodated on the stage for examination. The lower portion of the limb carries the illuminating apparatus, and is traversed by the hinge pin about which the limb may be *inclined* at any angle down to the horizontal position of the tube. Also in this extreme position of inclination, the wide foot ensures the requisite stability. Recesses likely to collect dust have been avoided wherever possible. *Brass sheaths protect the steel pinions of the motion heads against rusting from the moisture of the breath.* An *important improvement* is the *location of the slow motion head in the tilting axis of Stands U and H.* This prevents a push or pull coming on the frame in taking hold of or letting go the focusing head, because the observer's forearm can rest by its whole length on the table. The image therefore remains completely at rest, and its adjustment is not in any way disturbed in operating the slow motion.

An especially low stand, of a design widely departing from that of customary types, is Stand L.

All of the stands listed in the following section can be used with oblique viewing devices for both monocular and binocular observation except Stand F, which is furnished with straight monocular and binocular tubes only. In all cases, the change from monocular to binocular observation is easily made in a few moments.

Completely Equipped Microscopes*)

a) Medium Stand E

Stand E is of medium size, but has the same coarse and fine motions as the large stands. For this reason, Stand E may be used to advantage not only with achromatic objectives, but also with the apochromatic objectives listed on page 59. The stand is made in *two basic models* differing in accordance with the height of the stage.

The first basic form can be furnished only with the fixed circular stage, the fixed rectangular stage C, the simplified mechanical stage A, the simplified revolving stage B with or without peripheral graduation, or the rectangular non-revolving stage G, page 105. These stages are attached to the stage carrier in the usual manner by four screws, and the simpler types may therefore at any later time be replaced by the more elaborate ones. *The second basic form* possesses, instead of the stage carrier, a fixed centring piece for the reception of revolving and centring vulcanite stage D and large mechanical stage E, which can be readily exchanged for each other on the centring piece. In ordering an E Stand, it should therefore be borne in mind that stages D and E cannot take the place of the others. For this reason and because one form cannot later be changed into the other, it is necessary to decide upon one or the other model from all beginning.

The fixed stages and the simplified mechanical stages may, however, be complemented by the addition of the attachable mechanical stage described on page 105, which gives a wide range of movement of the object in two directions at right angles to each other, and in many cases provides a satisfactory substitute for a large mechanical stage.

*) The microscope equipments recommended below constitute but specimen combinations and can readily be modified in compliance with the wishes of the purchaser and the requirements of any intended special work. The equipments are, moreover, not restricted to Stand E, but stands and equipments can be interchangeably used in a large variety of combinations.

Stand E is made with three types of illuminating apparatus. The simplest type consists of the movable plane and concave mirror, and a fixed sliding sleeve on the stage for the reception of the cylinder diaphragm or the condenser (pp. 91 and following), which must be equipped with an iris diaphragm. This stand, designated as Stand EB, represents our class and training microscope, but is also suitable for use by prescription druggists and chemists, and will in some instances even suffice for the simpler tasks of the medical practitioner.

The second type of illuminating apparatus, distinguished by the addition of the second letter S to give the designation ES of the stand, has a rack-and-pinion motion for the up and down adjustment of the condenser. Since the illuminating apparatus has no iris diaphragm of its own, the condenser must be provided with an iris diaphragm as in type B. Oblique illumination can therefore be produced only within a very narrow range. Below the condenser sliding sleeve is a plain swing-out ring for the reception of special stops, colored screens, or the like. The vertical adjustment of the condenser is required for the correct projection of the field diaphragm and for the adjustment of the dark field condenser. This stand is therefore preferable to Stand EB when dark field observation or work in a closely adjusted path of light are to be carried out in addition to the above named simple work. Stand ES is adapted to the uses of medical men, zoologists, botanists, and workers in similar branches of science.

The third type of Stand E, Stand EC, is equipped with the ABBE illuminating apparatus described in "Mikro 15e." This stand is of low design, but, when armed with the required optical equipment, is equal to the large stands as a working and research instrument for visual observation. It is also suitable for any photomicrographic work capable of being done with the microscope objectives proper in conjunction with eyepieces, Homals or Phoku cameras.

Observation in polarized light demands the attachment of a polarizer and analyser as per page 120, and calls for the use of a revolvable stage.

Stand E is supplied in an alder case.

Besides this form of Stand E representing the hitherto customary monocular type with straight eyepiece, we furnish the stand as

Stand E bi with Inclined Binocular Tube.

Fig. 9, p. 26, shows Stand *ESC bi* with inclined binocular tube. The double eyepiece tube with the prism body can be withdrawn from the lower part of the tube in the same manner as a draw tube. Any combination of illuminating apparatus, stage, and optical equipment within the limitations previously mentioned may be employed.

Stand *E bi* may either be ordered in the first instance with an inclined binocular tube, or it may be completed later by inserting the "Bitukni I" inclined binocular tube (page 128) in the place of the extensible tube or the fixed eyepiece tube. The straight eyepiece tube for interchangeable use with the "Bitukni" is always sent with the latter, since it is needed whenever, for instance, work is to be done with a drawing apparatus or a photomicrographic camera, including the "Phoku".

The extensible tube or the fixed eyepiece tube may also be replaced by the "Monokni E" inclined monocular tube (p. 128). Fig. 7, p. 24, shows Stand E with oblique eyepiece.

For detailed description of Stand E, see "Mikro 405e."



13722

Fig. 4
About 1/3 actual size

Training and Class Microscope

Stand EB

Code word: *Minervalem*

Non-extensible tube, fixed circular stage with condenser sliding sleeve, in alder case.

Equipment No. 102 — Magnifications: 56× to 600×

Iris cylinder diaphragm No. 11 41 05

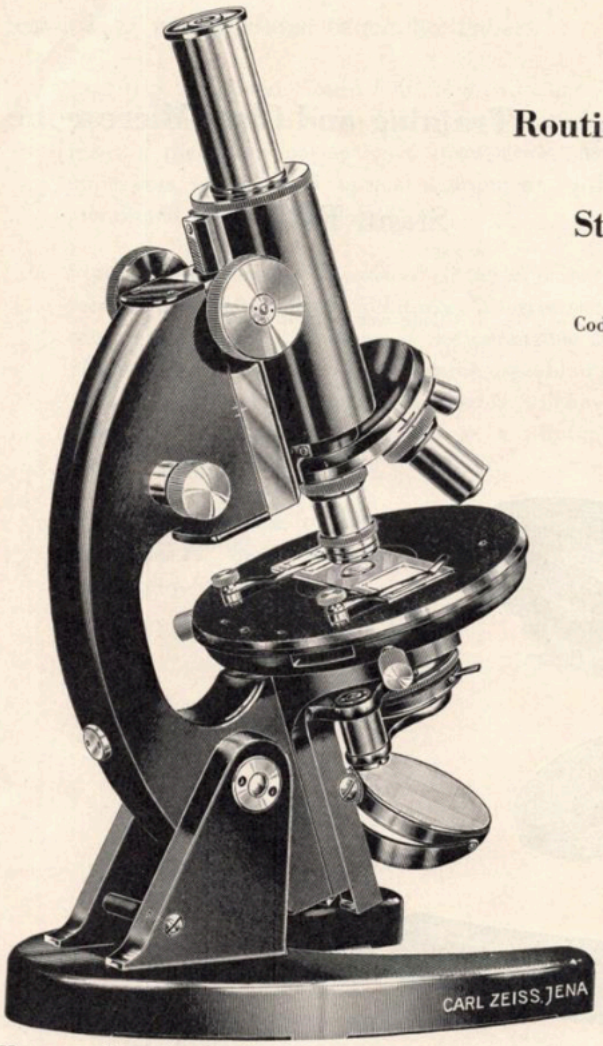
Achromatic objectives	**8,** N.A. 0.20;	**40,** N.A. 0.65
Huygens eyepieces	**7**×	**15**×

Code word: *Kaufa*

Stand EB with Equipment No. 102
for use with above:

No. 12 08 06.	**Simplified attachable mechanical stage**	Code word: *Kaoss*
No. 12 12 05.	**Double revolving nosepiece**	Code word: *Minuebare*
No. 11 35 10.	**Huygens eyepiece 10**×	Code word: *Miluam*
		Code word: *Migliarina*

CARL ZEISS JENA



13721

Fig. 5
About 1/2 actual size

Routine Microscope

Stand ESA

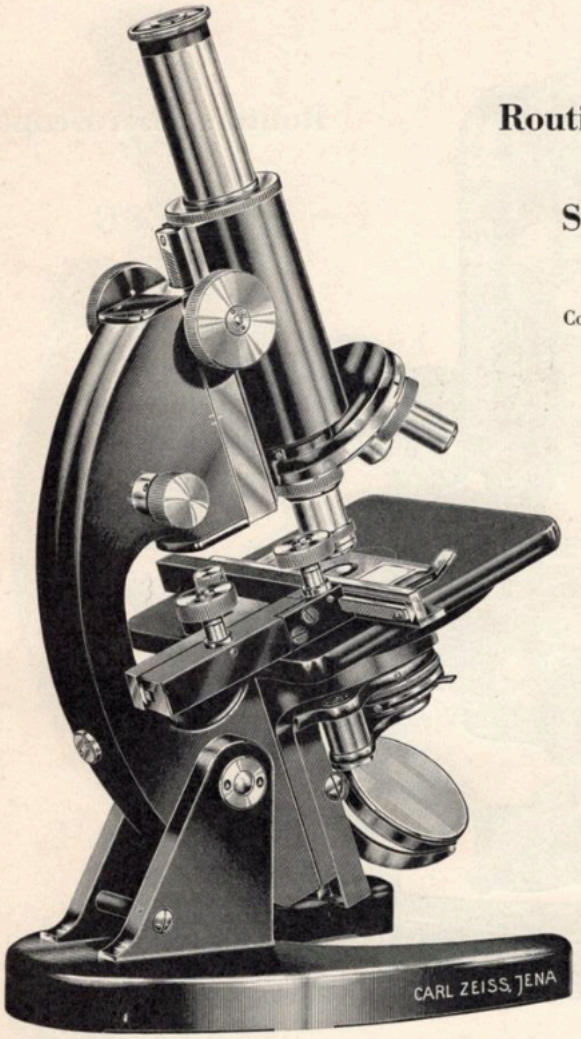
Code word: *Mineriame*

Non-extensible tube, simplified mechanical stage A, simplified illuminating apparatus with rack-and-pinion motion, in alder case.

Equipment No. 116 Magnifications: 56× to 1350×

Condenser 1.2, with iris diaphragm, **Quadruple** revolving nosepiece
Achromatic objectives **8,** N.A. 0.20; **40,** N.A. 0.65;
Oil immersion **90,** N.A. 1.25 with iris diaphragm (also for dark field observation)
Huygens eyepieces, **7**× **15**×

Stand ESA with Equipment No. 116 Code word: *Kauid*
for use with above: Code word: *Minervina*
No. 11 35 10. **Huygens eyepiece** **10**× Code word: *Migliarina*



13717

Fig. 6
About 1/3 actual size

Routine Microscope

Stand ESC

Code word: *Mineriari*

Non-extensible tube, fixed rectangular stage C, simplified illuminating apparatus with rack-and-pinion motion, in alder case.

Equipment No. 117 Magnifications: 56× to 1350×

Condenser 1.2, with iris diaphragm, **Triple** revolving nosepiece.
Achromatic objectives **8,** N.A. 0.20; **40,** N.A. 0.65;
Oil immersion **90,** N.A. 1.25, with iris diaphragm (also for dark field observation)
Huygens eyepieces **7**× **10**× **Compensating eyepiece** **15**×

Stand ESC with Equipment No. 117 Code word: *Kauje*
for use with above:
No. 12 08 06. **Simplified attachable mechanical stage** Code word: *Kauni*
(shown in place in illustration) Code word: *Minuebare*

CARL ZEISS JENA

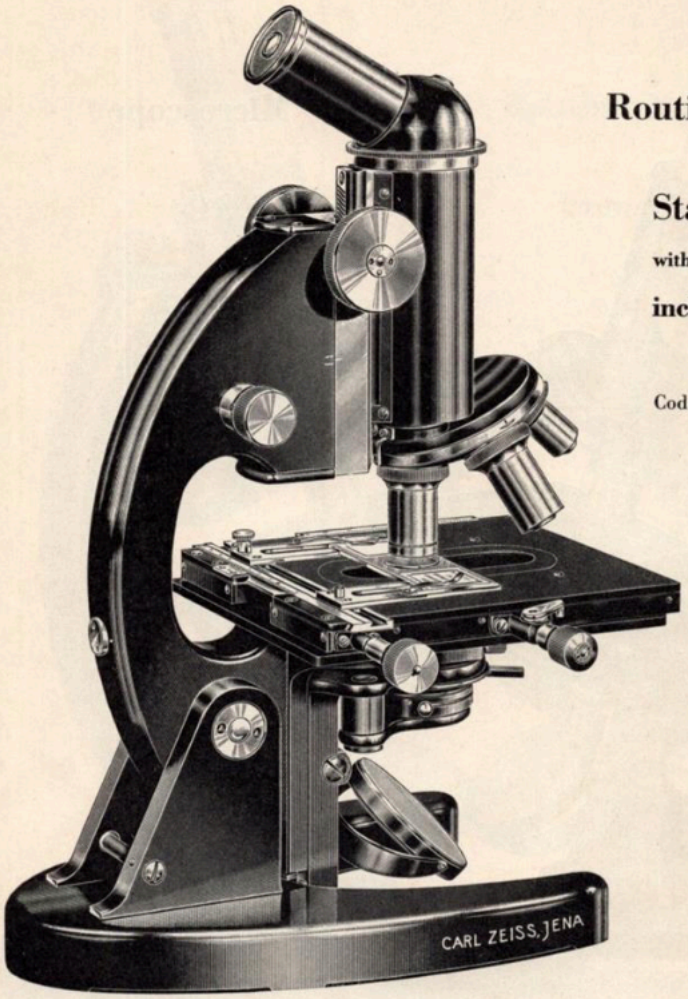
Routine Microscope

Stand ESG

with

inclined eyepiece

Code word: *Kavau*



22423

Fig. 7
About 1/2 actual size

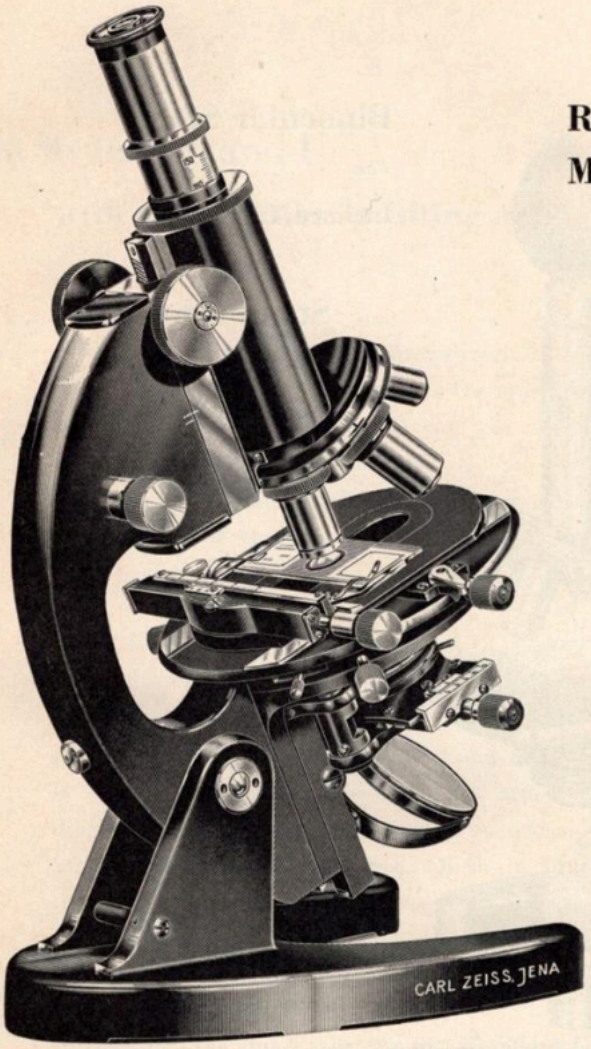
Inclined eyepiece tube, rectangular non-revolvable mechanical stage G, simplified illuminating apparatus with rack-and-pinion motion, in alder case.

Equipment No. 152 (for the examination of blood and similar purposes) Magnifications: 50× to 1350×

Swing-out condenser 1.2, with iris diaphragm **Quadruple** revolving nosepiece
Apochromatic objectives **10,** N.A. 0.30; **20,** N.A. 0.65;
Oil immersion **90,** N.A. 1.30 and
60, N.A. 1.0 (X) with iris diaphragm (especially for dark field observation)
Compensating eyepieces **5**×, **10**×, **15**×

Code word: *Kavey*

Stand ESG with inclined eyepiece, with Equipment No. 152 Code word: *Kaooo*



Routine and Research Microscope

Stand ECE

Code word: *Minorater*

13716

Fig. 8
About 1/3 actual size

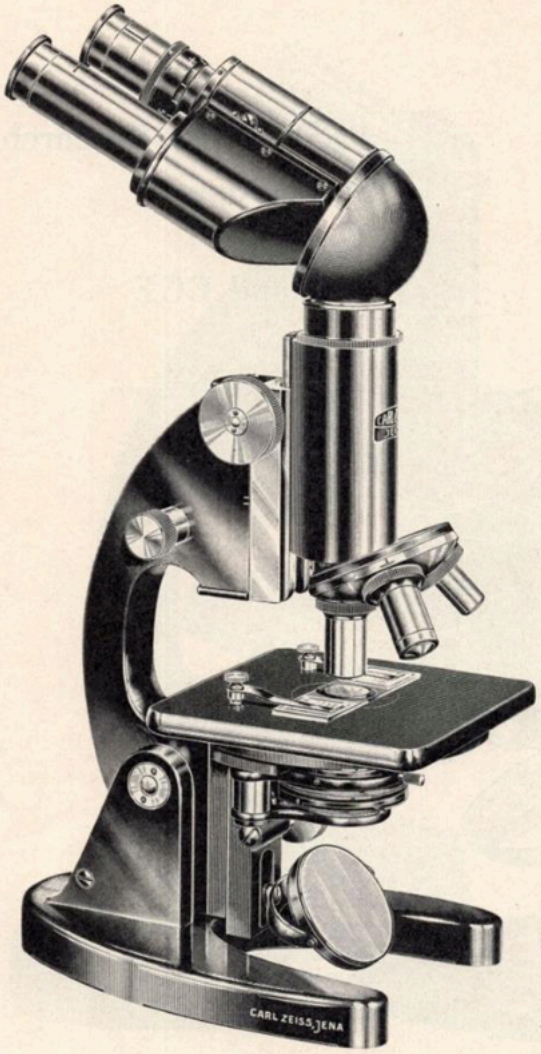
Draw tube with millimetre scale, large mechanical stage E, ABBE illuminating apparatus, in alder case.

Equipment No. 330 Magnifications: 15× to 1500×

Condenser 1.2 **Quadruple** revolving nosepiece
Achromatic objectives **3,** **8,** N.A. 0.20; **40,** N.A. 0.65;
Fluorite objective Oil immersion **100,** N.A. 1.30
Huygens eyepieces **5**×, **7**× (micrometer), **10**×, **Compensating eyepiece** **15**×
1:100 Object micrometer

Code word: *Kavga*

Stand ECE, with Equipment No. 330 Code word: *Kakko*



22308

Fig. 9
About 1/5 actual size

Binocular Stand

with

Inclined Tube

Stand ESC bi

Code word: *Kaklp*

Extensible binocular inclined tube, interchangeable with straight monocular eyepiece tube, fixed rectangular stage, simplified illuminating apparatus with rack-and-pinion motion, in alder case.

Equipment No. 218 Magnifications: 21× to 1350×

Condenser 1.2, with iris diaphragm **Quadruple** revolving nosepiece

Achromatic objectives **3,** **8,** N.A. 0.20; **40,** N.A. 0.65;

Oil immersion **90,** N.A. 1.25, with iris diaphragm (also for dark field observation)

Paired Huygens eyepieces **7×,** **10×** **Paired compensating eyepieces** **15×**

for use with above: Code word: *Kavic*

No. 12 08 06. **Simplified attachable mechanical stage** (Fig. 6)

Code word: *Minuebare*

Stand ESC bi, with simplified attachable mechanical stage and Equipment No. 218

Code word: *Kavke*

b) Medium Stand U

with slow motion in tilting axis

Stand U is of otherwise the same design as Stand E, but has the *slow motion heads in the tilting axis* instead of in the upper portion of the limb. This is a valuable new feature because it prevents the adjustment of the microscopic image from being in any way disturbed by the observer's hand in taking hold of or letting go the focusing head. Assurance in working is thereby increased, and the forearm of the observer can remain resting by its whole length on the table.

Stand U is furnished either as Stand UC with *ABBE illuminating apparatus C*, or as Stand UT with *simplified illuminating apparatus T*. Illuminating apparatus T differs from the ABBE illuminating arrangement in that the diaphragm carrier with lateral motion and rotating device for the iris diaphragm is omitted, leaving only the swing-out arm with the iris diaphragm. The iris diaphragm may therefore be swung to one side to produce oblique illumination, but cannot be revolved. Both in illuminating apparatus C and T, *condensers without iris diaphragm* and with rack-and-pinion vertical adjustment are used. Illuminating apparatus T may at any later time be converted into C by ordering the diaphragm carrier.

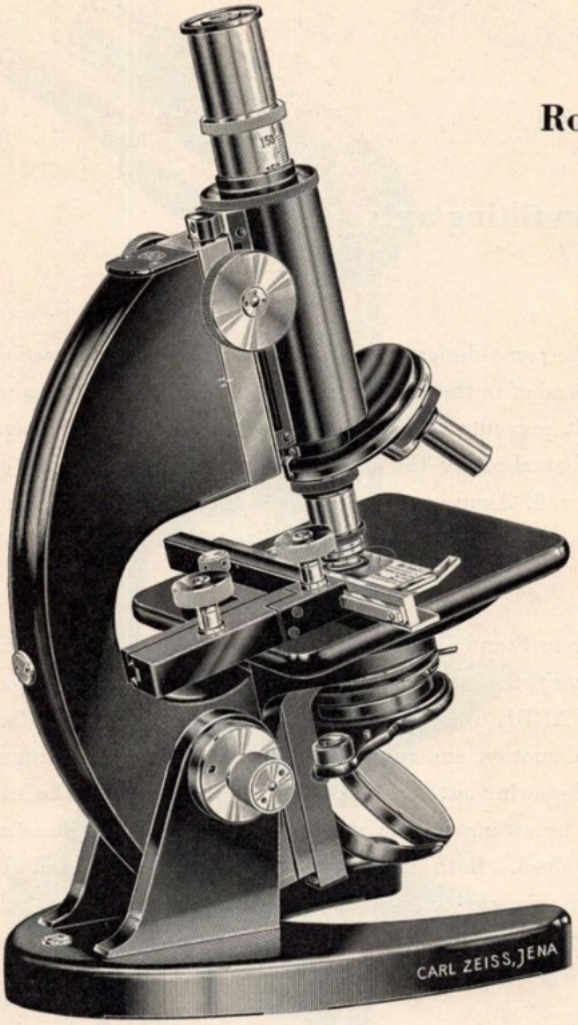
In regard to the stages, the remarks on Stand E apply.

Stand U can be used the same as Stand E with the "*Monokni E*" *inclined monocular tube*, or *with the* "*Bitukni I*" *inclined binocular tube*. When the "Bitukni" is used, adapter No. 12 85 21/3 is screwed to the body tube in place of the sleeve for the draw tube.

Routine Microscope

Stand UTC

Code word: *Karnl*



22354

Fig. 10
About $^1/_2$ actual size

Draw tube with millimetre scale, fixed rectangular stage C, and vertically adjustable illuminating apparatus T with iris diaphragm, in alder case.

Equipment No. 317 — Magnifications: 56× to 1350×

Condenser 1.2 — **Triple** revolving nosepiece

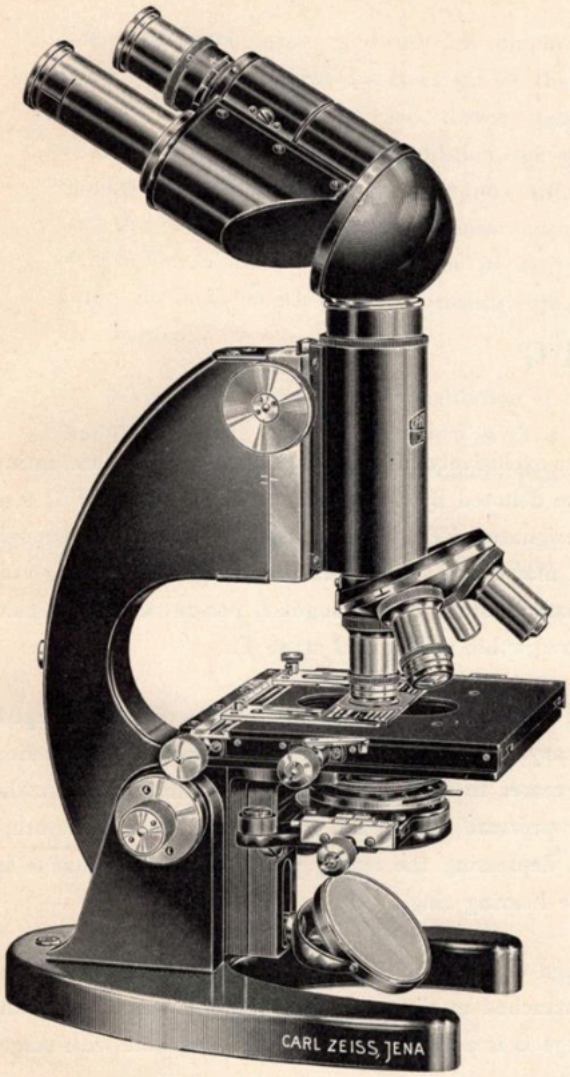
Achromatic objectives **8,** N.A. 0.20; **40,** N.A. 0.65;
Oil immersion **90,** N.A. 1.25, with iris diaphragm (also for dark field observation)

Huygens eyepieces **7**×, **10**× — **Compensating eyepiece** **15**×

Stand UTC, with Equipment No. 317 — Code word: *Kavoi*

for use with above: — Code word: *Kavun*

No. 12 08 06. **Simplified attachable mechanical stage** (shown in place in Fig. 10) — Code word: *Minuebare*



Routine and Research Microscope

Stand UCG bi

Code word: *Karek*

22355

Fig. 11
About $^1/_2$ actual size

Inclined binocular tube, interchangeable with straight eyepiece tube, ABBE illuminating apparatus, rectangular mechanical stage, in alder case.

Equipment No. 631 Magnifications: 70× to 1500×

Condenser 1.2
Quadruple revolving nosepiece
Achromatic objectives **10,** N.A. 0.3; **20,** N.A. 0.4;
Fluorite objectives **40,** N.A. 0.85 in correction mount;
Oil immersion **100,** N.A. 1.3;
Paired Huygens eyepieces **7×, 10×;** **Paired compensating eyepieces** **15×**
Code word: *Kavvo*

Stand UCG bi, with Equipment No. 631 Code word: *Katup*

c) Large Stands F and G

The large Stands F and G are exclusively furnished with the ABBE illuminating apparatus, and are therefore denoted by the second letter C. Stand F is also made in a second form designated FZ. Both stands are inclinable through an angle of 90 degrees, and may be equipped with revolving and centring vulcanite stage D, large mechanical stage E, rectangular, non-revolvable mechanical stage G, or photomicrographic mechanical stage F.

The vulcanite stage and the large mechanical stage can be directly interchanged. To do this, it is only necessary to turn the two centring screws in the centring piece back until the stage ceases to follow, and then to lift the stage from the centring piece with a light pressure against the spring pin in front. The other stage is then inserted by depressing the spring pin, which must engage in the milled slot in the stage bearing ring.

Rectangular mechanical stage G does not fit the centring piece of stages D or E, and must therefore be attached to the stage carrier of the stand by means of a threaded adapter. Stage G is accordingly not interchangeable with stages D and E.

Photomicrographic mechanical stage F also does not fit the centring piece of stages D and E, but is attached with the aid of an intermediate piece which must be screwed to the stand in the place of the centring piece, and then adjusted. It is further necessary to adapt the stop of the illuminating apparatus for the vertical adjustment of the condenser to the stage height of F. If at all practicable, this fitting should be done at our works.

The diaphragm carrier and the iris diaphragm are both graduated. From these scales, the lateral displacement of the iris diaphragm from the centre position can be accurately read, thereby permitting the iris diaphragm to be used in stereoscopic work. In addition, the graduation on the iris diaphragm renders it possible to determine at any time the diameter of the aperture, *i. e.*, the effective size of the condenser opening, and therewith the aperture of the illumination. The diameter of the diaphragm opening, divided by twice the focal length of the condenser, equals the numerical aperture of the illumination.

For purposes of obtaining close regulation of the path of the illuminating light, Stands F and G may be furnished with a universally movable rectangular prism (p. 90), in place of the customary plane and concave mirror.

Additional price of Stands with rectangular prism

Additional Code word: *Kavys*

1. Stand F

Stand F is a stand *with interchangeable tubes*. It is a large stand with a straight binocular tube, an extensible monocular tube, and a polarizing tube. The tubes are seated on a fixed shoulder provided with a slideway for holding the revolving nosepiece, the small sliding objective changer, the vertical illuminator, or other adapters for objectives as required. One slide fitting is furnished with the Stand. Objectives need not be exchanged.

The binocular tube is intended for observation with both eyes and stereoscopic observation with *one objective*. The draw tube of the wide monocular tube may be locked by a clamp. The binocular tube therefore unites the advantages of the extensible and the non-extensible tube. It is not, however, intended for use with Planars, which require special adapters (see Mikro 422e).

The polarizing tube is intended for biological and histological examinations in polarized light. It has an insertable polarizer in the telecentric light beam directly above the objective, as well as a slide for gypsum and mica plates. The polarizing tube may be equipped with a wide eyepiece tube for a 6×eyepiece with extra large flat field of view.

Stand F is supplied in two forms differing by their illuminating apparatus. One of these, Stand FC, is provided with the standard ABBE illuminating apparatus described in "Mikro 15e" and shown in Fig. 16a. The other model, Stand FZ, is equipped with an illuminating apparatus having a *slideway*, Fig. 16b, instead of the usual sliding sleeve for the reception of condensers. Stand FZ cannot therefore be used with the customary condensers, but requires *special condensers* provided with slides fitting the slideway. The slide arrangement affords a means of individually centring the condensers.

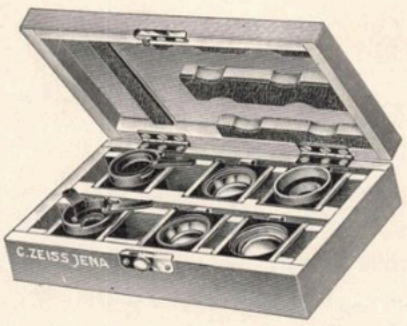


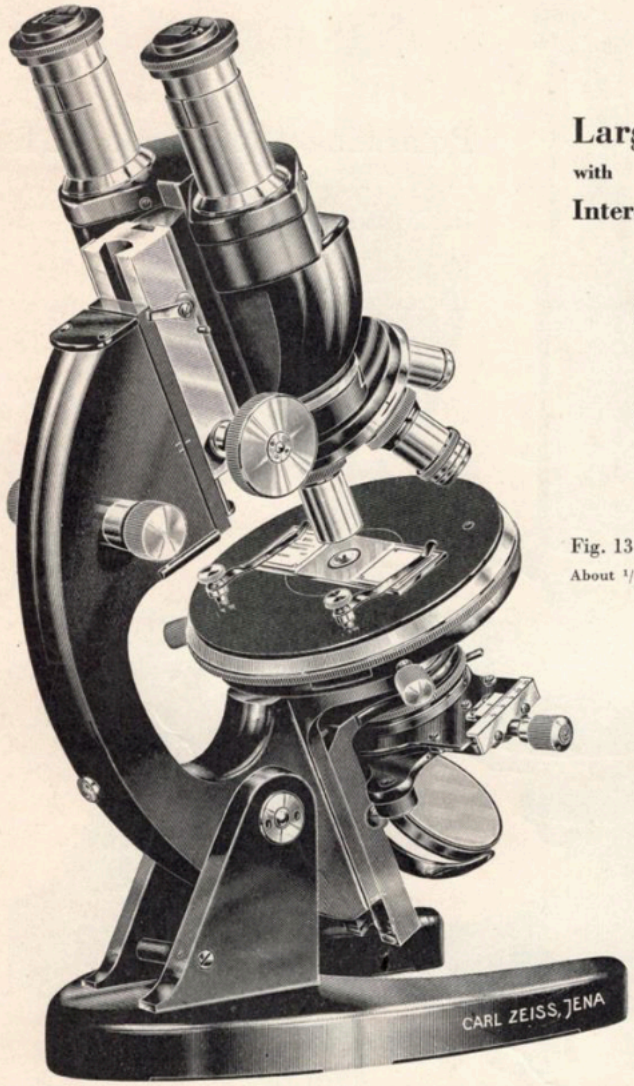
Fig. 12. About 1/6 actual size 11745

A special small wooden case is provided for the safe keeping of the slide condensers Z for Stand FZ.

No. 12 14 25. Case for 6 slide condensers Z

Code word: *Miniemur*

For detailed description of Stand F, see "Mikro 418e."

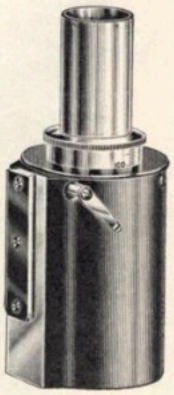


Large Microscope
with
Interchangeable Tubes

Stand FCD

Code word: *Kawha*

Fig. 13
About 1/3 actual size



13385

Straight binocular and monocular tubes, revolving and centring vulcanite stage D, ABBE illuminating apparatus, in mahogany case.

Equipment No. 654 Magnifications 70× to 1350×

Aplanatic condenser 1.4 **Quadruple** revolving nosepiece

Apochromatic objectives **10,** N.A. 0.30; **20,** N.A. 0.65; **40,** N.A. 0.95;
Oil immersion **90,** N.A. 1.30

Paired "*Mobimi*" compensating eyepieces **7**×, **10**×, **15**×

Code word: *Kawib*

Stand FCD with Equipment No. 654 Code word: *Minimato*

CARL ZEISS JENA

Polarizing Microscope FCE

for

Biological

and

Histological Work

Code word: *Kawle*

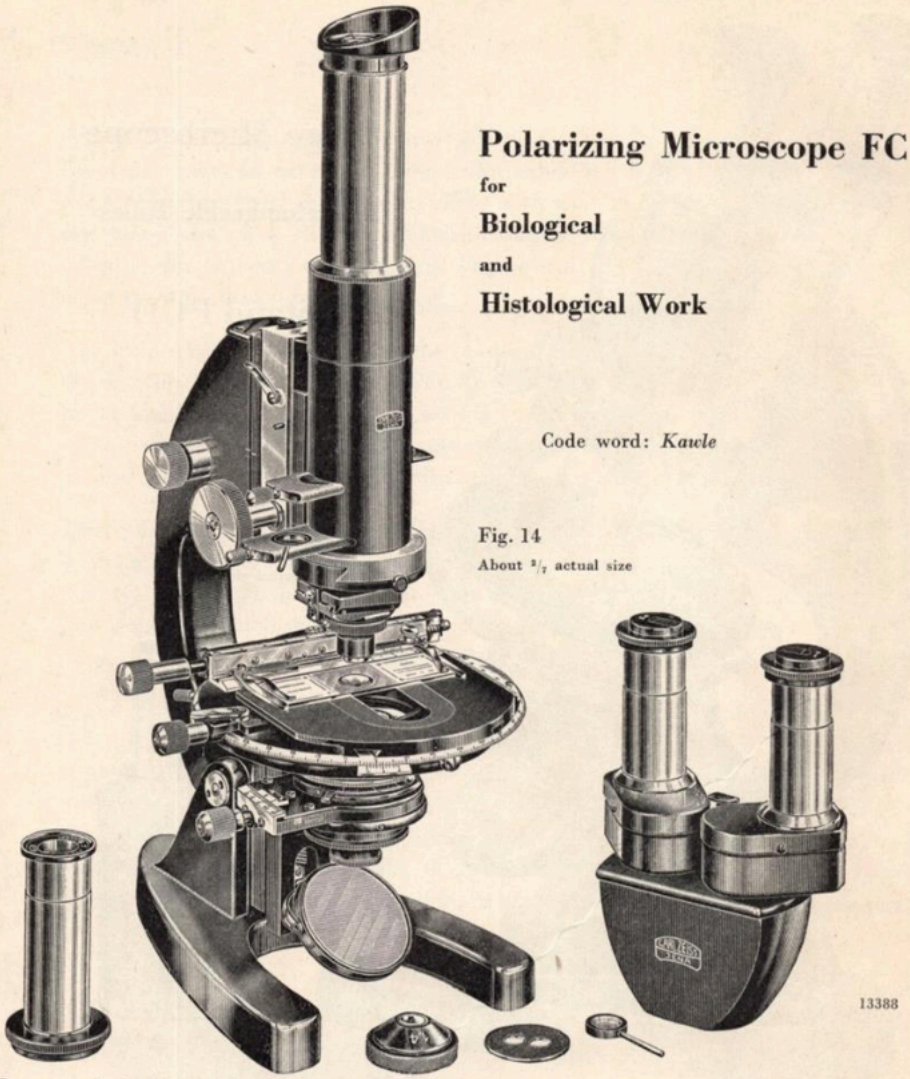
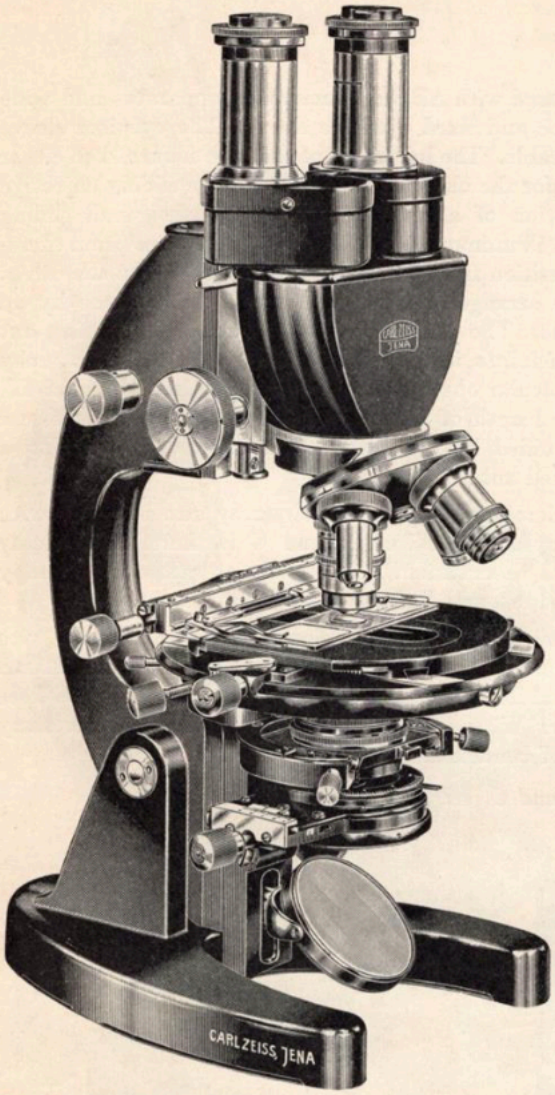


Fig. 14
About $^1/_7$ actual size

13388

Large mechanical stage E with graduated rim, **polarizing tube** with sliding analyser, slide with gypsum plate R I, $^1/_4$ wave mica plate and polarizer I, in mahogany case.

Equipment No. 591 Magnifications: 21× to 1350×
Condenser 1.2 Small tube slide with 5 objective slides
Achromatic objectives 3; **20**, N.A. 0.40; Case for 6 objectives with slides
40, N.A. 0.65; Oil immersion **90**, N.A. 1.25 with iris diaphragm
Eyepiece H 7× with cross lines, **Micrometer eyepiece H 10**×, **Compensating eyepiece 15**×
Special objective M = 8, N.A. 0.2, with **6**× eyepiece with wide eyepiece tube for large flat field of view Code word: *Kawoh*
Stand FCE, with Equipment No. 591 Code word: *Kawpi*
For use with above;
Binocular tube, with one each **H 7**×, **H 10**×, and **K 15**× eyepiece Code word: *Kawsk*



Large Microscope

with

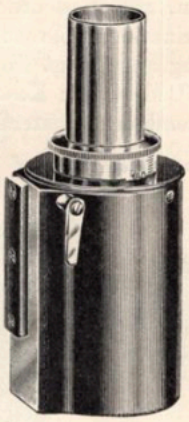
Interchangeable Tubes

and

Centring Slide Condenser

Stand FZE

Code word: *Kawum*



13895

Fig. 15

About 1/3 actual size

Straight binocular and monocular tubes, large mechanical stage E, ABBE illuminating apparatus with centring slide for Z condensers, in mahogany case.

Equipment No. 592 Magnifications: 15× to 2400×

Aplanatic Z condenser 1.4, with slide **Quadruple** revolving nosepiece

Apochromatic objectives **5,** N.A. 0.15; **10,** N.A. 0.30; **20,** N.A. 0.65 **40,** N.A. 0.95;
Oil immersion **60,** N.A. 1.4; **90,** N.A. 1.3; **120,** N.A. 1.3; **60,** N.A. 1.0 (X)
with *iris diaphragm* (especially for dark field observation)

Paired "Mobimi" eyepieces, **K 7**×, **K 10**×, **K 15**×, **K 20**×

Single compensating eyepieces, **K 3**×, **K 5**×, **K 7**× (micrometer)

1:100 stage micrometer Code word: *Kawwo*

Stand FZE, with Equipment No. 592 Code word: *Minimava*

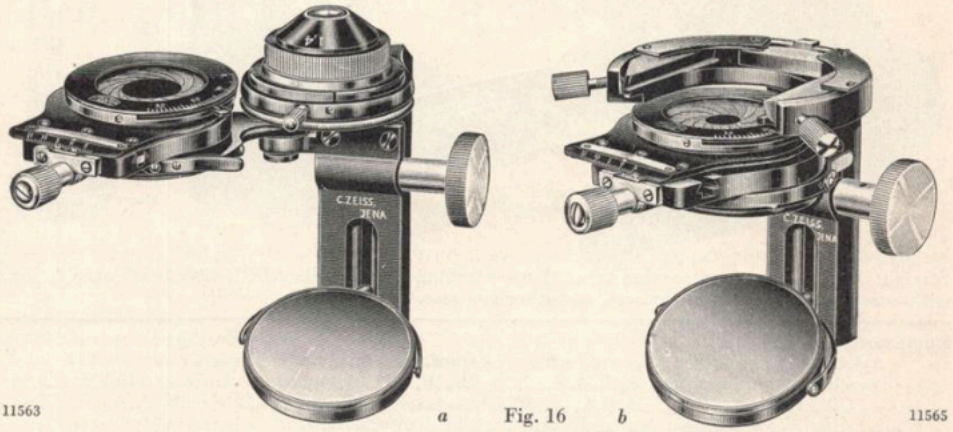
2. Stand G

Stand G is a *large monocular stand* with ABBE illuminating apparatus and wide tube equipped with draw tube and fixed eyepiece sleeve. The eyepiece sleeve and draw tube are interchangeable. The lower end of the tube is furnished either with a nose plate with thread for the objectives, or with a large sliding objective changer made for the reception of a revolving nosepiece, the small sliding objective changer, the vertical illuminator, or a single objective. Provision therefore exists for convenient transition from one mode of observation to the other. Binocular observation can be arranged for by replacing the draw tube by an inclined binocular tube (p. 128). The exchange is simply made by pulling out one tube and sliding the other into its place. In like manner, the stand may be equipped for inclined monocular observation by inserting the "Monokni H" (p. 128). The increase in tube length of 5 mm. ordinarily resulting from the use of the "Monokni" may be avoided by replacing the ordinary draw tube by a special adapter for the inclined tube.

With the wide tube, photomicrographic general views may also be taken with Planars and similar photographic objectives. Stand G is therefore not only particularly adapted to visual observation, but equally to photomicrograhpy and projection (see "Mikro 414e" and "Mikro 440e").

In addition, and if so ordered, Stand G may be equipped as Stand FZ with the Z illuminating apparatus for centring condensers, instead of the usual *ABBE* illuminating apparatus. For additional price of Stands GZ over Stands GC see additional Code word: Kawyr. With type GZ stands, it is of course necessary to use Z condensers instead of condensers with sliding sleeve.

For detailed description of Stand G, see "Mikro 425e."

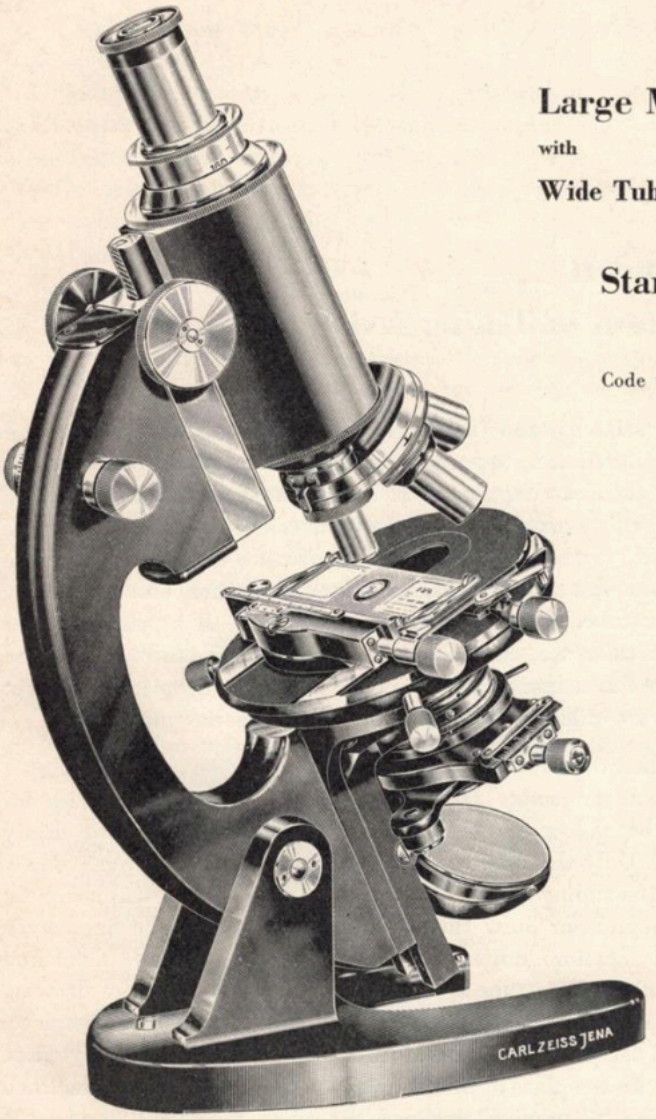


11563 *a* Fig. 16 *b* 11565

ABBE Illuminating Apparatus

a) with sliding sleeve condenser (Stands FC, GC, HC, and SC)

b) with centring slide for Z condensers (Stands FZ, HZ, etc.)



Large Microscope

with

Wide Tube

Stand GCE

Code word: *Minguado*

13710

Fig. 17

About $^1/_2$ actual size

Large mechanical stage E, ABBE illuminating apparatus, in mahogany case.

Equipment No. 355 Magnifications: 25× to 1800×

Aplanatic condenser 1.4

Quadruple revolving nosepiece

Apochromatic objectives **5,** N.A. 0.15; **10,** N.A. 0.30; **20,** N.A. 0.65; **40,** N.A. 0.95; Oil immersion **90,** N.A. 1.30;

Compensating eyepieces **5**×, **10**×, **15**×, **20**×, and **7**× (micrometer)

1:100 stage micrometer

Code word: *Kaxas*

Stand GCE, with Equipment No. 355 Code word: *Minimis*

d) New Large Stand H with Slow Motion in Tilting Axis

The new Stand H is a large stand capable of being inclined through 90° and equipped with ABBE illuminating apparatus and interchangeable tubes. Stand H is capable of a wide range of adaptation. It may be used as a *monocular stand* either *with straight eyepiece*, or *with inclined eyepiece* as in Fig. 20. It can be changed into a *binocular stand with inclined eyepiece* as in Fig. 19, which is convertible in the simplest possible manner for monocular observation by exchanging the upper tube. It may further be equipped with a *polarizing tube for monocular and binocular* use, and with a *photomicrographic tube*. The stand may first be purchased as a monocular stand with straight eyepiece, and supplemented as needed by ordering any or all of the accessories mentioned.

In changing from observation with one eye to observation with both eyes and vice versa, the monobjective body tube with the changing device for the objectives and the sliding sleeve for the eyepiece tubes remains firmly attached to the stand. Only the eyepiece tube with the eyepiece is removed by withdrawing it from the sliding sleeve. The simplest case is represented by the use of the straight monocular draw tube, which, however, can be fixed by a clamping device and therefore unites the advantages of both the fixed and extensible eyepiece tubes. This tube is required, for instance, when a drawing apparatus is used. It is further of advantage in adjusting a micrometer eyepiece, and can be employed for photomicrographic work with objective and eyepiece or with the "Phoku." In the place of this tube, either the "Monokni H" inclined monocular tube, or the "Bitukni I" inclined binocular tube (p. 128) may be used in the body tube.

If the first tube is to be used interchangeably with the polarizing or photomicrographic tubes, or if the latter tubes are to be alternately employed, then the complete tube with objectives is freed by loosening the lateral clamp, withdrawn from the dovetail guide of the tube carrier, and replaced by the tube to be used with the required optical equipment.

The polarizing tube is provided with a sliding analyser and telecentric path of light for the analyser. It may be used for observation in polarized or in ordinary light. Its wide eyepiece sleeve may be reduced by slip-in adapters, to enable the tube to be employed in conjunction with ordinary eyepieces and eyepieces with enlarged field of view. Besides, the adapter for the inclined eyepiece tubes may be screwed in place, allowing binocular observation to be made in polarized light.

The special photomicrographic tube has a lateral eyepiece permitting visual observation, with the camera in place, by the use of a prism which can be inserted into the path of the light. Rapid transition to the photographic exposure is effected by simply withdrawing the prism from the path of the light. Special adapters are provided to enable the tube to be used with Planars.

An important innovation is the design of the slow motion. The axis of the focusing head coincides with the tilting axis, and is thus at a height allowing the hand and arm of the observer to remain comfortably supported on the work table. A particular advantage of this arrangement is that in taking hold of or releasing the manipulating head and in operating the slow motion, no pressure whatever capable of disturbing the focusing adjustment on the preparation is transferred to the tube. At the same time, the new slow motion is twice as sensitive as formerly. While, in hitherto existing microscopes of our manufacture, one revolution of the slow motion is equivalent to a vertical shift of the tube of about 0.1 mm., it equals but 0.05 mm. in Stand H. One interval on the slow motion head therefore corresponds in Stand H to a tube movement of about 0.001 mm.

Like Stand F, Stand H is furnished with one of two types of illuminating apparatus. Of these, Stand HC has the usual ABBE arrangement. The illuminating apparatus of the second form, Stand HZ, like Stand FZ (p. 32), does not have a sliding sleeve for the condensers, but is instead made with a slideway permitting only the use of the Z condensers. In Stand HZ, the condensers can therefore be separately centred.

The diaphragm carrier and iris diaphragm are of the same design as in Stands F and G.

The stages used with Stand H are D, E, F, and in special cases G. Stages D and E are interchangeable in the customary way. The other stages have a screw adapter instead of a centring piece, and are therefore not interchangeable. Stage F, moreover, requires an alteration in the limit stop of the illuminating apparatus. If this alteration is to be made at any time after purchase, the stand will have to be sent in to our factory.

For detailed information, see "Mikro 488e."

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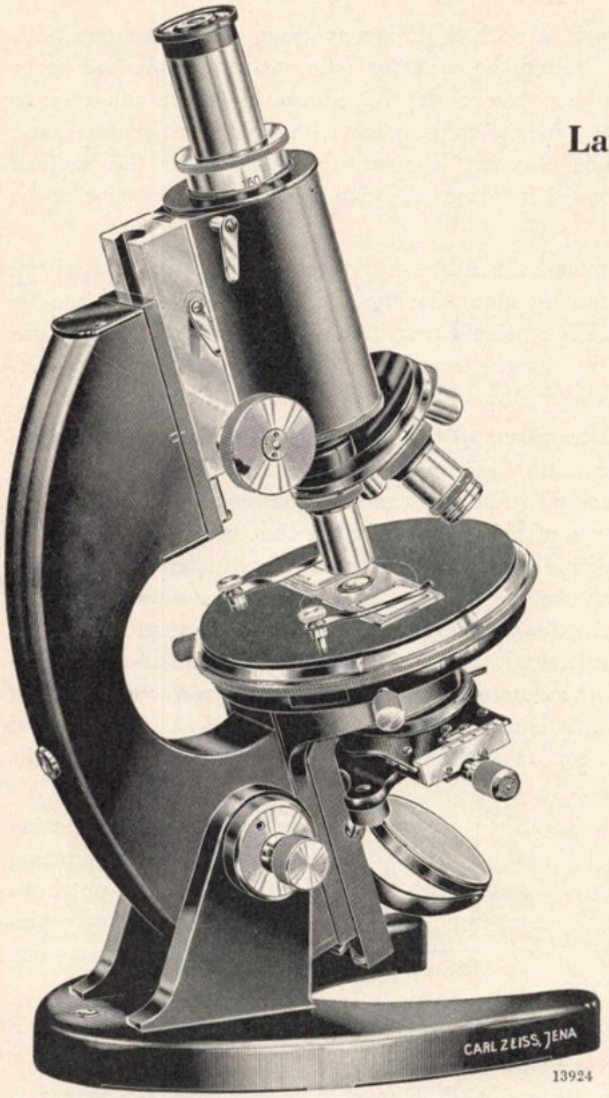


Large Microscope

Stand HCD

Code word: *Kabiw*

Fig. 18
About 1/2 actual size

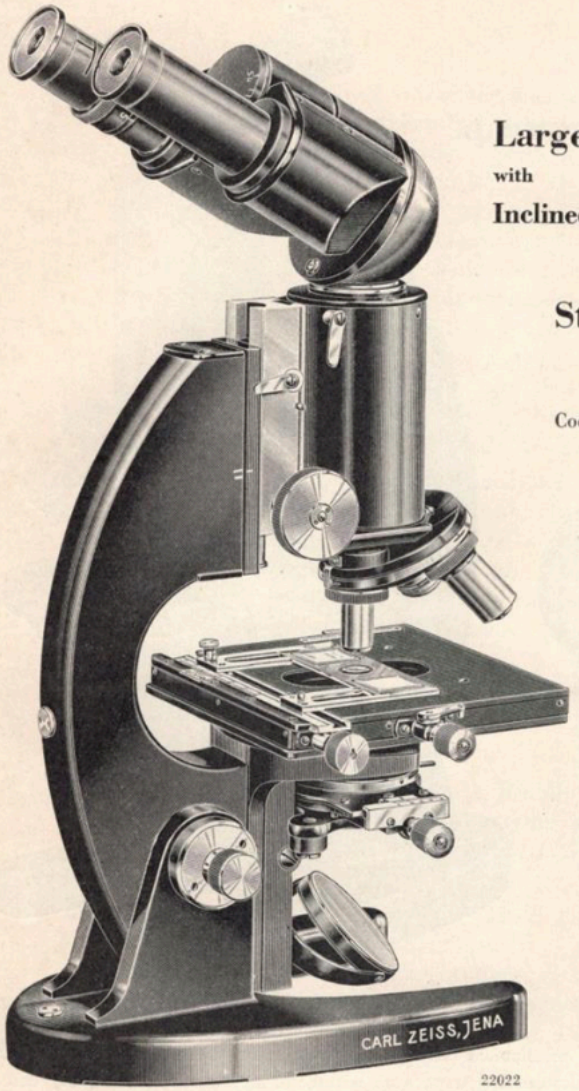
Slow-motion head in tilting axis, revolving and centring stage D, ABBE illuminating apparatus, in mahogany case.

Equipment No. 331 Magnifications: 70× to 1500×

Condenser 1.2 **Quadruple** revolving nosepiece
Achromatic objectives **10,** N.A. 0.3; **20,** N.A. 0.4
Fluorite objectives **40,** N.A. 0.85, in correction mount;
Oil immersion **100,** N.A. 1.3;
Huygens eyepieces, **7**×, **10**×; Compensating eyepiece **15**×

Code word: *Kaxcu*

Stand HCD, with Equipment No. 331 Code word: *Kaxew*



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Large Binocular Microscope

with

Inclined Binocular Tube

Stand HCG bi

Code word: *Kaxgy*

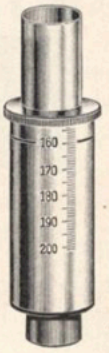


Fig. 19
About 2/3 actual size

Slow-motion head in tilting axis, inclined binocular tube, clamping draw tube, rectangular mechanical stage G, ABBE illuminating apparatus, in mahogany case.

Equipment No. 659 Magnifications: 35× to 1350×

Aplanatic condenser 1.4 **Quadruple** revolving nosepiece

Apochromatic objectives **5**, N.A. 0.15; **10**, N.A. 0.3; **20**, N.A. 0.65;
Oil immersions **60**, N.A. 1.4; **90**, N.A. 1.3;

Paired compensating eyepieces **7**×, **10**×, **15**× Code word: *Kaxia*

Stand HCG bi with Equipment No. 659 Code word: *Kaxme*

Large Tube Change Microscope
with
Inclined Eyepiece Tubes

Stand HZE

Code word: *Kaxog*

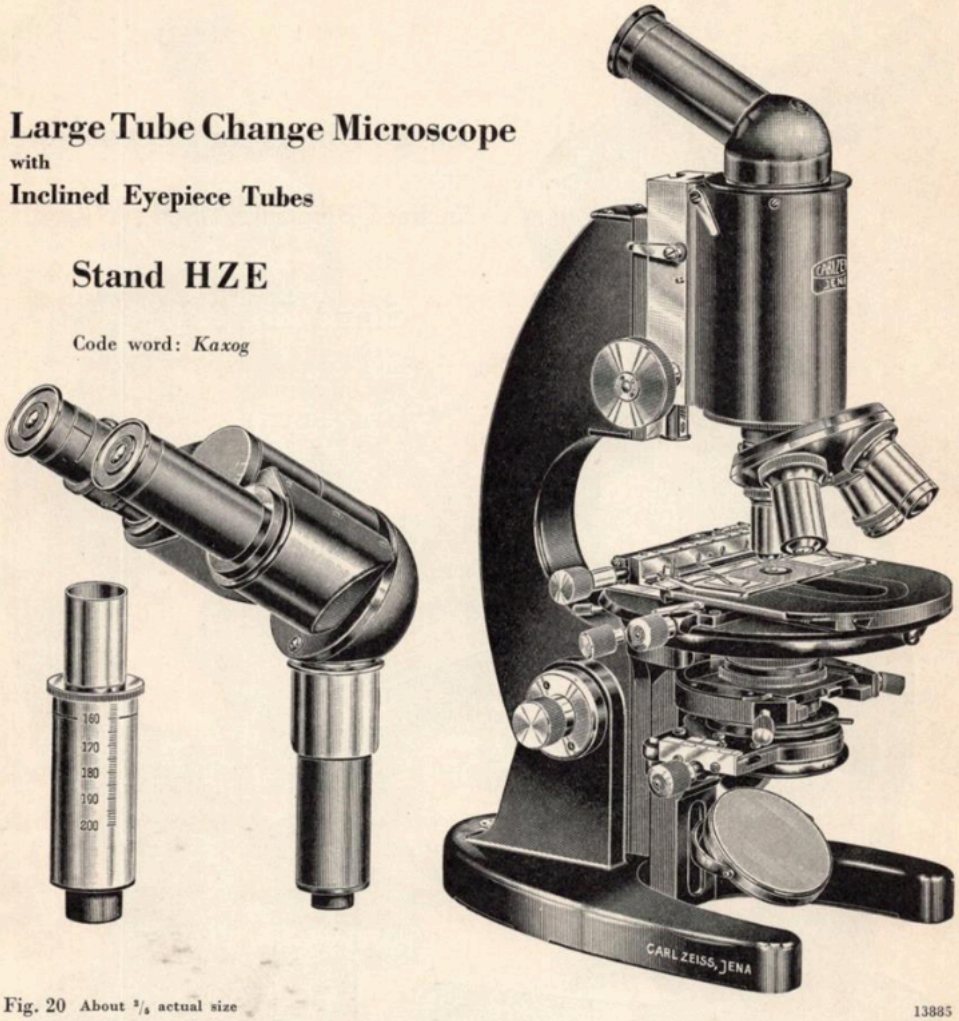


Fig. 20 About 1/6 actual size

13885

Slow-motion head in tilting axis, large mechanical stage E, clamping draw tube, inclined monocular tube, inclined binocular tube, ABBE illuminating apparatus with centring slide, in mahogany case.

Equipment No. 593 Magnifications: 50× to 1800×

Aplanatic Z condenser 1.4 **Quadruple** revolving nosepiece

Apochromatic objectives **10**, N.A. 0.3; **20**, N.A. 0.65; **40**, N.A. 0.95
Oil immersions **60**, N.A. 1.4; **90**, N.A. 1.3

Compensating eyepieces **5**×, micrometer, **7**× adjustable, **20**×,

Paired eyepieces K **7**×, **10**×, **15**×

1:100 object micrometer Code word: *Kaxri*

Stand HZE, with Equipment No. 593 Code word: *Kaxul*

e) Stand L

Stand L is a new and novel stand of unusually *low design*. All motion devices are arranged one behind the other below the plane of the stage, making the stand very deep at the bottom. From this point, the limb sweeps up and forward in a wide curve, terminating in the optical axis of the instrument in a head made with a thread on top and an oblique slideway at the bottom. The tube commonly used in ordinary stands is eliminated. To the top of the head, an inclined *monocular or binocular tube* may be directly screwed, while a triple or quadruple revolving nosepiece provided with a suitable slide fitting is introduced into the oblique slideway below. It is from these features that the stand derives its unusually low form. The binocular tube increases the total magnification to 1.5 times the normal, and a lower eyepiece magnification will therefore as a rule have to be used. Because of the presence of the inclined eyepiece, the stand has no provision for tilting.

Stand L may be equipped with *three types of illuminating arrangement*. One of these is the simplified illuminating apparatus T, which differs from the ABBE illuminating apparatus by the omission of the diaphragm carrier proper with adjustable and revolving iris diaphragm. The iris diaphragm in illuminating apparatus T is fixed to the diaphragm carrier, and is merely capable of being swung out sideways with it. The condenser is vertically adjustable by a rack-and-pinion motion.

The second form of the stand is LC, with ABBE illuminating apparatus. Illuminating apparatus T as well as C can be used with the condensers in sliding sleeve without iris diaphragm.

Finally, Stand L may be fitted with illuminating apparatus Z, *i. e.*, with an ABBE illuminating apparatus with centring slide for the condensers. With the stand in this form, only the "Z" or slide condensers can be employed.

The stages ordinarily provided are the revolving and centring vulcanite stage D, and the large mechanical stage E. These have the same centring piece and are therefore readily interchangeable. For special work in polarized light, the stages may be furnished with graduated rim (see p. 106). Stands L may also be equipped with non-revolvable rectangular mechanical stage G (p. 105). Finally, a photomicrographic stage F (p. 107) is provided for photomicrographic work in which it is not necessary to search large surfaces, but where very exact adjustments of the stage must be made within small ranges.

For use with a drawing apparatus or with the "Phoku" photographic eyepieces, a straight tube with fixed eyepiece may be interchangeably screwed to the head of the carrier arm. In addition, a quadruple revolver with inclined eyepiece and a so-called Epi-bar are provided. The bar is designed for holding the Epi-condenser W described on page 102, in observing objects placed by the side of the stand.

For detailed description, see "Mikro 492e."

Modern Routine Microscope

with

Inclined Eyepiece Tube

Stand LTD

Code word: *Kaxxo*



Fig. 21
About 1/3 actual size

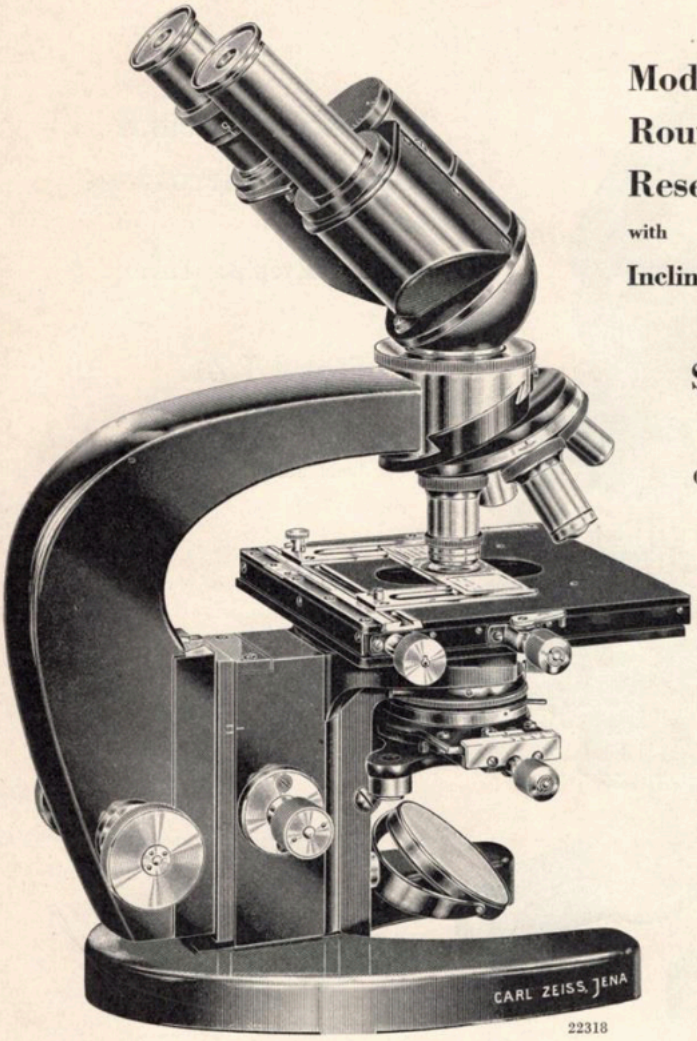
Coarse and slow motions close to foot, inclined monocular tube, illuminating apparatus T| with swing-out iris diaphragm, revolving and centring vulcanite stage D, in mahogany case.

Equipment No. 319 L Magnifications: 56× to 1350×

Condenser N.A. 1.2 **Quadruple** revolving nosepiece on slide
Achromatic objectives **8**, N.A. 0.20; **20**, N.A. 0.40; **40** N.A. 0.65
Oil immersion **90**, N.A. 1.25, *with iris diaphragm* (also for dark field observation)
Huygens eyepieces **7**×, **10**×; **Compensating eyepiece** **15**×

Code word: *Kaxyp*

Stand LTD, with Equipment No. 319 L Code word: *Kaobb*



Modern Binocular Routine and Research Microscope

with

Inclined Eyepiece Tube

Stand LCG

Code word: *Kayar*

Fig. 22
About 1/2 actua size

Coarse and slow motions close to foot, inclined binocular tube L (1.5 × magnification), ABBE illuminating apparatus C, rectangular mechanical stage G, in mahogany case.

Equipment No. 636 L Magnifications: 75× to 1500×

Swing-out condenser, N.A. 1.2 **Quadruple** revolving nosepiece on slide

Achromatic objectives **10**, N.A. 0.30; **20**, N.A. 0.40

Fluorite objective 40, N.A. 0.85, in correction mount; Oil immersion **100,** N.A. 1.30;

Paired Huygens eyepieces **5**×, **7**× **Paired compensating eyepieces** **10**×

Code word: *Kaybs*

Stand LCG, with Equipment No. 636 L Code word: *Kayct*

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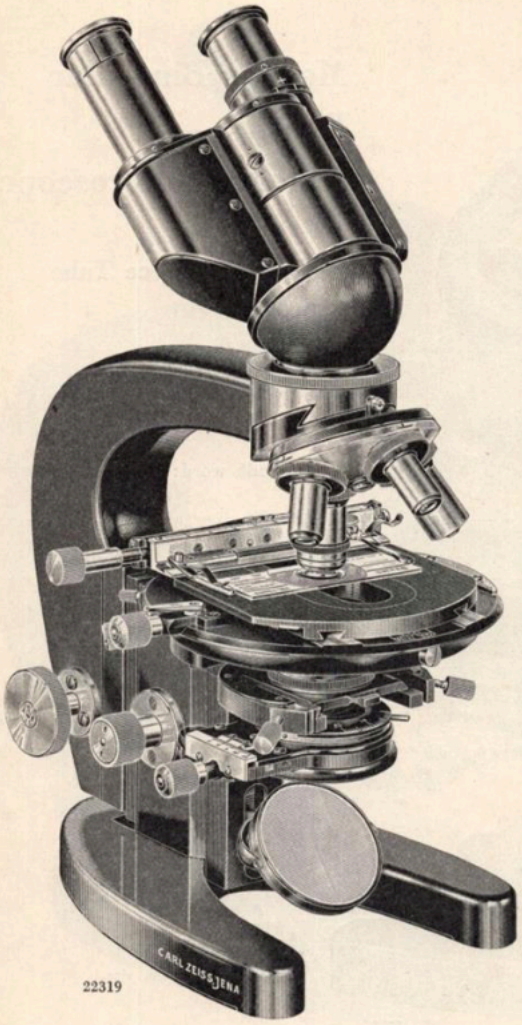

Modern Monocular Research Microscope

with

Inclined Eyepiece Tube

Stand LZE

Code word: *Kaydu*

Fig. 23
About $^1/_2$ actual size

Coarse and slow motions close to foot, inclined binocular tube L (1.5 × magnification), ABBE illuminating apparatus Z with centring slide for Z condensers, large mechanical stage E, in mahogany case.

Equipment No. 857 L — Magnifications: 52× to 2000×

Aplanatic condenser N.A. 1.4 — **Quadruple** revolving nosepiece on slide

Apochromatic objectives **5**, N.A. 0.15; **20**, N.A. 0.65;

Oil immersions **60**, N.A. 1.0 *with iris diaphragm*, especially for dark field observation

90, N.A. 1.3

Paired compensating eyepieces **7**×, **10**×, **15**× — Code word: *Kayev*

Stand LZE, with Equipment No. 857 L — Code word: *Kayiz*

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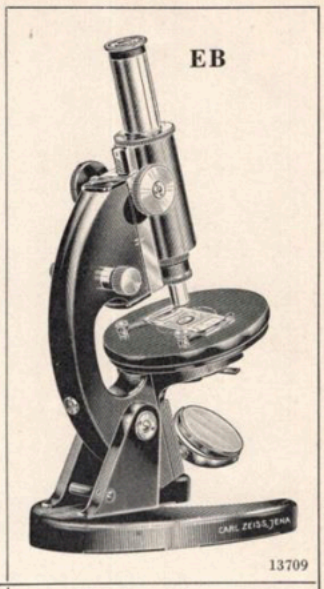
Stands EB

Simple Microscope Stands for Use of Classes and Beginners

Non-extensible Tube

Stage with Fixed Condenser Sliding Sleeve



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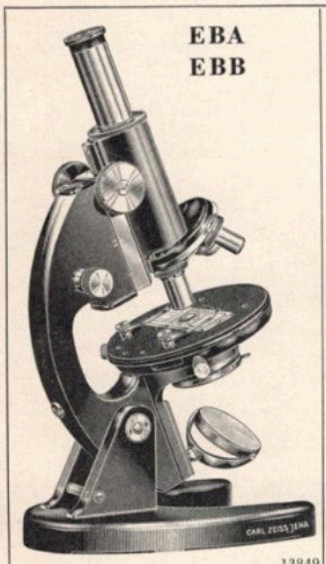

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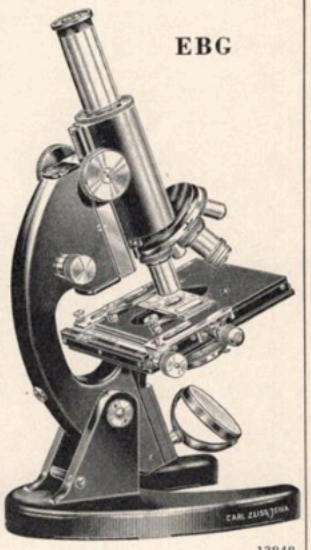

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No.		Code word
12 32 05	**Stand EB** with fixed circular stage	*Minervalem*
12 32 06	**Stand EBA** with simplified mechanical stage **A**	*Minervalor*
12 32 07	**Stand EBB** with simplified revolving stage **B**	*Minervalyt*
12 32 08	**Stand EBC** with fixed rectangular stage **C**	*Minerval*
12 32 09	**Stand EBG** with non-revolving rectangular stage **G**	*Minervalus*

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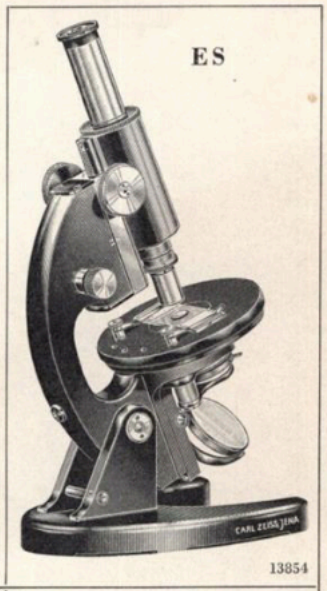
Stands ES

Routine Microscopes

Non-extensible Tube

Simplified Illuminating Apparatus with rack-and-pinion motion



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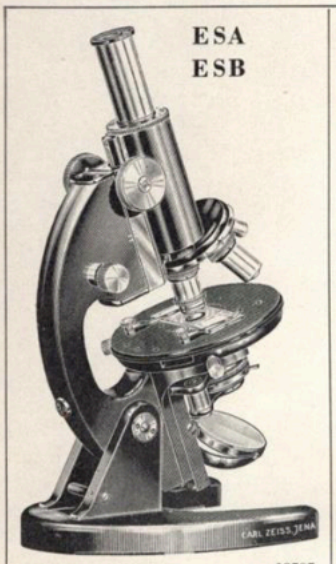

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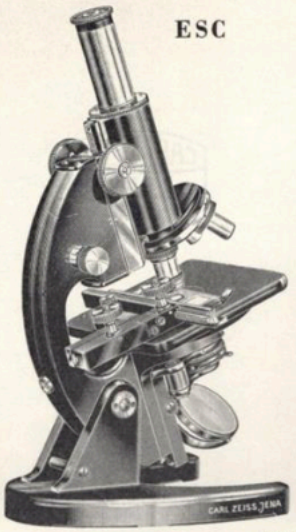

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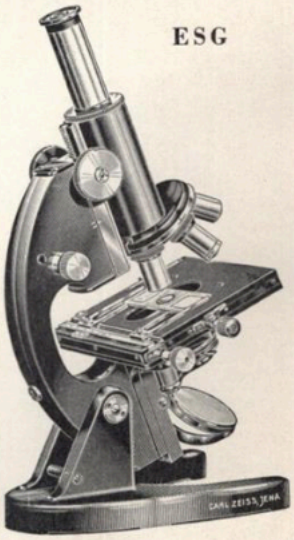

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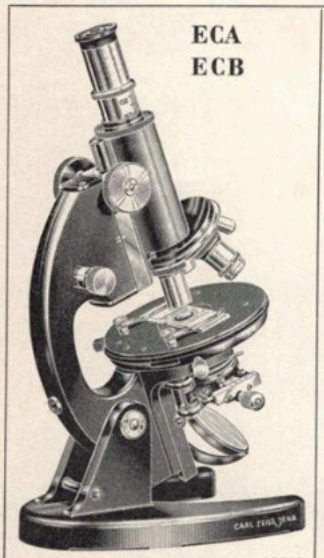
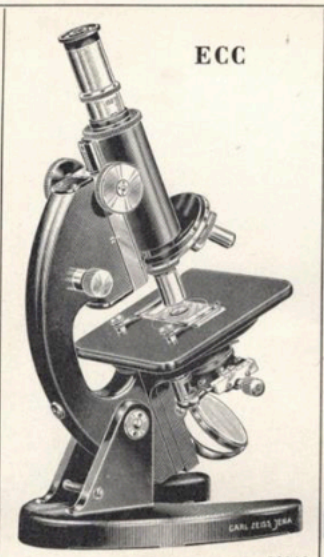
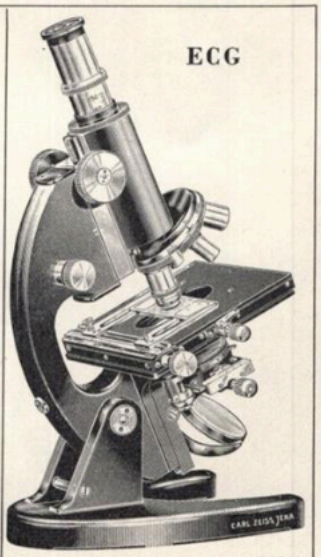
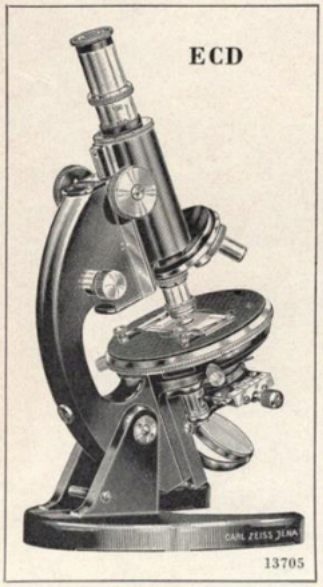
No.		Code word
12 33 05	**Stand ES** with fixed circular stage	*Mineria*
12 33 06	**Stand ESA** with simplified mechanical stage **A**	*Mineriame*
12 33 07	**Stand ESB** with simplified revolving mechanical stage **B**	*Minerianno*
12 33 08	**Stand ESC** with fixed rectangular stage **C**.....	*Mineriari*
12 33 09	**Stand ESG** with non-revolving rectangular mechanical stage **G**	*Mineriasu*
—	Extra for Stands with extensible tube	*Minervalia*
12 32 04	Extensible tube only	*Minerviulo*







No.		Code word
12 32 16	**Stand ECA** with simplified mechanical stage **A**	*Minora*
12 32 21	**Stand ECB** with simplified revolving mechanical stage **B**	*Minoterie*
12 32 20	**Stand ECC** with fixed rectangular stage **C**.....	*Minorato*
12 32 19	**Stand ECG** with non-revolving rectangular mechanical stage **G**	*Minorabis*



Stands EC

Draw Tube
with Millimetre Scale

ABBE
Illuminating Apparatus

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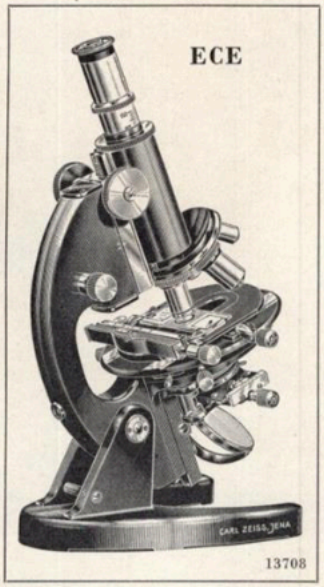
JENA



No.		Code word
12 32 17	**Stand ECD** with revolving and centring vulcanite stage **D** ..	*Minoraba*
12 32 18	**Stand ECE** with large compound mechanical stage **E**	*Minoraber*
12 32 03	Fixed eyepiece sleeve	*Minotier*

Plate 1

Stands E

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Plate 2

Stands U

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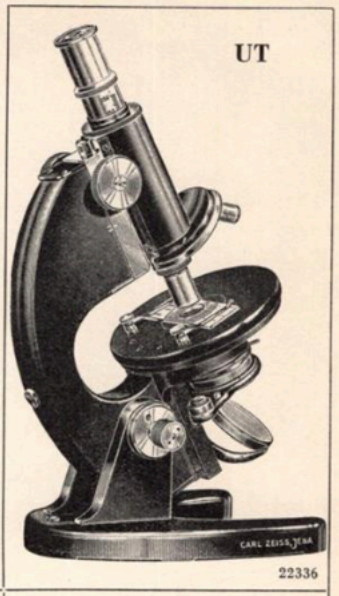
JENA

Stands UT

Slow-Motion Head in Tilting Axis

Draw Tube with Millimetre Scale

Vertically Adjustable Illuminating Apparatus T with swing-out iris diaphragm



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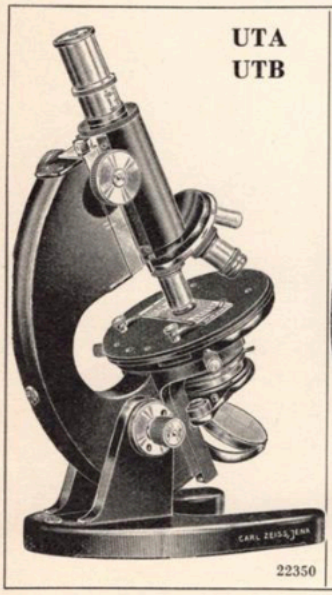

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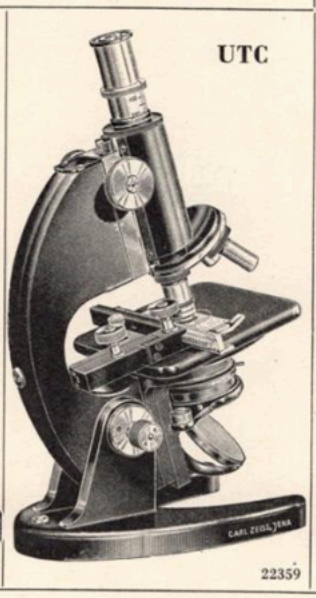

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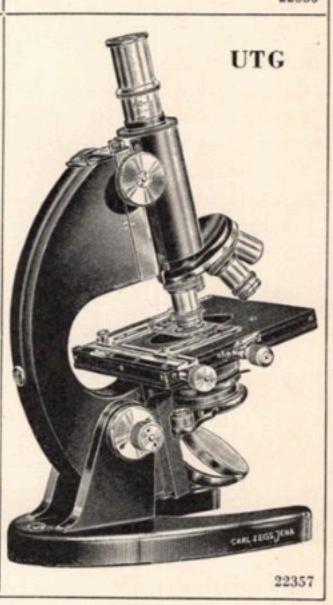

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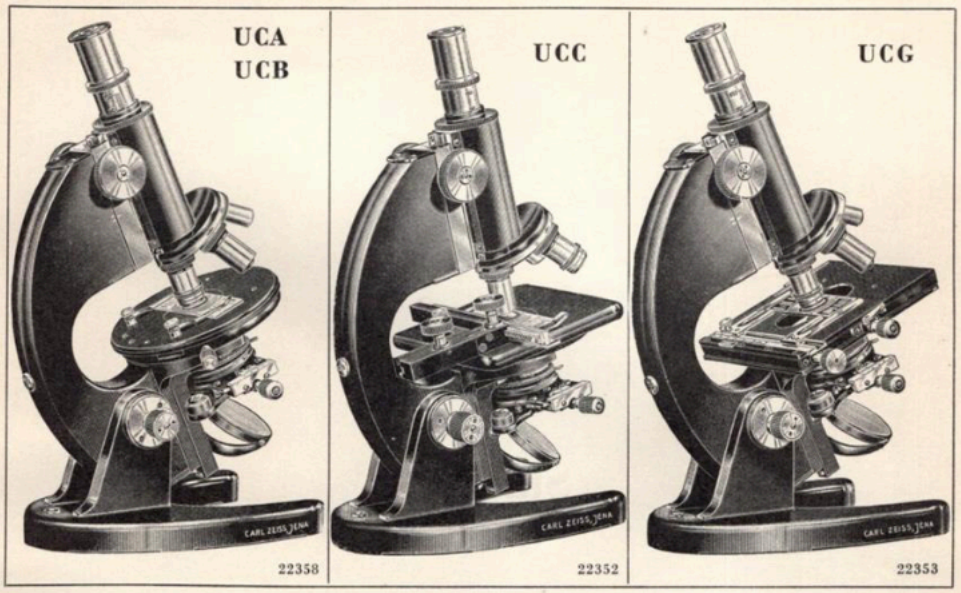
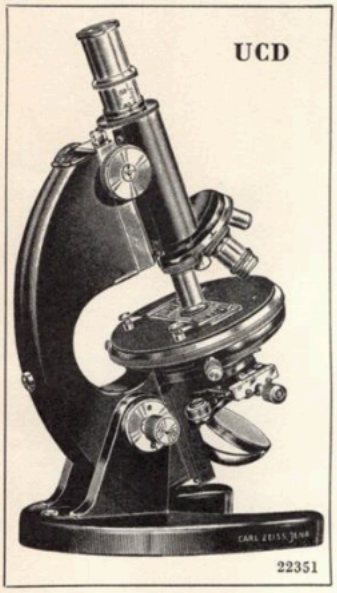
No.		Code word
12 39 11	**Stand UT** with fixed circular stage	*Karki*
12 39 12	**Stand UTA** with simplified mechanical stage **A**	*Karmk*
12 39 13	**Stand UTB** with simplified revolving mechanical stage **B** ...	*Kaysi*
12 39 14	**Stand UTC** with fixed rectangular stage **C**	*Karnl*
12 39 18	**Stand UTG** with non-revolving rectangular mechanical stage **G**	*Karsp*



No.		Code word
12 39 02	**Stand UCA** with simplified mechanical stage **A**	*Karwu*
12 39 03	**Stand UCB** with simplified revolving mechanical stage **B**	*Kayuk*
12 39 04	**Stand UCC** with fixed rectangular stage **C**	*Karyw*
12 39 08	**Stand UCG** with non-revolving rectangular mechanical stage **G**	*Kasda*



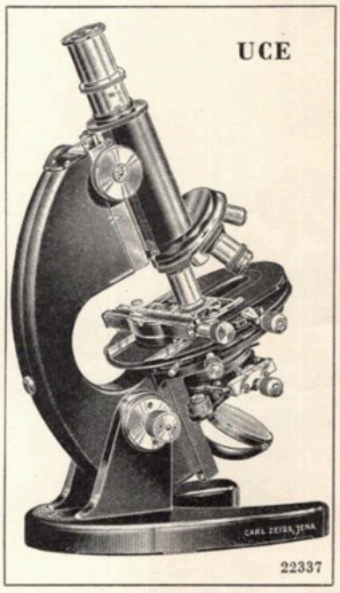
Stands UC

Slow-Motion Head in Tilting Axis

ABBE Illuminating Apparatus

Draw Tube with Millimetre Scale

CARL ZEISS JENA



No.		Code word
12 39 05	**Stand UCD** with revolving and centring vulcanite stage **D** ..	*Kasax*
12 39 06	**Stand UCE** with large compound mechanical stage **E**	*Kasby*

Plate 3

Stands F and G

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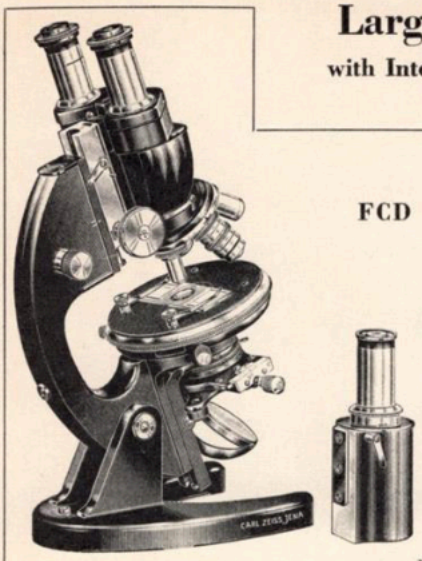
Large Stands F

with Interchangeable Tubes

FCD



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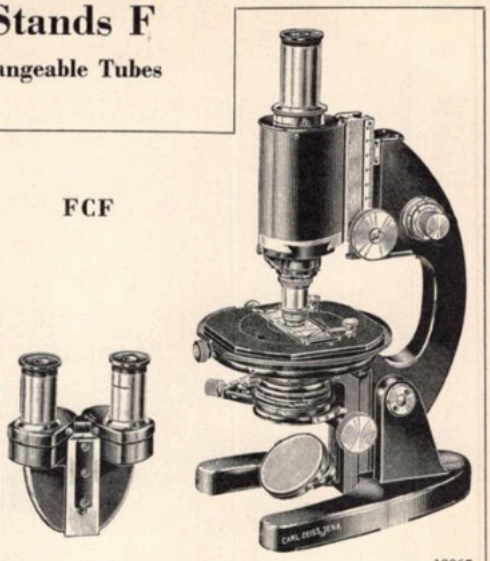
FCF



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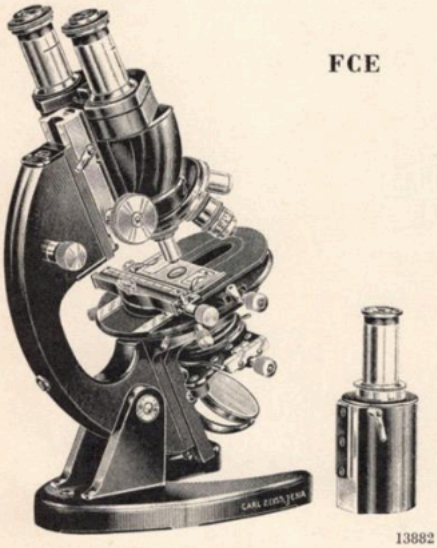
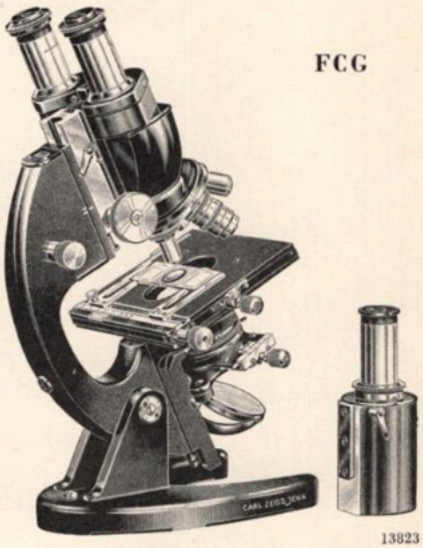
FCE



13882

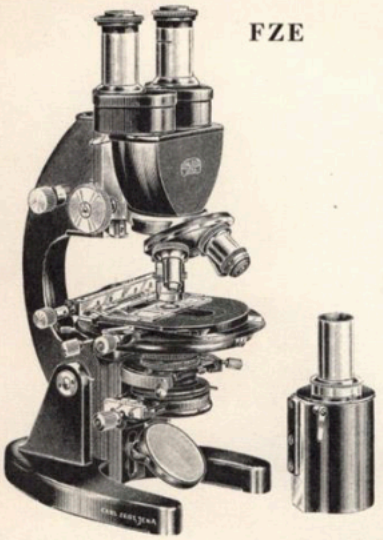
FCG



13823

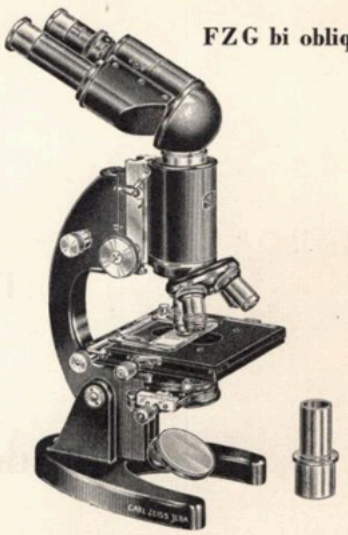
No.		Code word
	Stands FC with ABBE illuminating apparatus, **without tube:**	
12 29 05	**Stand FCD** with revolving and centring vulcanite stage **D**	*Miniatis*
12 29 06	**Stand FCE** with large compound mechanical stage **E**	*Miniatius*
12 29 07	**Stand FCF** with photomicrographic mechanical stage **F**	*Miniatom*
12 29 08	**Stand FCG** with non-revolving rectangular mechanical stage **G**	*Kazap*
	For use with above:	
12 29 10	**Binocular tube** (with two stereoscopic stops)	*Miniatore*
12 29 11	**Wide monocular tube** with clamping draw tube	*Miniatorum*
12 31 18	**Polarizing tube**	*Minuisca*

FZE



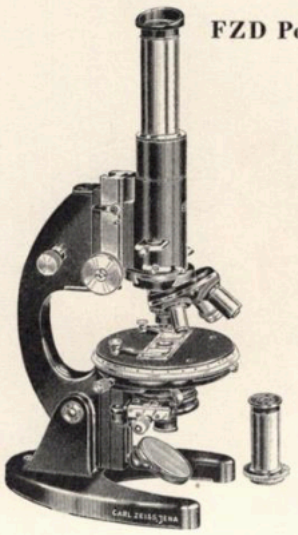
13881

FZG bi oblique



22020

FZD Pol.



22015

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No.		Code word
	Stands FZ with ABBE illuminating apparatus and centring condenser slide, **without tube:**	
12 28 05	**Stand FZD** with revolving and centring vulcanite stage **D** ...	*Miniatote*
12 28 06	**Stand FZE** with large compound mechanical stage **E**	*Miniatrice*
12 28 08	**Stand FZG** with non-revolving rectangular mechanical stage **G**.	*Kazeu*
	For use with above:	
12 29 10	**Binocular tube** (with two stereoscopic stops)	*Miniatore*
12 29 11	**Wide monocular tube** with clamping draw tube	*Miniatorum*
12 86 12	**Inclined binocular tube** with body tube	*Kazka*
12 31 18	**Polarizing tube**	*Minuisca*

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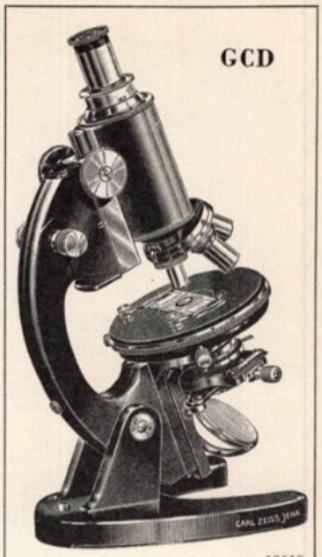
Large Stands G

ABBE Illuminating Apparatus

Draw Tube with Millimetre Scale

Wide tube



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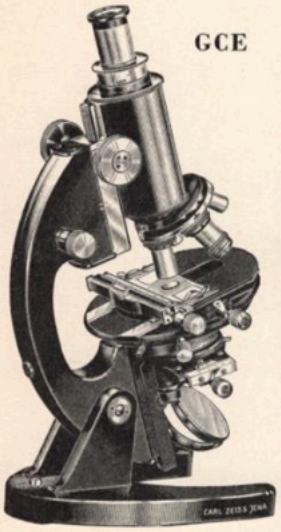

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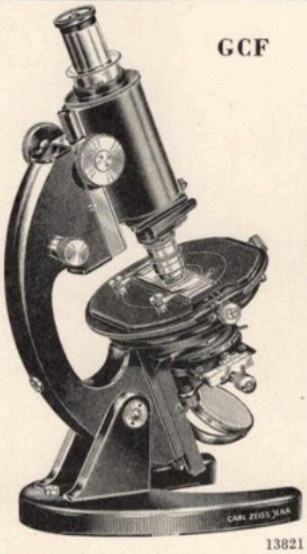

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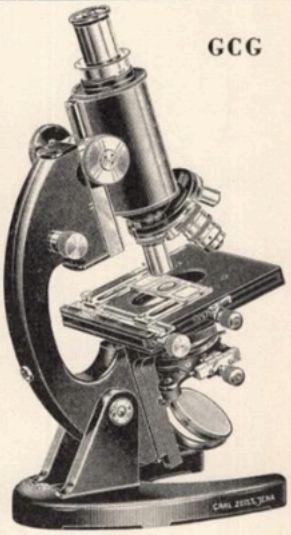

13824

No.		Code word
12 30 05	**Stand GCD** with revolving and centring vulcanite stage **D** ...	*Mingua*
12 30 06	**Stand GCE** with large compound mechanical stage **E**	*Minguado*
12 30 07	**Stand GCF** with photomicrographic mechanical stage **F**.....	*Mingrana*
12 30 08	**Stand GCG** with non-revolving rectangular mechanical stage **G**	*Minot*

Plate 4

Stands H

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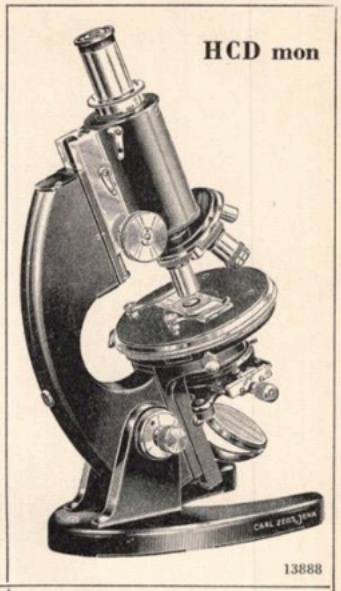
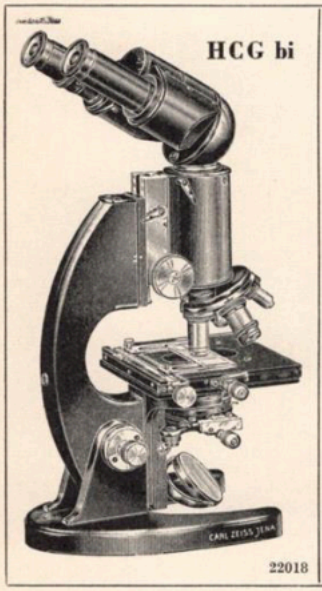
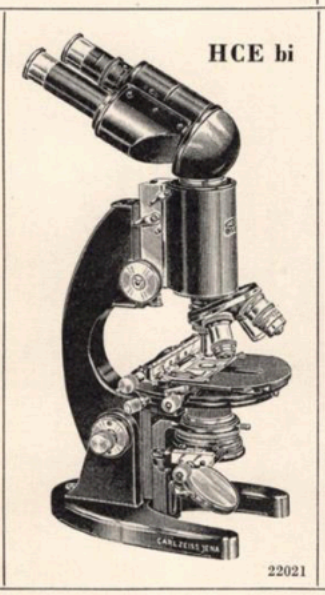
Large Stands H

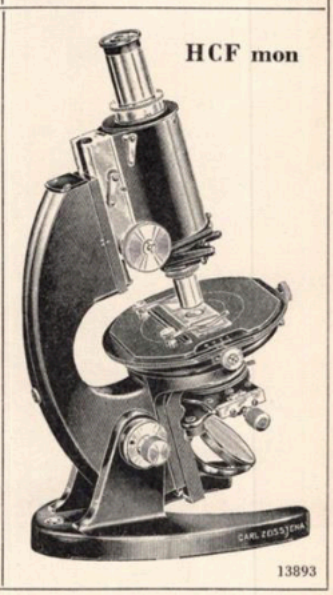
with Slow Motion Head

in Tilting Axis

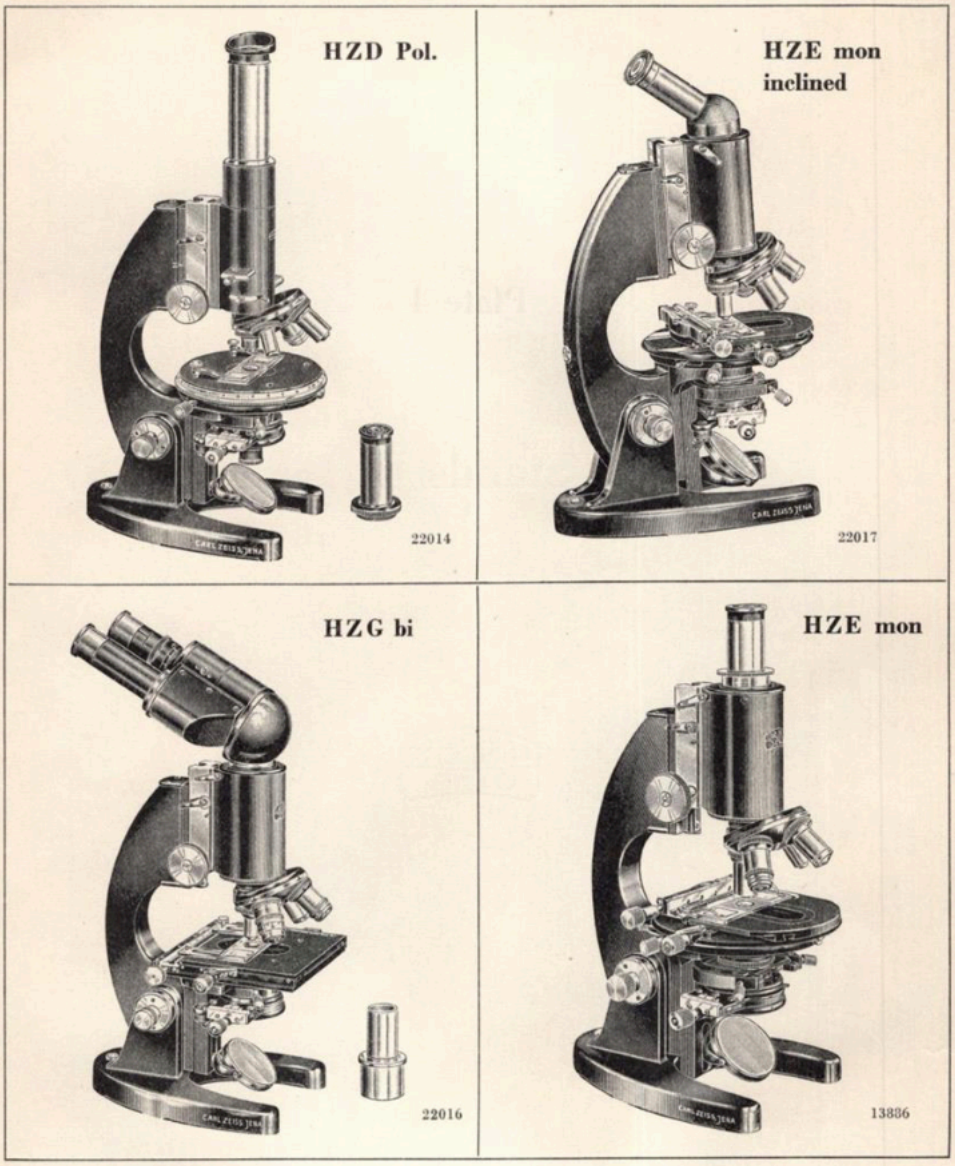








No.		Code word
	Stands HC with ABBE illuminating apparatus, **without tube:**	
12 29 15	**Stand HCD** with revolving and centring vulcanite stage **D** ...	*Kecev*
12 29 16	**Stand HCE** with large compound mechanical stage **E**	*Kechy*
12 29 17	**Stand HCF** with photomicrographic mechanical stage **F**	*Keciz*
12 29 18	**Stand HCG** with non-revolving rectangular mechanical stage **G**.	*Kecja*



No.		Code word
	Stands HZ, with ABBE illuminating apparatus and centring condenser slide, **without tube:**	
12 29 95	**Stand HZD** with revolving and centring vulcanite stage **D** ...	*Kazoe*
12 29 96	**Stand HZE** with large compound mechanical stage **E**	*Kazti*
12 29 98	**Stand HZG** with non-revolving rectangular mechanical stage **G**	*Kazuj*
	For use with above:	
12 29 28	**Wide monocular tube** with clamping draw tube	*Kazyn*
12 86 18	**Inclined monocular tube** with body tube	*Kazzo*
12 86 12	**Inclined binocular tube** with body tube	*Kecdu*
12 29 26	**Polarizing tube**	*Kacly*

Plate 5

Stands L

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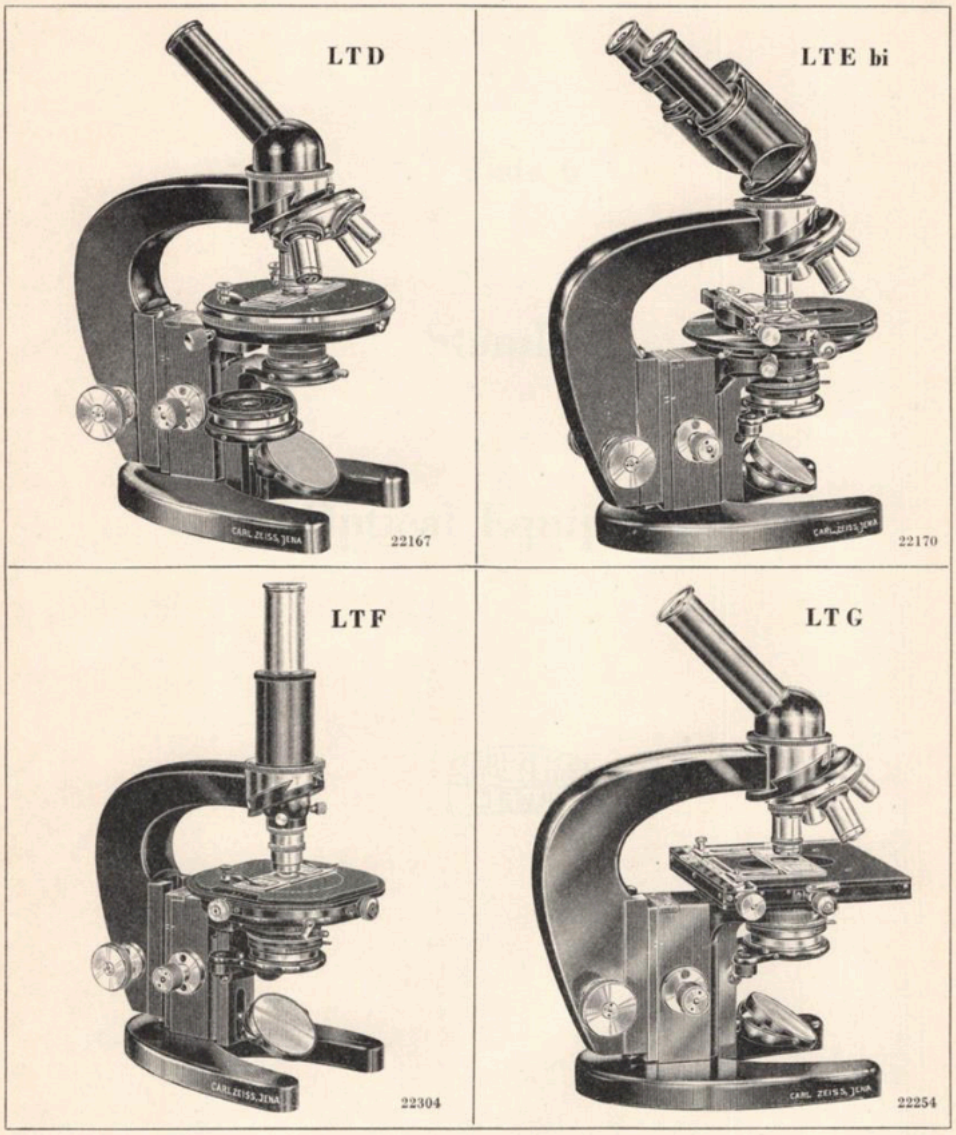
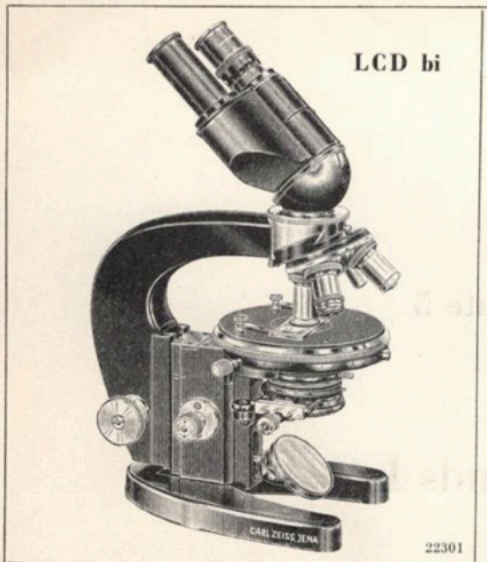
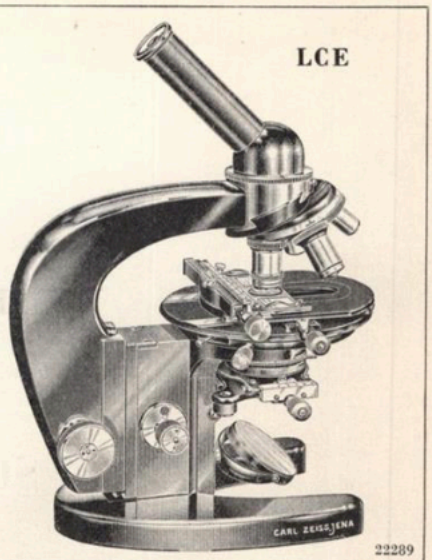
Stands L

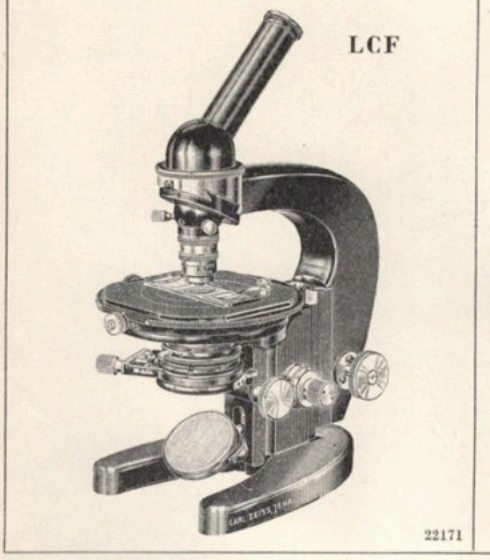
New Microscope Type with Interchangeable Upper Tubes
Slow and coarse Motion Heads Close to Foot

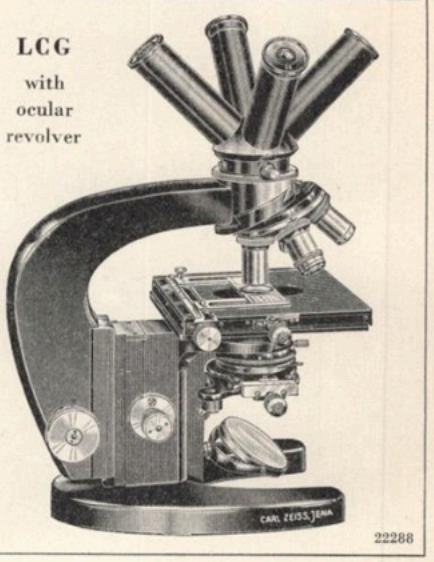


No.		Code word
	Stands LT with illuminating apparatus T with swing-out iris diaphragm (**without upper tube** and **nosepiece slide**)	
12 38 64	**Stand LTC** with fixed rectangular stage **C**	*Kewif*
12 38 65	**Stand LTD** with revolving and centring vulcanite stage **D**....	*Kalxa*
12 38 66	**Stand LTE** with large compound mechanical stage **E**	*Kalyb*
12 38 67	**Stand LTF** with photomicrographic mechanical stage **F**	*Kamac*
12 38 68	**Stand LTG** with non-revolving rectangular mechanical stage **G**.	*Kamce*



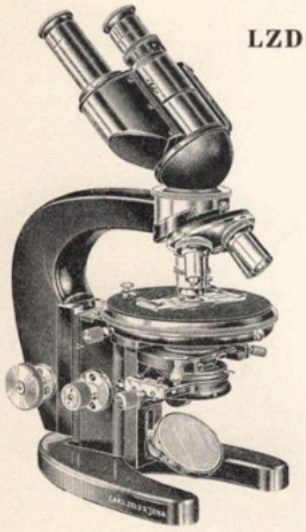






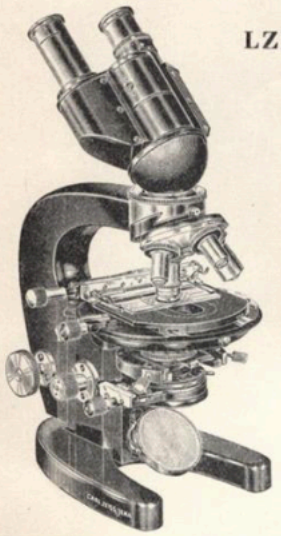
No.		Code word
	Stands LC with ABBE illuminating apparatus C **(without upper tube** and **nosepiece slide)**	
12 38 55	**Stand LCD** with revolving and centring vulcanite stage **D** ...	*Kameg*
12 38 56	**Stand LCE** with large compound mechanical stage **E**	*Kamgi*
12 38 57	**Stand LCF** with photomicrographic mechanical stage **F**	*Kamik*
12 38 58	**Stand LCG** with non-revolving rectangular mechanical stage **G**.	*Kammo*
	Stands LZ with ABBE illuminating apparatus Z with centring condenser slide **(without upper tube** and **nosepiece slide)**	
12 38 75	**Stand LZD** with revolving and centring vulcanite stage **D** ...	*Kamor*
12 38 76	**Stand LZE** with large compound mechanical stage **E**	*Kamsu*
12 38 78	**Stand LZG** with non-revolving rectangular mechanical stage **G**.	*Kanab*

LZD bi



22 329

LZE bi



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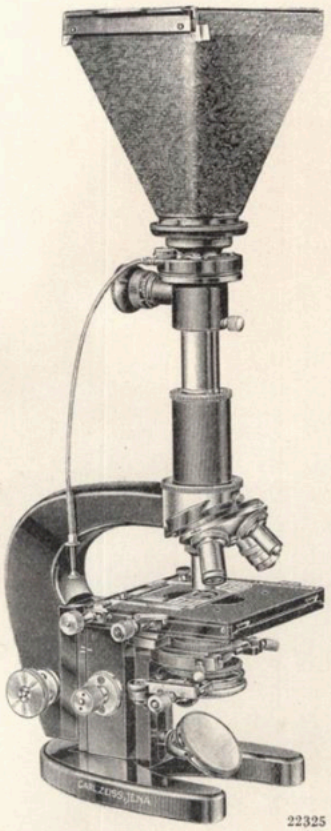

22325

LZG

with Phoku 9:12 cm.

No.	Upper Tubes and Nosepiece Slides	Code word
12 86 25	**Inclined monocular tube L** (without case)	*Kalos*
12 86 27	**Inclined binocular tube L** (without case)	*Kalnr*
12 38 34	**Straight monocular tube** with fixed eyepiece sleeve	*Kabbo*
12 12 71	**Quadruple eyepiece revolver** with inclined eyepieces	*Kabgu*
12 12 73	**Triple revolving nosepiece on slide**	*Kalru*
12 12 74	**Quadruple revolving nosepiece on slide**	*Kalux*
12 92 14	**Centring slide** for objectives and vertical illuminator	*Kalvy*

Plate 6

Stands S

Optical Equipments

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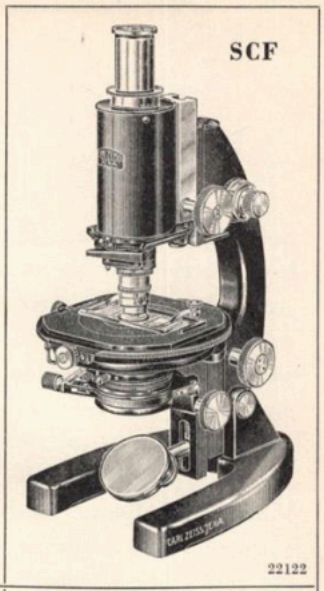
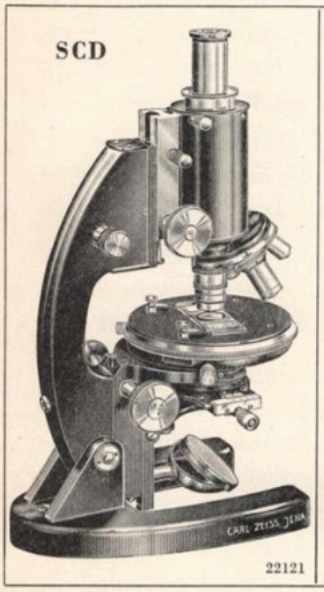
Large Stands S

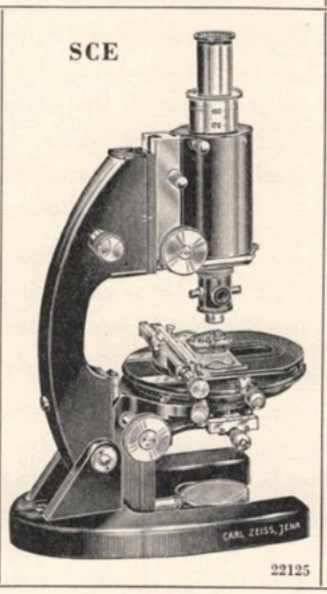
Interchangeable Tubes

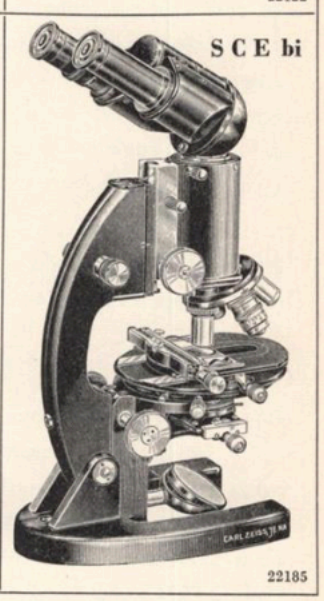
Vertically Adjustable Stage

ABBE Illuminating Apparatus









No.		Code word
	Stands S with wide monocular tube and clamping draw tube:	
12 23 56	**Stand SCD** with revolving and centring vulcanite stage **D** ...	*Minting*
12 23 57	**Stand SCE** with large compound mechanical stage **E**	*Mintiras*
12 23 58	**Stand SCF** with photomicrographic mechanical stage **F**	*Mintirer*
	For use with above:	
12 85 21	**"Bitukni" inclined binocular tube,** in plain case	*Mirabunta*

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Optical Equipments for Miscellaneous Purposes

for alternative use with stands in place of accessories previously listed. These equipments represent but suggestions, and may be modified to any desired extent. Prices for objectives and eyepieces will be found in the lists of combinations on pages 56 and following.

		Code word
For Class Microscopes (Stands EB and ES)		
No. 101 Magnifications: 80× and 200×		
Cylinder diaphragm		
Achromatic objectives **8,** N.A. 0.20; **20,** N.A. 0.40		
HUYGENS eyepiece **10**×		*Kecne*
No. 103 Magnifications; 56× to 400×		
Condenser 1.2, with iris diaphragm **Double** revolving nosepiece		
Achromatic objectives **8,** N.A. 0.20; **40,** N.A. 0.65		
HUYGENS eyepieces **7**× **10**×		*Kecof*
For Prescription Druggists and Simple Chemical Work (Stands EB and ES)		
No. 104 Magnifications: 56× to 400×		
Condenser 1.2 with iris diaphragm **Double** revolving nosepiece		
Achromatic objectives **8,** N.A. 0.20; **40,** N.A. 0.65		
HUYGENS eyepieces **7**× **10**× (micrometer)		*Kecsi*
For General Work (Stands ES)		
No. 115 Magnifications: 40× to 900×		
Swing-out condenser 1.2, with iris diaphragm		
Triple revolving nosepiece		
Achromatic objectives **8,** N.A. 0.20; **40,** N.A. 0.65		
Oil immersion **90,** N.A. 1.25, with iris diaphragm (also for dark field)		
HUYGENS eyepieces **5**× **10**×		*Kecuk*

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	Code word
For Botanical, Zoological, Bacteriological, and General Work (Stands EC, UT, UC, and others) *)	
No. 318 Magnifications: 21× to 1350×	
Condenser 1.2 **Quadruple** revolving nosepiece	
Achromatic objectives **3**; **8**, N.A. 0.20; **40**, N.A. 0.65	
Oil immersion **90**, N.A. 1.25, with iris diaphragm (also for dark field)	
HUYGENS eyepieces **7**×, **10**×; compensating eyepiece **15**×	*Kasol*
No. 618 Binocular	*Kasso*
Tropical Equipment (Stand ES)	
No. 133 Magnifications: 50× to 1500×	
Swing-out condenser 1.2, with iris diaphragm	
Quadruple revolving nosepiece	
Apochromatic objective **10**, N.A. 0.30	
Achromatic objective **40**, N.A. 0.65	
Fluorite objective **100**, N.A. 1.30 (oil immersion)	
Compensating eyepieces **5**×, **10**×, **15**×	*Kecyo*
Tropical Equipment (Stands EC, U, GC, and others) *)	
No. 333 Magnifications: 50× to 1500×	
Swing-out condenser 1.2	
Quadruple revolving nosepiece	
Apochromatic objective **10**, N.A. 0.30	
Achromatic objective **40**, N.A. 0.65	
Fluorite objective **100**, N.A.1.30 (oil immersion)	
Compensating eyepieces **5**×, **10**×, **15**×	*Kedap*
Apochromatic Equipment for Routine Work, such as the examination of blood (Stands EC, U, GC, and others) *)	
No. 353 Magnifications: 70× to 1350×	
Aplanatic condenser 1.4 **Quadruple** revolving nosepiece	
Apochromatic objectives **10**, N.A. 0.30 **20**, N.A. 0.65	
Oil immersions **60**, N.A.1.0, with iris diaphragm (for dark field); **90**, N.A. 1.30	
Compensating eyepieces **7**×, **10**×, **15**×	*Kasur*
No. 653 Binocular	*Kasyv*

*) On stands with illuminating apparatus Z, the requisite Z condensers must be used. The slide nosepiece must be attached with Stand L.

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Code word

Apochromatic Equipment for Exacting Requirements (Stands EC, U, GC, HC, and others) *)

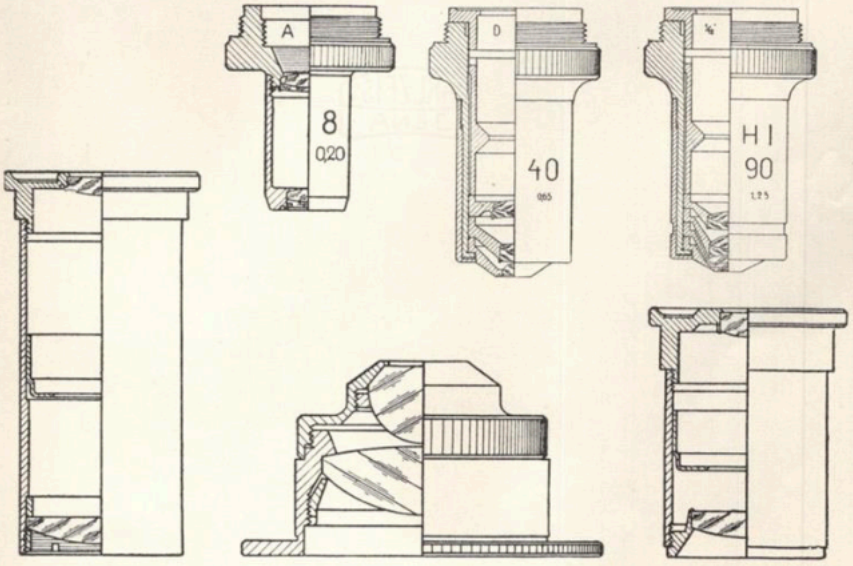
No. 356 Magnifications: 25× to 1800×

Aplanatic condenser 1.4 **Quadruple** revolving nosepiece
Apochromatic objectives **5**, N.A. 0.15 **10**, N.A. 0.30;
20, N.A. 0.65 **40**, N.A. 0.95;
Oil immersions **60**, N.A. 1.40; **90**, N.A. 1.30
Compensating eyepieces **5**×, **10**×, **15**×; **7**× (micrometer)
20× (adjustable)
1:100 object micrometer

Kataw

When "Bitukni L" is used, the above magnifications must be multiplied by 1.5.

Schematic Section Through the Components of a Commonly Used Optical Equipment



11623

*) See note on page 3

f) Large Stand S

Microscope stands are not only intended for working in transmitted light, but may also be used for observing opaque objects with the aid of a vertical illuminator. As a rule, however, stands do not have a vertically adjustable stage, and this may be of great advantage in examining objects of greatly varying thickness, of the kind especially met with in metallographic work, since the vertical illuminator (p. 101), which is screwed to the tube for such work, demands a source of light remaining at the same level relative to it. This means that the source of light would have to be adjusted for height every time the coarse motion is operated. In order to avoid this drawback, Stand S is provided with a stage capable of movement through a range of two inches in the direction of the microscope axis. Stand S is therefore equally suitable for use with the stage in the horizontal, inclined, or vertical position, for work in transmitted or in incident light, and for visual observation as well as for photomicrography. It can also be used to advantage in examining objects of unusual thickness. Stand S can be supplied equipped with stages D, E, or F as Stand SCD, SCE, or SCF with ABBE illuminating apparatus. Stages D and E may be interchanged in the usual manner.

The stand may also be supplied with the same stages but without the ABBE illuminating apparatus, in the form of Stands SD, SE, or SF, if it is to be used only for the observation of opaque objects.

Stand S is a large model with interchangeable tubes similar to the Stand H described on page 38. Depending upon the equipment ordered with it, it may be employed as a monocular stand with straight or inclined eyepiece, as a binocular stand with inclined eyepiece, and as a stand with polarizing tube for either monocular or binocular observation. The polarizing tube with its objectives is interchangeable in the dovetail guide of the carrier with the monobjective under part of the other tubes, and with the special photomicrographic tube. These various parts may be purchased separately.

The tubes end below in a slideway for the reception of the large slide fittings listed on page 108.

For detailed description of Stand S, see "Mikro 236e."

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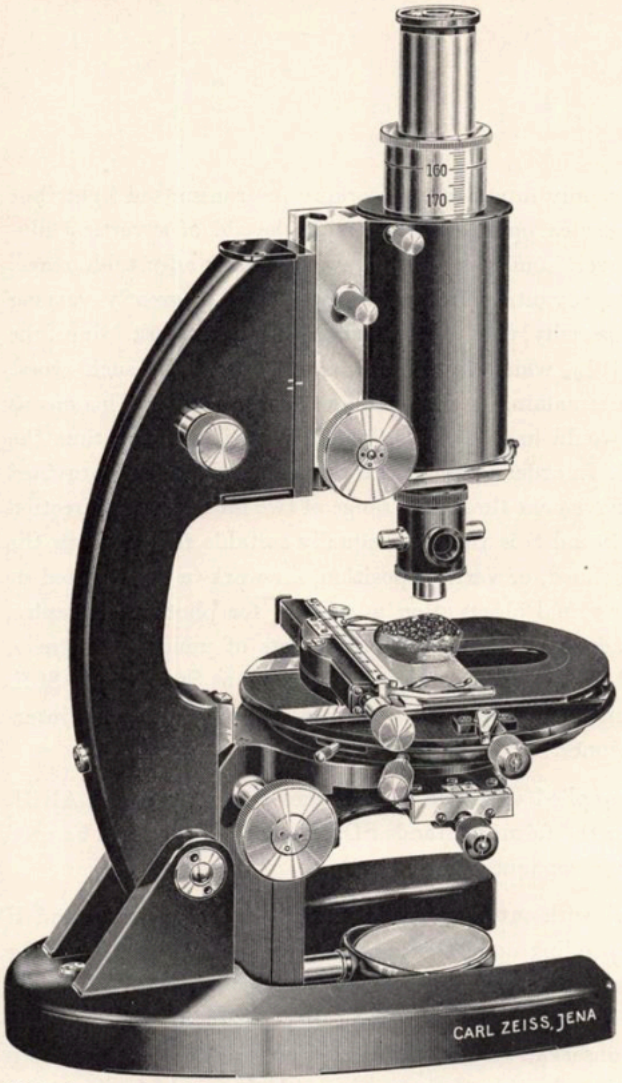


22124

Fig. 24
About 1/2 actual size

Large Microscope

for Metallographic and other Work

Stand SCE

Code word: *Mintiras*

Wide draw tube with millimetre scale, vertically adjustable large mechanical stage E, ABBE illuminating apparatus C, in mahogany case.

Equipment No. 590

Magnifications: 25× to 1400×

Aplanatic condenser 1.4
NACHET vertical illuminator } each on large centring slide fitting
BECK vertical illuminator }
Small tube slide on large slide fitting
4 small objective slides
Case for 6 objectives with screwed-on slide fittings

Apochromatic objectives		Comp. eyepieces
11, N.A. 0.30	in short mounts, for opaque objets *without* cover glass	**5**×
22, N.A. 0.65 Homog. oil imm.		**10**×
94, N.A. 1.30		**15**×
5, N.A. 0.15	in standard mounts, for transparent objects *with* cover glass	**7**×(micrometer)
40, N.A. 0.95		1:100 metal stage micrometer
2 extensions for **11** and **94**		

Code word: *Kaymd*

Stand SCE with Equipment No. 590

Code word: *Minimose*

g) Travelling Microscope

The stand is of light design, and is equipped with simplified illuminating apparatus S with rack-and-pinion coarse motion, geared slow motion, and rectangular stage. The foot is designed to fold. The instrument, with the optical equipment and set of working implements 12 40 90, may be furnished in a compact tightly closing oak case with shoulder strap. The total weight of the complete microscope is about 10 lb.

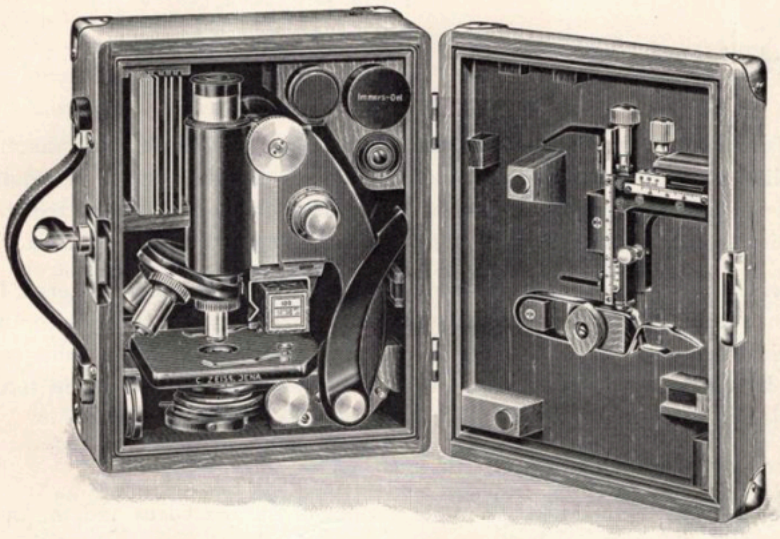


Fig. 25
About 1/4 actual size
11965

Stand inclinable through 30°, extensible tube with millimetre scale, rectangular stage, simplified illuminating apparatus with rack-and-pinion motion, oak case with leather handle. With 10 object slides, 100 cover glasses, glass vial for immersion oil in metal box.

No. 12 40 44. Travelling Stand Code word: *Minotto*

Equipment for above: Magnifications: 40× to 900×

Condenser 1.2, with iris diaphragm **Triple** revolving nosepiece

Achromatic objectives **8**, N.A. 0.20; **40**, N.A. 0.65;

Oil immersion **90**, N.A. 1.25, with iris diaphragm (also for dark field observation)

Huygens eyepieces **5**×, **10**× Code word: *Kayof*

Travelling Stand with Optical Equipment Code word: *Kayne*

For use with above:

No. 12 08 04. Simplified attachable mechanical stage (without case)
Code word: *Minx*

No. 12 40 90. Working implements: Straight scissors, Cornett forceps, straight forceps, scalpel, straight dissecting needle with metal handle, capsule for vaseline.
Code word: *Micabam*

For detailed description, see "Mikro 445e."

Objectives and Eyepieces

a) General

All our objectives have the so-called *Standard English Thread* and may therefore be applied also to stands of other makes, provided the tube has this standard thread. In this case care must, however, be taken to see that the correct tube length is maintained, and *eyepieces of our manufacture only* must be used.

The *mounts* of our objectives are not screwed into each other, but each lens is set in a small cylinder, and these cylinders are then assembled in a common cylindrical cell. By this arrangement, centring defects such as are liable to be caused by repeatedly screwing on and off of the several components in setting the objectives are avoided.

Objectives mounted in cylindrical cells must not be taken apart.

Cleaning must be confined to the under surface of the front lens and the upper surface of the back lens. In the more powerful objectives, the back lens is usually seated deeply in the mount. Under no circumstances must any attempt be made to clean the lens surface by introducing a cloth by means of a wire or forceps, as this would be liable to result in damage to the lens. A small softwood stick only should be employed if a cloth is used*). A better way is to clean the lens with a perfectly clean, soft brush. If the microscope is properly treated, and in particular, if it is always kept under the glass bell shown on page 134 when not in use and is never left standing without eyepiece when objectives are in place, it will but rarely be necessary to clean the back lens, and then only after long continued use.

The front lenses of the immersion systems, on the other hand, should be carefully cleaned each time they have been used. The oil sticking to them is removed by dabbing with soft linen or absorbent paper. The front lens is then well moistened with benzine or xylol, and the lens and mount are carefully wiped

*) Upon order, we will furnish a suitable softwood pin with leather pad.

dry with very soft linen or Japanese rice paper. Alcohol should not be employed, as it will dissolve the shellac used in setting the front lens.

If cleaning the front and rear lenses does not have the desired effect of restoring the objective to a condition wherein it yields a clear image, then it should be returned to us for inspection and re-setting, as it is only in our shops that the requisite equipment and trained workers are available. Foggy and indistinct images are not, by the way, always produced by dirt, but also by the use of wrong cover glasses (see p. 16).

In order to reduce difficulties due to the entry of dust, we have changed the procedure of placing the objectives into and removing them from their boxes. Formerly, objectives were set with the front lens downward in the long cylindrical box, and dust was therefore able to enter while the objective was being put in or taken out. The new way is to set the objective with the front lens up into the lid of the box, which is made with a suitable recess. The long cylindrical box is then placed over the objective and screwed to the lid. The principal notation engraved on the objective is therefore no longer on the lid, which now forms the bottom, but on the smaller upper terminal face of the brass box.

The *magnification* of the microscope for the prescribed tube length is the product of the magnifications of the objective and the eyepiece. These data will be found engraved on each mount.

If an optical device causing a change in the magnification of the image produced by the objective is introduced between the objective and the eyepiece, then the product of the objective and eyepiece magnifications must be further multiplied by the magnification stated on the device used.

The *capacity* of an objective depends upon the quality of the work in manufacture and the extent to which it is possible to eliminate the defects in projection characteristic of optical images produced by lenses, by appropriate modifications of design. The means available to this end are the number of lenses, the different materials from which they are made, and their interrelation. Accordingly, objectives are classified into three groups, namely achromatic, fluorite, and apochromatic objectives. The last-named afford by far the greatest number of correction factors. Thus, for instance, the apochromatic oil immersion system of Fig. 3 is made up of ten lenses, as against six in the corresponding fluorite oil immersion. The apochromats therefore furnish images in which the aberration for all colours is eliminated with the exception of very slight residuals. This is true only, however, if they are to be used in conjunction with compensating eyepieces. It is only in this manner, moreover, that it is possible to avoid an error which cannot be eliminated in the objectives

by themselves,—the difference in magnification of the images of the colours composing white light. Achromatic objectives have fewest possibilities of correction, and they are therefore the least expensive. These, too, however, are corrected for not less than two spectrum colours, so that they go a good way towards fulfilling the demands for perfection of image.

A midway position between the achromats and apochromats is occupied by the fluorite objectives. While the number of lenses in them is the same as in achromatic objectives, they show a sensibly better chromatic correction than achromats due to the employment of fluorite. By comparison with apochromatic objectives, however, they lack the correction for spherical aberration for different colours.

Since natural fluorite is never entirely free from occlusions, tiny dark specks will be perceived in looking through fluorite objectives. These specks cannot be avoided, but do not detract from the performance of the objective.

The images of flat objects produced by microscope objectives are not plane, but curved. The image of the lateral portions of the object is nearer to the objective than the image of the central portion. Hence the centre and the margin of the field do not simultaneously appear sharply defined, and must therefore be successively focused by means of the slow motion. The curvature of the image field rises with increasing power of the objective, and generally speaking, is greater with achromatic objectives than with apochromats. An image free from curvature is furnished by special objective 8 (p. 56) in combination with the special 6× eyepiece (p. 62).

Objectives are tested for correction for spherical and chromatic aberration and for the cover glass thickness required with them, by means of the *test plate*.

No. 12 76 10. Abbe Test Plate (see "Mikro 116e")

Code word: *Michauxie*

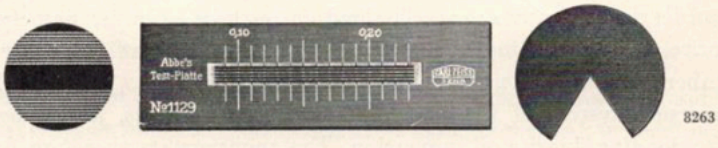


Fig. 25a About $^{2}/_{3}$ actual size

ABBE test plate with sector stop for insertion into diaphragm carrier of illuminating apparatus.

The *numerical aperture* of the objective constitutes a measure of its resolving power (see pages 11 and 12), for the higher the numerical aperture the smaller are particles still just discernible with the microscope. On the other hand, a certain minimum magnification is required in order to render the finest details visible to the eye. These two considerations furnish the following practical rule:

The total magnification corresponding to the maximum performance of the objective should be between 500 and 1000 times the value of its numerical aperture.

This actually *usable* or *effective magnification*, and not the possible magnification, determines the value of the microscope.

The numerical aperture will be found engraved on each objective, provided its value exceeds 0.1. It may be determined by means of the *apertometer*.

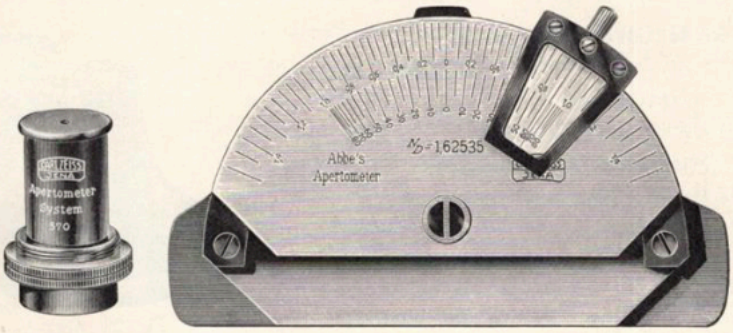


Fig. 26 About $^2/_3$ actual size 22205

No. 12 76 07 Apertometer

with base and apertometer objective, in case Code word: *Mimadoa*

For detailed description, see "Mikro 114e."

Tube length. Unless otherwise stated on them, all of our objectives are corrected for a tube length of 160 mm. The tube length may be read from the draw tube scale. It should be borne in mind that the tube length includes a revolving nosepiece or other intermediate piece of a length of 15 mm. (p. 13).

Cover glass thickness. Wherever, in the list to follow, a note to that effect appears in the column headed "Remarks", the cover glass thickness of the preparation

must be exactly adhered to with the objective concerned, because otherwise the quality of the image will appreciably suffer. Our objectives are as a rule adjusted for a cover glass thickness of 0.17 mm.

Since cover glasses of the required thickness will not always be at hand, it is advisable in the case of high powers to use *objectives with correction mounts* (Fig. 27). By simply turning the correction collar, these objectives may be adjusted for any cover glass thickness between 0.1 and 0.2 mm.

The *cover glass thickness* is measured with a *cover glass gauge* (Fig. 28).

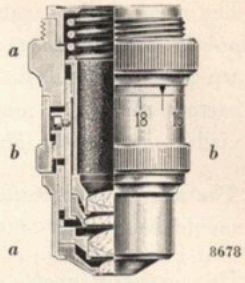


Fig. 27 Actual size

Objective in correction mount

Turning correction collar *bb* varies the distance between the two upper lenses and the two lower lenses fixed in the body of the mount *aa*.

No. 12 65 01 Cover glass gauge

Code word: *Middeling*

The cover glass gauge has a $^1/_2$ mm. pitch screw spindle carrying a drum for traversing it and bearing a scale with 50 divisions. With this arrangement, thicknesses are directly read to 0.01 mm. A ratchet on the end of the drum allows the correct measuring pressure to be automatically maintained.

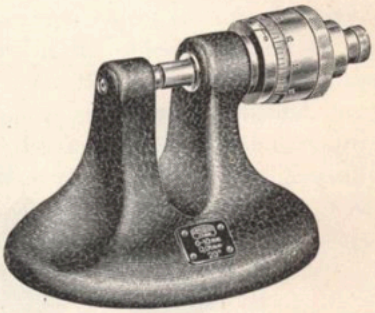


Fig. 28 About $^1/_2$ actual size 13796

Cover glass gauge

The *oil immersion lenses* should be used only with the cedarwood oil supplied with them, which has a refractive index $n_D = 1.515$. After use, this oil must be removed with benzine or xylol, and the lens carefully dried with a soft clean linen rag. Oil from other sources, or substitutes, should not be used, at least not unless they have first been examined for their refractive and dispersive properties. For this purpose, we supply the

No. 12 01 65 Oil Testing Device

consisting of a semi-circular glass disk or "trial glass" of a refractive index of 1.515, and a 3 mm. wide slit diaphragm for insertion into the diaphragm carrier of the ABBE illuminating apparatus.

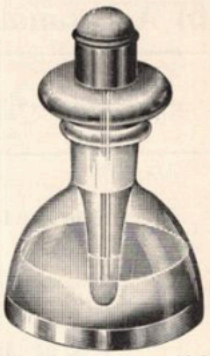
Code word: *Minaretol*

For detailed description, see "Mikro 371e."

No. 11 30 05 Double Bottle
for cedar oil and xylol (Fig. 29).

Code word: *Miabais*

For detailed description, see "Mikro 352e."



8649

Fig. 29
About $^1/_2$ actual size

No. 11 30 15 Bottle of Cedar Oil, 10 gm.

Code word: *Milicia*

No. 11 30 22 Bottle of Cedar Oil, 100 gm.

Code word: *Kagir*

With *water immersion lenses*, distilled water only should be used.

Dark field work requires a sharp separation of the numerical apertures of the illuminating pencil (*i. e.*, the condenser), and of the objective. The ranges of these two apertures must not overlap. The preparation is illuminated by rays of a certain numerical aperture, and observation made with an objective of lower numerical aperture. In this manner, the image is produced only by the rays due to diffraction of the light within the preparation, while the illuminating rays themselves are excluded. The background of the field of view of the microscope remains dark, and the object shows brightly luminous on this dark field. The more pronounced the contrast, the more distinctly will details be visible.

Perfect dark field illumination is produced with the special *dark field condensers* (see p. 98, and "Mikro 230e," "Mikro 365e," and "Mikro 407e").

Special objectives for dark field observation are the achromatic homogeneous oil immersion 50, N.A. 0.85 ($^1/_7$) for paraboloid and change-over condensers, and the apochromatic homogeneous oil immersion objectives 35, N.A. 0.85, and 60, N.A. 1.0 (X), with iris diaphragm for use with these condensers and the cardioid condenser. These objectives are also suitable for bright field observation as immersion objectives with large working distance. Of the other oil immersion objectives, only achromatic homogeneous oil immersion 90, N.A. 1.25 ($^1/_{12}$) with iris diaphragm can be employed with the above condensers.

As against this, all objectives up to numerical aperture 1.3 may be directly used with the *luminous spot ring condenser* described on page 100.

CARL ZEISS JENA

b) Achromatic Objectives

	Order No.	Notation: Primary Magnification	Notation: Numerical Aperture	Focal Length mm.	Free Working Distance [1] mm.	Old Notation [2]	Remarks		Code word
Dry Series	**11 10 01**	**1-1.5**		55	64/47	a_0	Lens may be raised and lowered within its mount. This causes the initial magnification to vary continuously within the stated limits. These objectives cannot be used on a revolving nosepiece except in the position of greatest magnification		*Migabamos*
	11 10 02	**1.5-2**		45	32/25	a_1			*Migado*
	11 10 04	**1.2-2.4**			33/7	a*	The upper member is movable in the manner of a correction mount. The primary magnification may thereby be varied at the ratio of 1:2		*Migajaria*
	11 10 08	**2**		50	60		Cannot be adjusted to focal agreement on revolving nosepiece		*Mingote*
	11 10 03	**3**		36	29	a_2			*Migaja*
	11 10 05	**5**		25	19	a_3	Without front diaphragm. Working distance 18 mm.		*Migajada*
	11 10 06	**6**	0.17	23.5	9	aa	Adjusted to focal agreement with the higher power "dry" lenses on revolving nosepiece		*Migajaron*
	11 11 08	**8**	0.20	18	9	A			*Mileon*
	11 11 10	**10**	0.30	15.6	7.5	AA			*Migalha*
	11 11 20	**20**	0.40	8.3	1.6	C			*Migalhada*
	11 10 40	**40**	0.65	4.4	0.55	D	"Dry" lens of highest power, not appreciably affected by variations in the thickness of the cover glass		*Migalhamos*
	11 11 09	**8 M**	0.20	18	15		Special objective with *flat field* for flat objects and with large working distance		*Minuiremo*
	11 11 23	**20 Epi**	0.40	8.3	1.6		For Epi-lamp 8 and Epi-mirror (pp. 101, 102), for uncovered objects only		*Mipoux*
	11 11 40	**40 Epi**	0.65	4.3	0.53				*Mippi*

[1]) The free working distance is the distance between the upper surface of the cover-glass and the lower rim of the lens mount when the objective is sharply focused upon a preparation covered with a 0.17 mm. glass.

[2]) The new objectives are not identical with objectives bearing the old notation listed in the same row. The listing merely shows which of the older objectives most closely approaches the present designs.

	Order No.	Notation: Primary Magnification	Notation: Numerical Aperture	Focal Length mm.	Free Working Distance [1] mm.	Old Notation [2]	Remarks		Code word
Water Immersion Series	**11 11 07**	**6*)**	0.11	24.7	36	Pl	For the examination of objects in water. Large working distance. Deep vessel required for use with **6** [3].		*Migardes*
	11 11 47	**40*)**	0.75	4.3	1.9	D*			*Migaremos*
	11 10 91	**90**	1.18	2.0	0.07	I	With correction mount for 0.1 to 0.2 mm. cover glasses		*Migarmosa*
Glycerine Immersion	**11 11 60**	**60**	1.0	3.0	0.12	V	With iris diaphragm. Can be used only with 0.75 mm. quartz cover glasses		*Minianda*
	For Cardioid Ultra-microscope								
Homogeneous Oil Immersion Series	**11 10 50**	**50**	0.85	3.5	0.40	1/7	For dark field observation with paraboloid and change-over condensers, and for *bacteriological work*		*Milesa*
	11 10 92	**90**	1.25	2.0	0.15	1/12	Working objectives for training courses and routine work.		*Migaveis*
	11 10 93	**90** with Iris diaphragm	1.25	2.0	0.16	1/12	For dark field observation only if used with iris diaphragm		*Mindinha*
	12 87 20	[3]) Glass vessel for water immersion 6, N. A. 0.11 (for Stands F, G, H, X).							*Miagolammo*

[1]) [2]) See p. 56, notes 1 and 2.

[3]) When so ordered, water immersions 6 and 40 may be furnished with a stainless steel guard sleeve.

No. 11 11 07/1. Guard sleeve for water immersion **6**, N.A. 0.11 ..... *Kaglu*

No. 11 11 47/1. Guard sleeve for water immersion **40**, N.A. 0.75 ..... *Kagox*

c) Fluorite Objectives [3])

(for use with compensating eyepieces)

	Order No.	Notation: Primary Magnification	Notation: Numerical Aperture	Focal Length mm.	Free Working Distance [1]) mm.	Old Notation [2])	Remarks		Code word
Dry Series	**11 10 48**	**40**	0.85	4.4	0.32	DD	Sensitive to slight variations (of ± 0.01 mm.) in cover glass thickness. The standard thickness of 0.17 mm. and the correct material for the cover glass should, therefore, be adhered to. **Objectives with Correction Mount** *to be preferred*, to permit adjustment to thickness of existing cover glass.		*Migalhando*
	11 10 69	**60**	0.90	2.9	0.12	E			*Migalharas*
	11 10 45	**40** with Corr.	0.85	4.4	0.32	DD			*Migamos*
	11 10 65	**60** with Corr.	0.90	2.9	0.12	E			*Migarais*
	11 10 95	**90** with Corr.	0.90	2.0	0.09	F			*Migaran*
Homogeneous Oil Immersion	**11 10 99**	**100**	1.30	1.8	0.10	1/12 Fl.	High-power oil immersion with exceptionally good chromatic correction.		*Migdal*

[1]) [2]) See p. 56, notes 1 and 2.

[3]) The natural fluorite used in these systems admits of exceptionally good chromatic correction, but is not free from occlusions, and tiny dark specks may therefore be seen in looking through the objective. These specks do not, however, adversely influence the performance of the objective.

d) Apochromatic Objectives

(for use with compensating eyepieces only)

	Order No.	Notation: Primary Magnification	Notation: Numerical Aperture	Focal Length mm.	Free Working Distance [1] mm.	Remarks		Code word
Dry Series	11 01 06	6	0.15	25.5	7.3	Cannot be adjusted to agreement with other higher power dry lenses on revolving nosepiece		*Miniaria*
	11 02 10	10	0.3	16.2	5	Adjusted to agreement with higher power dry lenses on revolving nosepiece		*Migma*
	11 01 20	20	0.65	8.3	0.7			*Migmata*
	11 01 40	40	0.95	4.3	0.12	With correction mount. By turning the collar on the mount, the objective may be accurately corrected for any cover glass thickness between 0.12 and 0.2 mm. The cover glass thickness must be ascertained by measurement with the gauge shown on p. 54.		*Migmatis*
	11 01 60	60	0.95	2.9	0.07			*Migmatum*
Water Immersion	11 01 70	70	1.25	2.5	0.11			*Mignard*
Homogeneous Oil Immersion Series	11 01 35	35 [2]	0.85	5	0.25	Special objectives for photomicrographic work and dark field observation.		*Minuritior*
	11 01 62	60 with iris diaphragm	1.0	2.9	0.22			*Mingled*
	11 01 63	60	1.3	2.9	0.15	Objectives with small primary magnification, affording a wide range of total magnification by changing eyepieces		*Mignardant*
	11 01 64	60	1.4	2.9	0.13			*Mignarder*
	11 01 93	90	1.3	2	0.11	Working objective		*Mignata*
	11 01 94	90	1.4	2	0.05	Special objective for research requiring high magnification and maximum resolving power. Front lens very sensitive to pressure such as caused by running against preparation		*Mignella*
	11 01 99	120	1.3	1.5	0.08	Special objective with exceptionally high primary magnification, for measuring, counting, or drawing at very high magnifications.		*Mignellir*

[1]) See p. 56, note 1.

[2]) Special advantages: Large field of view and pronounced brightness of image.

e) Objectives in Short Mounts

for 190 mm. tube length
for use with Vertical Illuminator (p. 101) **on uncovered objects.**

1. Achromatic Objectives

	Order No.	Notation: Primary Magnification	Notation: Numerical Aperture	Focal Length mm.	Free Working Distance [1] mm.	Remarks		Code word
Dry Series	**11 12 03**	**4**		36	29	Also suitable for covered preparations. Same optical data*) by using 30 mm. intermediate collar.		*Milesiase*
	11 12 06	**6**		25	19			*Milesienne*
	11 12 07	**7.3**	0.17	23.5	11			*Miniona*
	11 12 08	**9**	0.20	18	9			*Milesima*
	11 12 10	**12**	0.30	15.6	7.5			*Milesimos*
	11 12 21	**21**	0.40	8.3	1.6			*Milesimum*
	11 12 40	**40**	0.65	4.4	0.6	Not suitable for covered objects.		*Milesiora*
Homogeneous Oil Immersion Series	**11 12 53**	**53**	0.90	3.5	0.57	Also suitable for covered objects by using intermediate collar*)		*Milesium*
	11 12 95	**95**	1.25	2.0	0.32			*Miletum*

2. Fluorite Objectives

(for use with compensating eyepieces)

	Order No.	Notation: Primary Magnification	Notation: Numerical Aperture	Focal Length mm.	Free Working Distance [1] mm.	Remarks		Code word
Dry Series	**11 12 48**	**40**	0.85	4.4	0.32	Not suitable for covered objects.		*Milesioris*
	11 12 60	**60**	0.90	2.9	0.12			*Milestone*
Homogeneous Oil Immersion	**11 12 99**	**100**	1.30	1.8	0.27	Also suitable for covered preparations by using intermediate collar*).		*Miletuser*
*)	**12 04 55**	**Intermediate collar,** 30 mm. long						*Minuritis*

[1]) The free working distance in this case is the distance between the upper surface of the preparation and the lowermost edge of the objective mount when the microscope is sharply focused on an *uncovered* object.

3. Apochromatic Objectives

(for use with compensating eyepieces only)

	Order No.	Notation: Primary Magnification	Notation: Numerical Aperture	Focal Length mm.	Free Working Distance [1] mm.	Remarks		Code word
Dry Series	**11 03 10**	**10**	0.30	16.2	5	Suitable also for covered objects by using intermediate collar*)		*Milanionem*
	11 03 22	**22**	0.65	8.3	0.7	Not suitable for covered objects		*Milanionis*
	11 03 40	**40**	0.95	4.3	0.12			*Milax*
	11 03 60	**62**	0.95	2.9	0.04			*Milcorus*
Water Immersion	**11 03 70**	**74**	1.25	2.5	0.11			*Mildete*
Homogeneous Oil Immersion Series	**11 03 63**	**64**	1.30	2.9	0.30	Suitable also for covered objects by using intermediate collar*)		*Milden*
	11 03 64	**64**	1.40	2.9	0.30			*Mildened*
	11 03 93	**94**	1.30	2	0.28			*Mildewed*
*)	**12 04 55**	**Intermediate collar,** 30 mm. long						*Minuritis*

4. Special Objectives

a) Special objectives not suitable for ordinary observation and required for use with Epicondenser W (p. 102). These objectives will be found listed in "Mikro 476e."

b) Objectives for preparations without cover glass, in narrow mounts (suitable for string galvanometers, and similar objectives in narrow mounts corrected for infinity (for metallurgical microscopes) will be found in a special list of objectives and eyepieces in "Mikro 367e," as will also the water immersion objectives for the ELLINGER - HIRT Luminescence Microscope.

5. Monobromnaphtalene Immersion Objectives

	Order No.	Notation: Primary Magnification	Notation: Numerical Aperture	Focal Length mm.	Free Working Distance [1] mm.	Remarks		Code word
	11 03 74	**74**	1.60	2.5	0.07	A system of exceptionally high aperture. Not suitable for observation of covered objects.		*Minnow*

[1]) See p. 60, note 1.

f) Eyepieces

As a rule, achromatic objectives are used in conjunction with HUYGENS eyepieces. Orthoscopic objectives are employed with objectives up to 40, N.A. 0.65 for very high magnifications. These eyepieces give a large field of view. Achromatic objectives of higher numerical aperture are preferably used in combination with compensating eyepieces.

Apochromatic objectives are always employed with compensating eyepieces. Since apochromats have better definition than achromatic objectives, they will more readily stand being combined with very high-power eyepieces than achromatic objectives.

The eyepieces are denoted by their factorial magnification. With the compensating eyepieces, the factorial magnification is preceded by the letter "K", while the word "Orthoscope" is prefixed in orthoscopic eyepieces.

A special eyepiece is the *6× eyepiece*. This produces a flat image of a flat surface, and is therefore principally intended for use with *objective M* (p. 56). With this combination, *thoroughly flat general survey images with large field of view* are obtained. With other objectives, the field of view drops off more or less steeply towards the margin. The 6× eyepiece calls for a special wide eyepiece tube.

A further special eyepiece is the 15× compensating eyepiece for the monobromnaphtalene immersion listed on page 61.

HUYGENS and Orthoscopic Eyepieces

	HUYGENS eyepieces (H)					Orthoscopic eyepieces (with large field of view)		
Notation = factorial magnification	**4×**	**5×**	**7×**	**10×**	**15×**	**12.5×**	**17×**	**28×**
Focal length in mm.	63	50	36	25	17	20	15	9
Field of view number	24	23	18	14	8	16	13	6.5
Order No.	**11 35 04**	**11 35 05**	**11 35 07**	**11 35 10**	**11 35 15**	**11 35 12**	**11 35 17**	**11 35 28**
Code word	*Migeam*	*Miglia*	*Migliare*	*Migliarina*	*Migliarol*	*Migliora*	*Migliorato*	*Migliorom*

No. 11 36 15. **6× eyepiece** with large field of view, field of view number 28 for 30 mm. tube

Code word: *Minuiren*

Compensating Eyepieces (K)

Notation and factorial magnification	3×	5×	7×	10×	15×	20×	30×
Focal length in mm.	83	50	36	25	17	12.5	8.4
Field of view number	23	23	18	13	11	8	5.7
Order No.	**11 31 03**	**11 31 05**	**11 31 07**	**11 31 10**	**11 31 15**	**11 31 20**	**11 31 30**
Code word	*Mignol*	*Mignolano*	*Mignolare*	*Mignolassi*	*Mignolato*	*Mignolia*	*Minionette*

No. 11 31 16. 15 × Compensating eyepiece for monobromnaphtalene immersion, field of view number 9.2 Code word: *Minoratius*

In addition to these eyepieces, which may be used singly for monocular, or in pairs for binocular observation, we make paired eyepieces for Binocular Stand Magnifier XII (p. 82) and the "*Mobimi*" *paired eyepieces* for the binocular tubes of Stands D and F.

"Mobimi" Paired Eyepieces for Stands D and F

	HUYGENS eyepieces				Compensating eyepieces			
Notation and factorial magnification	5×*)	7×	10×	15×	K 7×	K 10×	K 15×	K 20×
Order No.	**11 35 37**	**11 35 38**	**11 35 39**	**11 35 40**	**11 31 38**	**11 31 39**	**11 31 40**	**11 31 41**
Code word	*Miniada*	*Minestrava*	*Miniadir*	*Minestravel*	*Minestravi*	*Miniadol*	*Minestrear*	*Miniadus*

*) Only for Stand D.

The "Mobimi" paired eyepieces resemble single eyepieces in their optical characteristics, and can therefore be used in their stead. The only difference is in the mount of the upper lens, which is so designed that in placing the stereoscopic stops of Stands D and F on the eyepieces, they will come into the correct position relative to the exit pupil. "Mobimi" paired eyepieces agree in every respect with the corresponding single eyepiece, and therefore bear the notations "15×" and "Mobimi" engraved on them. Other eyepieces are also gradually being brought into agreement with the single eyepieces, so that the special "Mobimi" eyepieces will eventually be eliminated.

The *total magnification* of the microscope for the prescribed tube length is obtained by multiplying the eyepiece number by the notation number of the objective. These figures are adhered to within a few per cent in manufacture.

When a device altering the magnification is introduced between the eyepiece and objective, then the magnification engraved on it must be used as a third factor to obtain the total magnification, as explained on page 51.

Field of view. The *field of view number of an eyepiece*, divided by the factorial magnification noted on the objective, gives the diameter in mm. of that portion of the object plane seen through the eyepiece and objective with correct tube length. When an additional component altering the magnification, such as Bitukni L, is employed, this result must be further divided by the individual magnification of this component.

Homals

The eyepieces above referred to are principally intended for visual observation, but are also used for photomicrographic work and projection with the microscope. It must be remembered, however, that the images projected by microscope objectives are curved, for the reasons explained on page 52. In order to enable a flat image of a flat object to be produced on the plane photographic plate, this curvature must be reduced by a special eyepiece. Such eyepieces are the *Homals* described in "Mikro 390e." When employed in conjunction with achromatic objectives, these eyepieces produce a practically flat image of a flat object on a plane surface such as is represented by the photographic plate. *Homals* are, however, *not adapted for visual observation*, since their exit pupil lies in the interior of the microscope tube.

Stereoscopic Dissecting Microscopes

A. GREENOUGH Binocular Microscopes Stands X

a) General

In these binocular image-erecting microscopes, two complete tubes, each with one objective and one eyepiece and inclined at an angle of eight degrees to the perpendicular, are combined into a *double tube*. This tube X is focused by means of a rack-and-pinion motion, in addition to having a coarse adjustment along a dovetail slide *a*, Fig. 30. By the fusion of two images seen from different angles, the observer receives a stereoscopic impression of the object, whilst the exit pupil is fully utilized. The preparation is not merely viewed with both eyes at the same time, but stands out in striking plastic relief. A necessary condition is that *the objectives* are *accurately centred* in their tubes. To facilitate interchange, each pair of objectives is mounted on a slide fitting common to both. The centring must be done *individually for each stand*, and the objectives are therefore provided with a centring device.

The instruments of this class are principally intended for dissecting purposes at low magnifications of the order of those of magnifiers. They may, however, also be used for a great many purposes of stereoscopic observation at the higher magnifications listed below. With the necessarily small numerical aperture of the objectives, magnifications exceeding 100× must, however, be considered as empty magnification.

A series of *seven paired objectives* are available, of which any desired number may be ordered. These objectives are designed for use with HUYGENS or orthoscopic eyepieces (p. 69).

The design of the Stands varies in accordance with whether they are intended for large or small objects and for special modes of observation. The *double tube*, however, remains *the same* in all models of the X series.

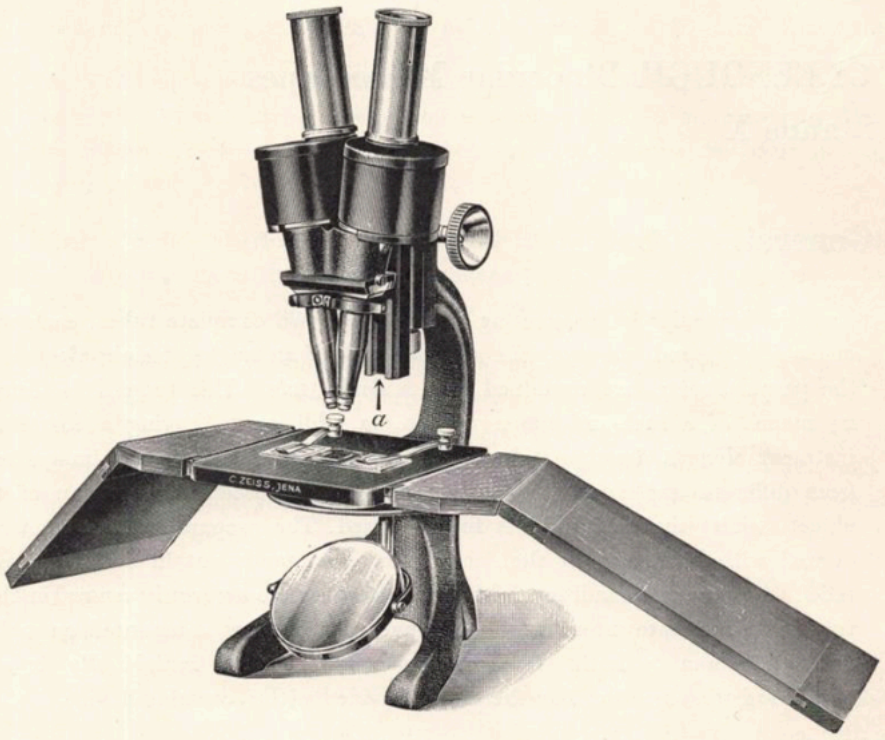
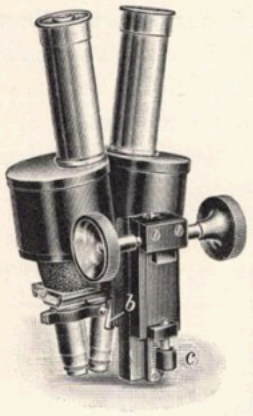


Fig. 30 About 1/3 actual size 8472

Stand XA, with objectives and eyepieces in place



8393 a

Fig. 31 About 1/4 actual size
Double tube X with motion box

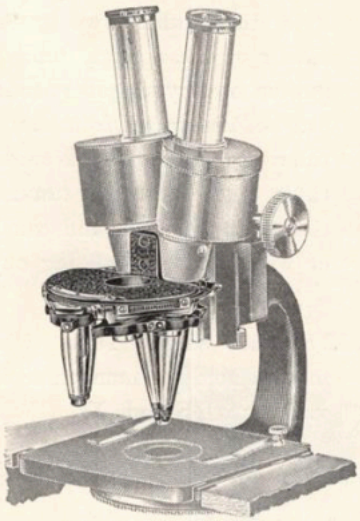

13834

Fig. 32 About 1/4 actual size
Double tube X with revolving nosepiece

No. 12 51 03. Double Tube X (with motion box)

The double tube with motion box, Fig. 31, forms a separate unit, which can be removed from the stand after loosening screw *c*, and set on any other type X stand. In this manner, one double tube X may by turns be used with any of the different stands X.

Code word: *Minestrone*

No. 12 51 05. Case for Double Tube X

Code word: *Minoranso*

Since the objectives are attached in pairs to slide fittings, they may be easily and quickly exchanged. If the observer can always make do with as few as three paired objectives, a still more rapid exchange may be had by arming double tube X with the triple revolving nosepiece shown in Fig. 32. In this case, all that is necessary is to turn the disk of the nosepiece in order to swing any pair of objectives into line with the axes of the double tube.

If the revolving nosepiece is to be employed, room must be provided for it by a recess in the prism body. The revolving nosepiece cannot be used with a double tube not having this recess.

No. 12 12 01. Revolving Nosepiece for Three Paired Objectives for Tube X

Code word: *Kedeu*

On the other hand, the place of double tube X on the motion box may be taken by a single tube. Two types of such monocular tubes, Fig. 33, are available. Either of these single tubes may be substituted for the double tube on the motion box by simply releasing thumb lever *b*, Fig. 31, when the tube in place can be withdrawn from slot *a* (Fig. 30), and the other tube substituted. All tubes are made with the same footpiece *c*, Fig. 33, fitting the slot *a*. The monocular tubes have the standard screw thread for microscope objectives mentioned on page 56, and can be used with the customary revolving nosepiece, or with the small sliding objective changer.

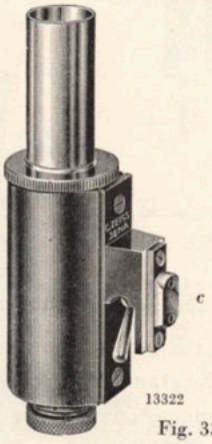
No. 12 51 21. Single Tube (without motion box) for monocular observation with Stands X

Code word: *Millionum*

No. 12 51 31. Image-Erecting Single Tube (without motion box) for monocular observation and dissecting.

The combination of Stand XA with this single tube constitutes a *monocular dissecting microscope.*

Code word: *Milliped*



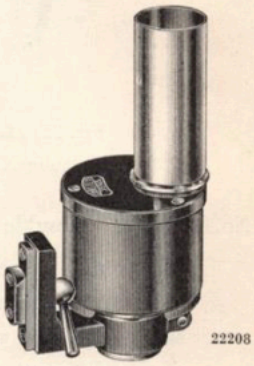


Fig. 33
About $^2/_3$ actual size
Single tube — Single image-erecting tube

No. 12 51 73/5. Adapter for Double Tube X

Code word: *Miolu*

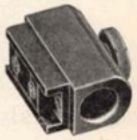


Fig. 34 About $^1/_2$ actual size
Adapter No. 12 51 73/5 for applying double tube X to Stands XII

With the aid of this adapter, both the double and the single tubes X may be used with the stands of Binocular Stand Magnifier XII (p. 80, Table 70).

On the other hand, double tube XII may be interchangeably used with microscope Stands XB to XH (p. 74).

For detailed description, see "Mikro 375e."

b) Paired Objectives and Eyepieces for Double Tube X

1. Paired Objectives

Notation and component magnification	(2)	(3)	(4)	(6)	(7) = (P)	(8)	(12)
Order No.	**11 21 02**	**11 21 03**	**11 21 04**	**11 21 06**	**11 21 07**	**11 21 08**	**11 21 12**
Code word	*Milhar*	*Milharada*	*Milharadom*	*Milharal*	*Minarum*	*Milharoz*	*Milheira*

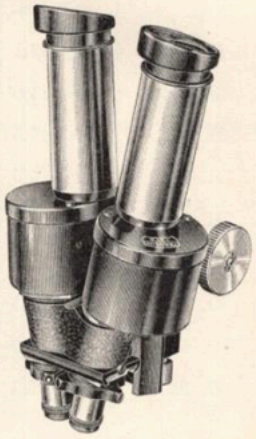
2. HUYGENS (H) Paired Eyepieces

Notation and component magnification	4×	5×	7×	10×	15×
Order No.	**11 35 44**	**11 35 45**	**11 35 47**	**11 35 50**	**11 35 55**
Code word	*Mimosal*	*Mimosea*	*Mimoseado*	*Miaremus*	*Miares*

3. Paired Objectives with enlarged field of view

Notation and component magnification	Bi 6×*)	Orthoscopic (O) 12.5×	17×	28×
Order No.	**11 35 46**	**11 35 52**	**11 35 57**	**11 35 58**
Code word	*Minuriebat*	*Middelader*	*Middel*	*Miargyros*

*) For 30-mm. eyepiece sleeve



13298

Fig. 35 About 1/3 actual size
Double tube X with **Bi 6×** **paired eyepieces** for large field of view

Paired objectives 7 (Pl) are water-immersion lenses. Because of their large working distance, these eyepieces can be used only in connection with water cell No. 12 87 20 (p. 57). The cell is filled to the brim with water, into which the objective should just dip.

The Bi 6× paired eyepieces call for the 30 mm. inside diameter adapter sleeves accompanying them. The exchange against the ordinary 23.3 mm. diameter eyepieces is effected by first inserting the adapter sleeves into the wide tube, and then sliding the eyepieces into these sleeves.

Table

of Magnifications, Free Working Distances, and Extent of Object included in field of view, for paired objectives and eyepieces for double tube X.

Paired objectives	(2)		(3)		(4)		(6)		(7) = (Pl)		(8)		(12)	
Free working distance mm.	75		56		45		32		35		24		17	
Paired eyepieces	Mag.	Field of view	Mag.	Field of view	Mag.	Field of view	Mag.	Field of view	Mag.	Field of view	Mag.	Field of view	Mag.	Field of view
		mm.		mm.		mm.		mm.		mm.		mm.		mm.
H. 4×	8	12.1	12	8.2	16	6.1	24	4.0	28	3.3	32	3.0	48	2.0
H. 5×	10	11.6	15	7.8	20	5.8	30	3.9	35	3.1	40	2.9	60	1.9
H. 7×	14	9.6	21	6.4	28	4.8	42	3.2	49	2.6	56	2.4	84	1.6
H. 10×	20	6.9	30	4.7	40	3.5	60	2.3	70	1.9	80	1.7	120	1.2
H. 15×	30	4.3	45	2.8	60	2.1	90	1.4	105	1.15	120	1.1	180	0.7
Bi 6×	12	15.5	18	10.1	24	7.2	36	4.7	42	4.0	48	3.5	—	—
O. 12.5×	25	9.5	37.5	6.4	50	4.7	75	3.1	87.5	2.6	100	2.4	150	1.6
O. 17×	34	7.0	51	4.7	68	3.5	102	2.3	119	1.9	136	1.7	204	1.2
O. 28×	56	3.3	84	2.2	112	1.6	168	1.1	196	0.9	224	0.8	336	0.55

Bi 6× to B 28× are Eyepieces with Enlarged Field of View

Magnifications above 100× are 'empty' magnifications and give relatively dark images.

Paired objectives cannot be used in the tubes of the older models XA. The paired 4×, 5×, and 7× eyepieces can be used only with the present double tube X.

The range of interpupillary distance is from about 56 to 80 mm. The least interpupillary distance with the Bi 6× paired eyepieces is about 59 mm.

c) Stand XA

The stage of Stand XA is square and has an opening about 40 mm. wide, which is reduced to about 20 mm. by the stop. Arranged below the stage is a revolvable disk with half of its surface white and half of it black, for observation in incident light against a light or a dark background. This disk has an opening with a sliding sleeve of 36.8 mm. inside diameter, designed for the reception of spectacle-lens or other low-power microscope condensers. In addition, the stage bears underneath a 70 mm. diameter plane and concave mirror in a universally movable holder. A cardboard disk in a light mount may be slipped over the mirror to furnish the diffused light required for obtaining a subdued and uniform illumination for transparent objects.

Upon releasing screw *c*, the double tube can be taken off Stand XA, Fig. 36, and placed on the intermediate carrier *d* of Dermatoscope Stand XD, Fig. 37, or on some other Stand X. Dermatoscope Stand XD may be supplied with narrow or wide forked base, or with pear-shaped base plate (see "Mikro 375e").

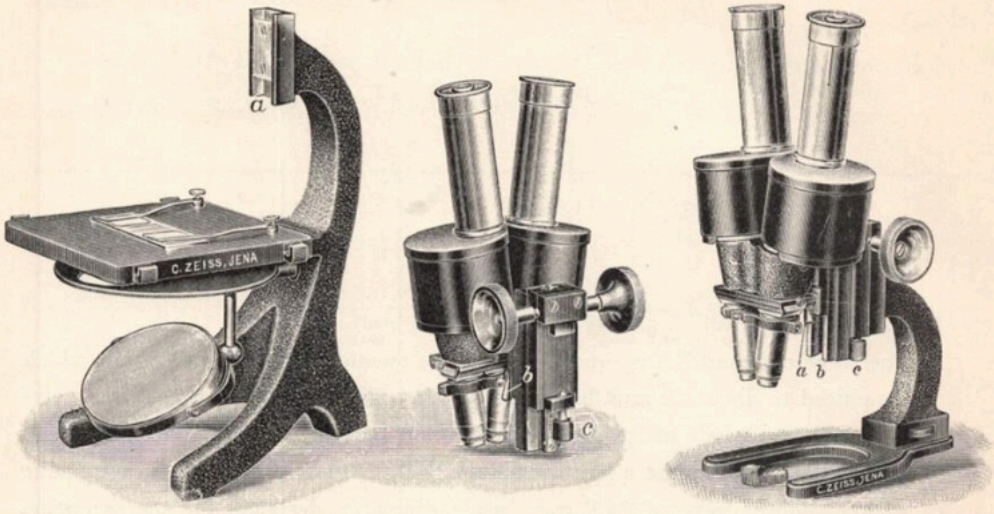


Fig. 36 About 1/4 actual size 8393
Stand XA
without hand rests

Double Tube X
with motion box

Fig. 37 About 1/4 actual size 8394
Dermatoscope XD

No.		Code word
12 52 00	**Stand XA** (without double tube) with hand rests, in cabinet ..	*Ministre*
12 52 01	**Stand XA** with hand rests (without Dermatoscope Stand XD, objectives, and eyepieces), in cabinet (Fig. 30)	*Minatarum*
12 52 02	**Stand XA** with hand rests and Dermatoscope Stand (without objectives and eyepieces), in cabinet	*Mincepie*
12 52 04	**Stand XA** (without hand rests, Stand XD, objectives, and eyepieces), in cabinet	*Kedka*
12 52 08	**Stand XA** with hand rests and **revolving nosepiece** (without Stand XD, objectives, and eyepieces), in cabinet	*Kedoe*
12 52 50	**Intermediate Arm d of XD** (Fig. 37)	*Millonario*
12 52 51	**Dermatoscope XD,** with narrow forked base (without objectives and eyepieces), in case (Fig. 37)	*Millones*
12 52 53	**Wide Forked Base** with vulcanite covering	*Milloraine*
12 52 54	**Narrow Forked Base** with vulcanite covering	*Millosa*
12 52 56	**Pear-shaped Base**	*Millouin*

d) Stands XB and XC

Stands XB and XC are mainly intended for the observation and dissection of large objects which cannot be accommodated on the stages of Stand XA. Additional uses of these stands are as *aquarium microscopes*, for the examination of large portions of plants, mineral specimens, metal blocks and plates, machinery parts, cloth, and the like, or, broadly, for the microscopic scrutiny of objects which are to remain intact. When observation with one eye with a higher power objective is desired, the double tube may be replaced by one of the two monocular tubes shown on page 68.

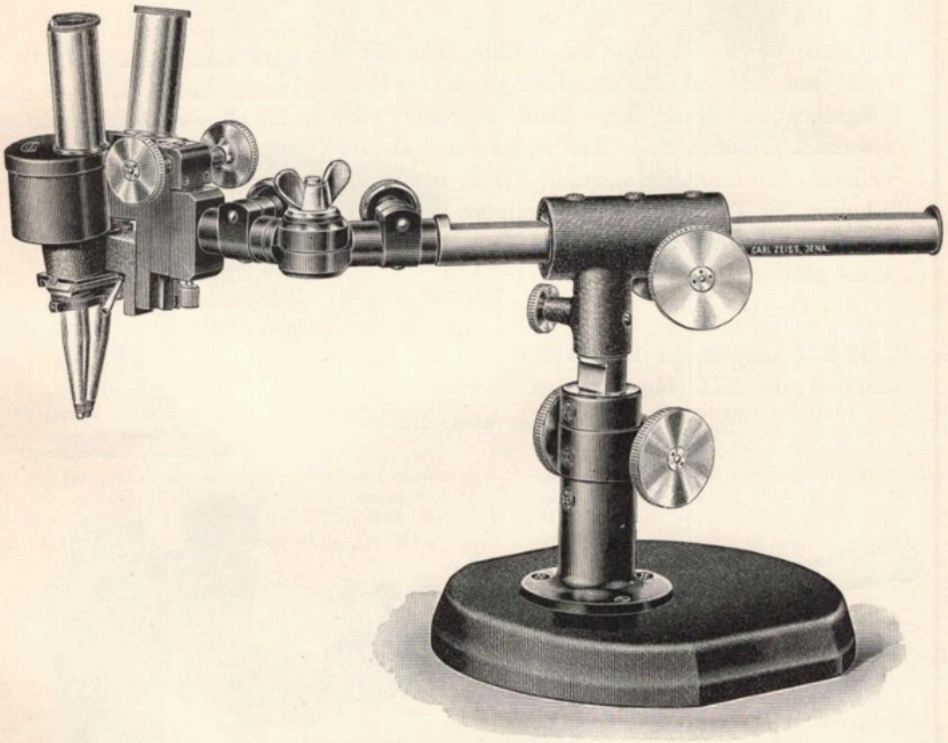


Fig. 38 About 1/4 actual size 11605

Stand XB

No. 12 52 25. Stand XB (Fig. 38)

The stand is mounted on a heavy base. It has three rack-and-pinion motions and is capable of four rotational movements. With these combined motions, large objects of pronouncedly irregular surface can be readily examined all over. The stand is supplied in an alder case. Code word: *Mingere*

No. 12 52 21. Stand XB (without tube), without case Code word: *Keduj*

No. 12 52 21/1. Case for Stand XB. Code word: *Kedyn*

No. 12 52 22. Offset Extension for XB and XC.

With Stand XB as regularly equipped, the tube cannot be lowered far enough to focus on the plane of the work table or other surface supporting the stand. This requires the use of the extension shown in Fig. 39.

Code word: *Millier*

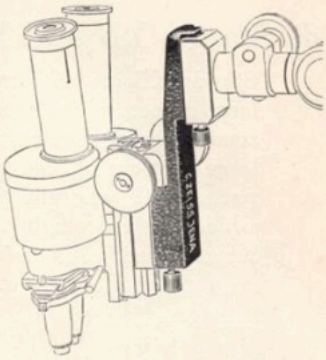


Fig. 39 About 1/4 actual size 11557
Extension for XB, for observation in the plane of the table surface

In place of double tube X, double tube XII (p. 81) may be used with Stand XB when very low magnifications with large field of view are required. Double tube XII is fastened above or below the cross bar of Stand XB by means of adapter No. 12 52 27 in the manner shown in Fig. 41. Double tube XII may be used in the same manner on Stand XC.

No. 12 52 27. Adapter for Stands XB and XC and double tube XII (Fig. 40).

Code word: *Mioludos*

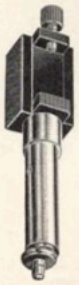


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Fig. 40 About 1/2 actual size

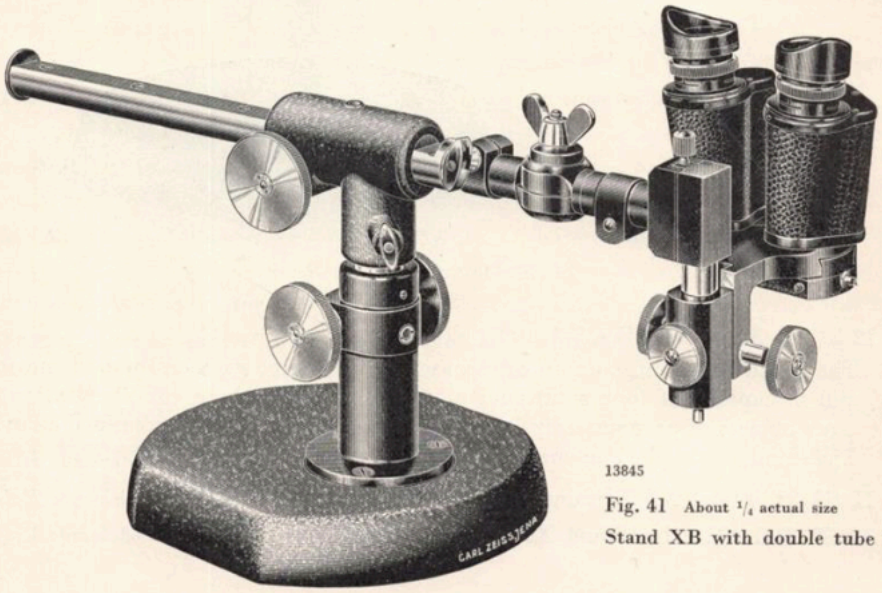

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Fig. 41 About 1/4 actual size
Stand XB with double tube XII

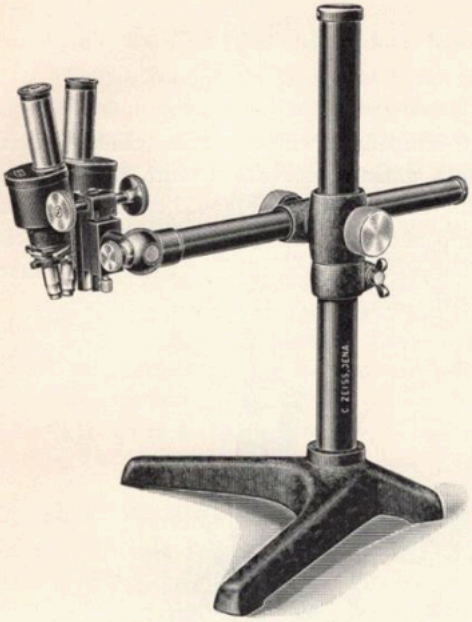


Fig. 42 About 1/7 actual size 11587

No. 12 52 41. Stand XC

Coarse vertical and lateral adjustments are effected by hand. Fine adjustment in focusing is made with the pinion head of the double tube. With this stand also, the double tube can be focused on the plane of the table only by the use of extension No. 12 52 22, Fig. 39. The double tube is supplied in an alder case, while the stand is supplied without case.

Code word: *Millimodor*

No. 12 52 40. Stand XC (without tube)

Code word: *Ministress*

Double tube XII can be attached with the aid of the adapter No. 12 52 27 described on page 74.

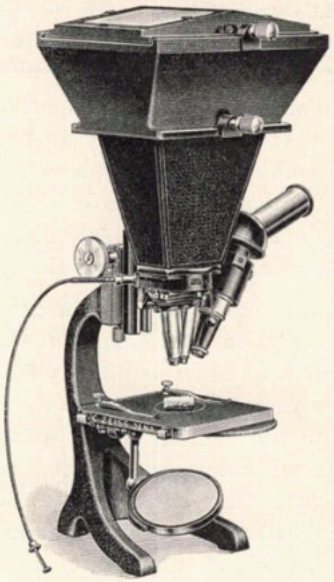


Fig. 43 About 1/6 actual size 11455

No. 12 51 51. Stereoscopic Camera

On Stands X, a $2^1/_2 \times 2^1/_2$ in. (6×6 cm.) DRÜNER Stereoscopic Camera may be used interchangeably with the double tube. See DRÜNER, "Über Mikrostereoskopie und eine neue vergrößernde Stereoscopkamera", Zeitschrift für wissenschaftliche Mikroskopie, No. 17, 1900, pp. 281 to 293, and *pamphlet* "*Mikro 257e.*"

Code word: *Millipora*

For use with above:

No. 12 51 65. Enlarging Attachment for stereoscopic camera.

Code word: *Miniarde*

No. 12 51 66. Side Microscope Tube with objective, without eyepiece.

Code word: *Miniaran*

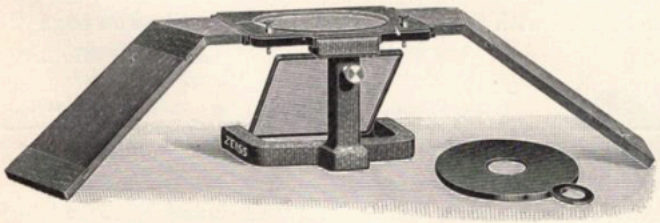


Fig. 44 About 1/6 actual size

Dissecting Stage for Stands XB and XC

8239

No. 12 52 24. Dissecting Stage for Stands XB and XC

and for Stands XII B and XII C (Table 7), for observation and dissecting in transmitted light.

Code word: *Micaceous*

e) Accessories

No. 12 51 07. Illuminating Attachment

For work in incident light, daylight or lamp light will as a rule suffice. When it becomes necessary to light the area under observation more intensively, double tube X may be armed with the attachment of Fig. 45, consisting of a tubular shell with a small filament lamp and two lenses, with the aid of which the field may be evenly illuminated. This device is attached in a simple manner to the double tube of the stand with the aid of a watch key.

The lamp has a current consumption of 1.1 amps. at 6 volts. It may either be directly fed from a three-cell battery, or connected to the lighting circuit through a small transformer in the case of alternating current, or through a resistance with direct current. The use of an adjustable resistance affords the possibility of changing the intensity of illumination by varying the voltage of the current. Two spare lamps are furnished with the attachment.

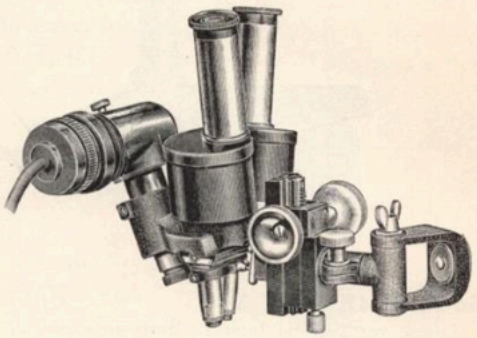


Fig. 45 About 1/4 actual size 8564

Illuminating Attachment for Double Tube X, with two spare lamps

Code word: *Milling*

No. 12 51 11. Side Illuminating Attachment

With Stand XB, inconvenience may be occasioned by the position of the illuminating attachment right in front of the double tube. When this is the case, an illuminating attachment designed for application to the side of the double tube, No. 12 51 11, may be supplied. This *side attachment only* can be employed if the double tube is to be used with the *revolving nosepiece* described on page 67.

Code word: *Ministret*

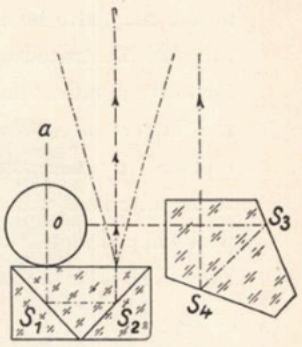
No.		Code word
13 90 81	**Spare 6-volt, 7-watt lamp**	*Minandae*
13 95 62	**Transformer for connection to 110 volts,** with lead	*Kedzo*
13 95 63	**Transformer for connection to 220 volts,** with lead	*Kefan*
13 90 83	**Regulating resistance for 110 volts**	*Mincerait*
13 90 84	**Regulating resistance for 220 volts**	*Mincerions*

No. 12 87 02. GREENOUGH Prism Rotator for Stand XA

The prism rotator is intended for the observation of small opaque objects of between 0.5 and 0.3 mm. diameter, such as insects eggs, from all sides. The objects are placed upon a prism accommodated in a glass cell, with which it can be rotated and laterally shifted. The upper surface of the object is directly viewed. The bottom is seen by double reflection through the rotating prism carrying the object, and the sides of the object through a lateral double-reflecting prism. These three modes of observation can be carried out with any pair of objectives up to 6×.

Fig. 46 is a diagram of the course of the rays.

Code word: *Micos*



13906

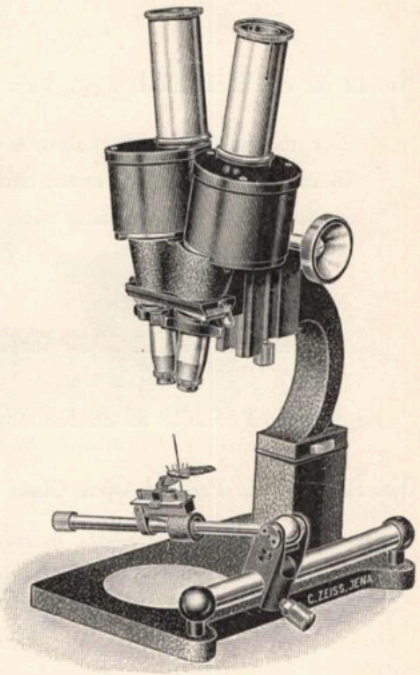
Fig. 46

No. 12 52 58. HELLER Object Holder for entomological work

In this device, a rectangular base bears at one end a block for the reception of the carrier with tube X, and on an adjoining side a guide rod for an articulated arm held by a strong spring clamp. A ball joint permits the arm to be moved in every direction. The object holder is slidable and rotatable on the arm, and carries a revolvable cork ring for receiving insect needles in a vertical position, and a hinged strip of cork for sticking them in horizontally. In addition, a small spring clip is provided for holding the needle by the head when the under side of the insect is to be viewed. The base has a removable opal glass disk which furnishes a light background for the objects under examination.

Observation is made by means of double tube X, which is attached to the block on the base by carrier arm *d*.

Code word: *Milviuser*



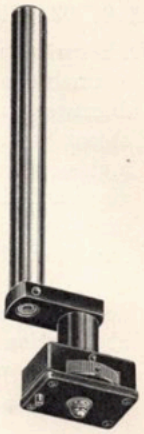
8822

Fig. 47 About 1/3 actual size
HELLER object holder with carrier arm and double tube: Stand XEH

No. 12 52 55. Stand XEH; HELLER Object Holder with carrier arm and double tube.

Code word: *Milva*

Instead of being used with double tube X, the object holder may also be equipped with one of the monocular tubes X illustrated on page 68, or with double tube XII for low magnifications with wide field of view (p. 81). In the latter case, the carrier arm *d* (Fig. 47) must be replaced by the standard illustrated in Fig. 48. This same standard must also be used on the forked and pear shaped bases of page 72 in place of *d*, when double tube XII is to be employed.



13844

Fig. 48
About 1/4 actual size

No. 12 52 28. Standard XII

for attaching double tube XII to Stands XD and XEH.

Code word: *Mioman*

No. 12 52 65. SÜFFERT 7 1/2 × 8 in. (19 × 20 cm.) Base Plate with plinth.

For use with double tubes X or XII. Heat-insulated side strips prevent chill to the fingers in dissecting and working with culture dishes.

Code word: *Kefbo*

For use with above:

Carrier Arm No. 12 52 50 for double tube X (p. 72)

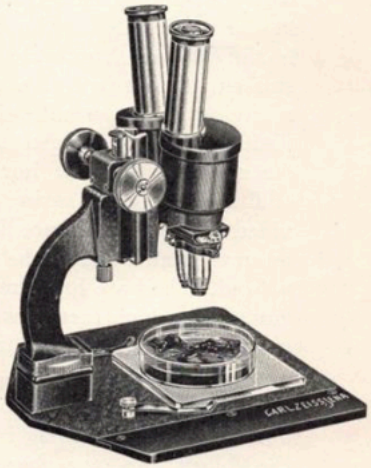
Standard No. 12 52 28 for double tube XII

No. 12 52 65/1. Frosted Opal Glass Stage Plate

Code word: *Kefes*

No. 12 52 65/2. Metal Stage Plate, white and black

Code word: *Kefgu*



22200

Fig. 49
About 1/6 actual size

f) ZEISSLER Plate Culture Microscope

for fully utilizing the methods of plate culture employed in bacteriology
(see Zentralblatt für Bakteriologie, Abt. I, Vol. 88, 1922, pp. 430 to 432).

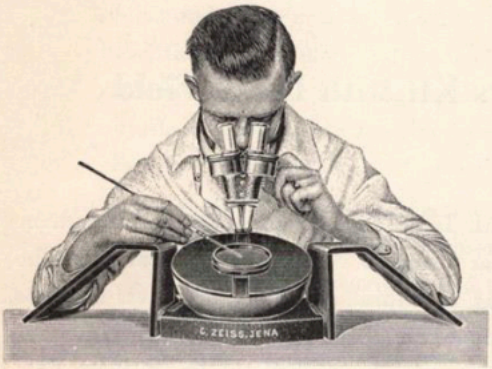


Fig. 50 About $^1/_{10}$ actual size 8504

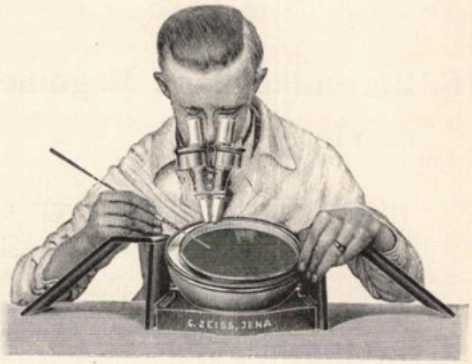


Fig. 51 About $^1/_{10}$ actual size 8505

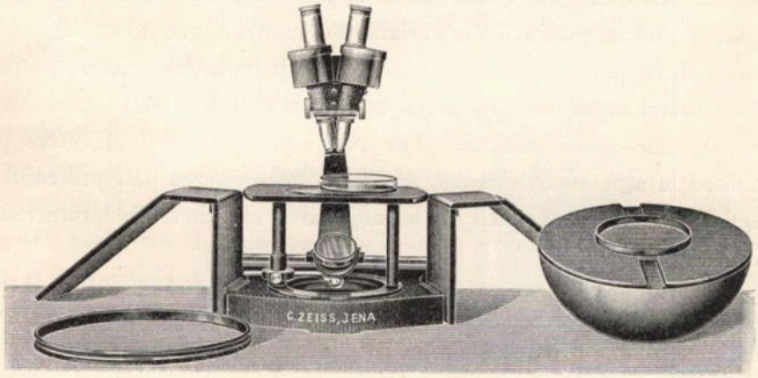


Fig. 52 About $^1/_8$ actual size 8508

The apparatus comprises:

Stand with binocular tube, large hemispherical stage for transmitted light, hand rests, pair of objectives (4) and pair of 5× eyepieces

No. 12 52 86 ..... Code word: *Milvaginum*

Used to advantage in place of the 5× paired eyepieces:

No. 11 35 46. 6× Paired Eyepieces with extended field of view (p. 69)

Code word: *Minuriebat*

For choice of other paired objectives and eyepieces, see list on page 69.

B. Binocular Stand Magnifiers XII with Large Field of View

Binocular Stand Magnifier XII with large field of view is an instrument extending the advantages of binocular vision to very low magnifications. The image is exceptionally plastic, giving a natural and striking effect, and the eyes are not tired even in protracted work. In combination with a number of stands, this simple optical instrument can be applied to almost every field of activity. By reason of its large free working distance and field of view, Binocular Stand Magnifier XII can be applied to numerous and widely differing purposes. The magnification is variable between 4× and 43×. The equipment includes three pairs of eyepieces and three pairs of objectives, which are all readily interchangeable. The prism body can be raised and lowered by means of a rack-and-pinion motion. The two higher-powered objective pairs are contained in a protective casing, while the low-powered pair protrudes with its objectives into the tube. All of the objectives are therefore protected against external influences.

Observation may be made either in incident light, or, by the employment of a suitable attachment, in transmitted light. The instrument can be furnished with an illuminating device designed to attach to the prism body and serving to light the object from above. The intensity of the illumination and the size of the radiant field must be adapted to the extent of the field of view and the magnification.

As in the case of the X series, the present instrument is made up into several models consisting of the same double tube, XII, with its objectives and eyepieces, and one of a number of widely differing types of stands. Unless work must be done at several points at the same time, one double tube, with one or more pairs of objectives, may therefore be used alternatively with several stands.

No. 12 51 70. Double Tube (Prism Body) XII Code word: *Minutina*

The double tube shown in Fig. 53 contains prisms serving the same twofold purpose as those in the field glass, of folding the long path of the rays into a small compass, and of producing the erect image which is desirable in manipulating an object under observation. Apart from its vertical range along the standard of the base, the double tube is adjustable up and down along its carrier by means of a rack and pinion for focusing during work. The two prism bodies are eccentrically adjustable around two axes for setting them to the interpupillary distance of the observer. The inclination of either tube to the central axis is about 5 degrees.

Any one of three pairs of objectives, of the factorial magnifications $^1/_2\times$, $1^1/_4\times$, and $2^1/_2\times$, may at choice be inserted into the prism body from below. The $^1/_2\times$ objective pair protrudes into the prism body. The pairs of eyepieces have component magnifications of $8\times$, $12^1/_2\times$, and $17\times$, respectively. The $17\times$ eyepieces are of the usual orthoscopic type mentioned on page 69, and are designed to be used in the wider eyepiece sleeve by the interposition of suitable adapters. The range of magnification therefore extends from $4\times$ to $43\times$.

The principal use of the instruments of this class will be for observation in incident light. For this reason, a large free working distance is provided, and daylight will therefore ordinarily afford sufficient illumination even when the object is well below the surrounding surface. If daylight should not prove adequate, however, then illumination of the desired intensity may be obtained by screwing a special illuminating attachment, Fig. 53, to the prism body.

Apart from double prism body XII, the binocular tube X, p. 67, or the monocular tubes X, p. 68, may be used with the type XII stands by employing an adapter of the kind illustrated in Fig. 34.

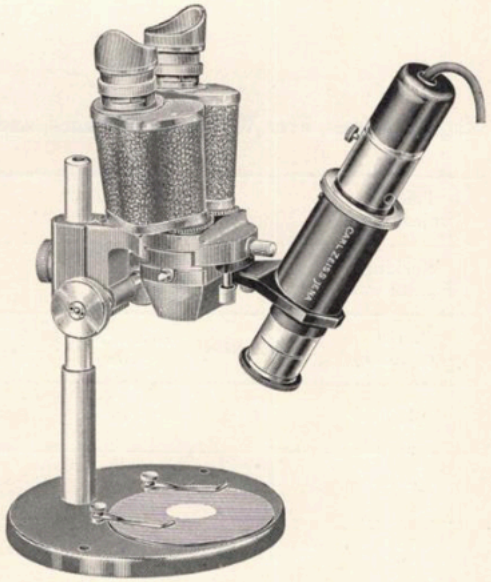


Fig. 53 About $^1/_4$ actual size 22214
XII A, with Illuminating Attachment No. 12 51 16

No. 12 51 16. Illuminating Attachment for double tube XII (Fig. 53) with two 8-volt, 0.6-amp. lamp bulbs in centring cap, and lead with plug

Code word: *Kaesc*

No. 13 96 01. Lamp Bulb, 8-volt, 0.6-amp., in centring cap

Code word: *Miopia*

No. 13 95 69. Transformer, 8-volt, 0.6-amp., for 110 or 220 volt alternating current, with lead

Code word: *Kaewg*

No. 13 90 76. Fixed Resistance for 110 or 220 volt direct current

Code word: *Kafoy*

	Paired Objectives			Paired Eyepieces		
Notation and component magnification	1/2	1 1/4	2 1/2	8×	12 1/2×	O. 17×*)
Order No.	**11 21 16**	**11 21 17**	**11 21 18**	**11 35 48**	**11 35 53**	**11 35 57**
Code word	*Minutalius*	*Minutame*	*Minutamos*	*Minutandi*	*Minutant*	*Middel*

*) For use with 17× paired eyepieces: **2 Adapter Sleeves No. 11 35 56**

Code word: *Minziek*

Magnifications, Free Working Distances, and Extent of Object included in field of view

Paired objectives	1/2		1 1/4		2 1/2	
Working distance cm.	14		12		8	
Paired eyepieces	Magnification	Field of view mm.	Magnification	Field of view mm.	Magnification	Field of view mm.
8×	4	40	10	14.9	20	7.7
12 1/2×	6 1/4	36	16	13.5	32	6.9
17×	9	26	23	10	43	5.2

For detailed description, see "Mikro 464e."

Plate 7

Binocular Stand Magnifiers XII

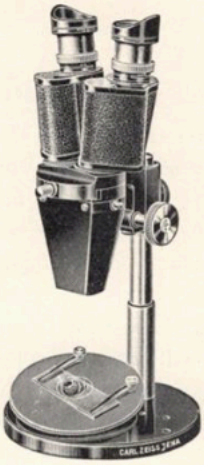
CARL ZEISS
JENA

Binocular Stand Magnifiers XII

with large field of view



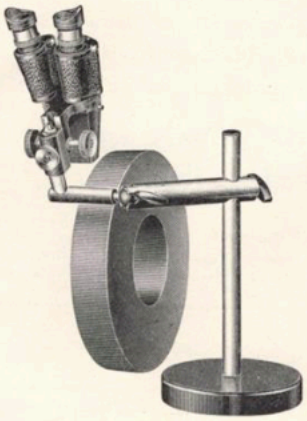
1 13537



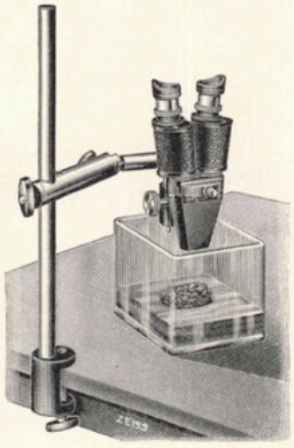
2 13831



3 13538



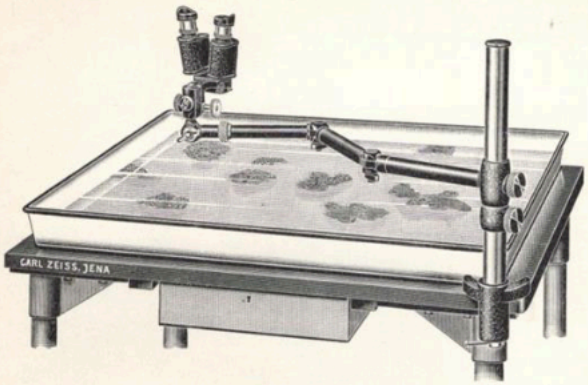
4 22211



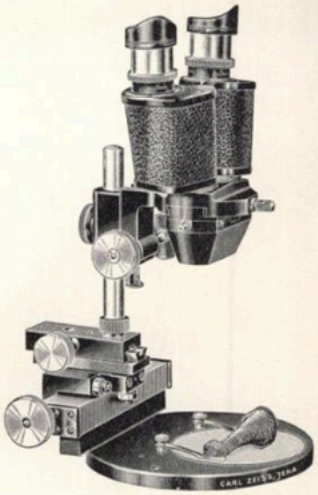
5 22209

Stands XII with Prism Body (without objectives and eyepieces)

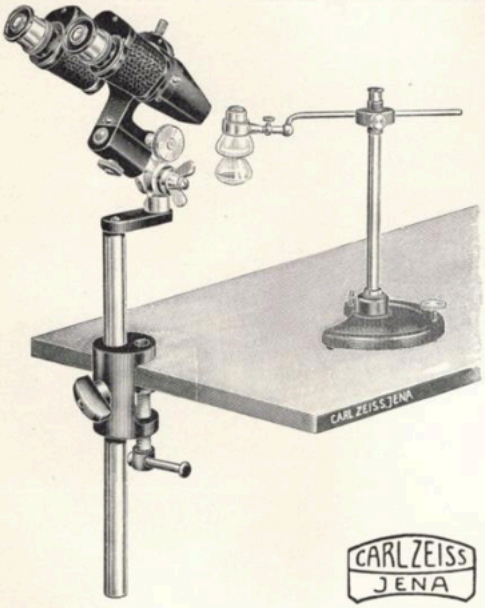
No.	Fig.		Code word
12 51 90	1	**Stand XII A:** Circular base with standard, in cabinet ...	*Kefiw*
12 07 12	2	**Hemispherical stage** for above	*Minutione*
12 51 91	3	Circular base with standard and sub-base for work in transmitted light, in cabinet ...	*Kefky*
12 51 93	4	**Stand XII B:** Circular base with standard and adjustable cross arm, prism body in case	*Kefma*
12 07 11		**Hemispherical stage** for above, with base ring	*Minutios*
12 51 94	5	**Stand XII C:** Standard with foot clamp, adjustable cross arm, prism body in case	*Kefoc*



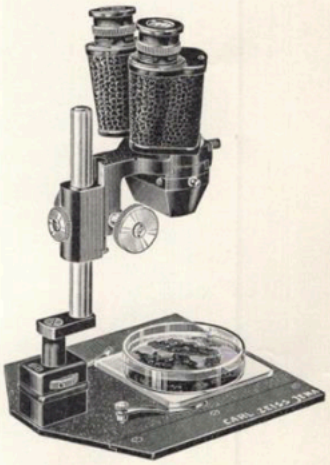
6 13555



8 22443



13857 7



9 13851

No.	Fig.		Code word
12 51 95	6	**Stand XII D:** Standard with foot clamp, adjustable double-jointed arm, prism body in case	*Kefre*
12 51 77	7	**Stand XII E:** Long standard, adjustable in foot clamp, prism body in case	*Kefuh*
12 51 78	8	**Stand XII F:** Circular base with compound slide, prism body in case	*Kefyl*
12 51 79	9	**Stand XII G:** SÜFFERT square base, with standard, prism body in case	*Kegam*

Magnifiers

a) Anastigmatic Magnifiers

The *magnification* of a magnifier of fairly high power is always very nearly the quotient of the conventional distance of vision (10 in. or 250 mm.) divided by the focal length of the magnifier.

In order to see as large a part of the object as possible, the observer *must bring his eye up close to the magnifier.* The observer perceives the enlarged image of the object through the free aperture of the magnifier in a similar manner as through a material stop. The higher the power of the magnifier, the larger will be the magnification and the smaller the free aperture. As a result, that portion of the object visible without shifting the object and magnifier relatively to each other is bound to grow smaller with increasing magnification.

Anastigmatic magnifiers are composed of four lenses. Even at the high 16×, 20×, and 27× magnifications, these magnifiers give a good image throughout the extent of a relatively large field of view, with a free working distance of surprising length.

Our anastigmatic magnifiers are supplied either in the form of single magnifiers in plain cylindrical mounts for use in dissecting stands, of single folding magnifiers, or of double folding magnifiers.



a 486 *b* 491 *c* 492 *d* 484

Fig. 54. **Anastigmatic Magnifiers.** About ²/₃ actual size

a: 16× single magnifier, in dissecting stand mount; **b:** 20× single folding magnifier; **c:** 10× and 20× double folding magnifier*); **d:** 16× and 27× double folding magnifier.

No.	Designation	Magnification	Free working distance mm.	Diameter of field of view mm.	Diameter of lenses mm.		Code word
11 60 20	**Anastigmatic single magnifier**	**16**	9	10	4.5		*Micturient*
11 60 21	**for dissecting stands**	**20**	7	8	4.0		*Micturio*
11 60 22	in tubular wooden box	**27**	5.5	6	3.1		*Micturios*
11 60 30	**Anastigmatic single**	**16**	9	10	4.5		*Micturire*
11 60 31	**folding magnifier**	**20**	7	8	4.0		*Micturirem*
11 60 32	in leather pocket	**27**	5.5	6	3.1		*Micturires*
11 60 40*)	**Anastigmatic double folding magnifier** in leather pocket	**10*) & 20**	12 7	15 8	13 4.0		*Micturisse*
11 60 41		**16 & 27**	9 5.5	10 6	4.5 3.1		*Micturite*
11 60 42		**20 & 27**	7 5.5	8 6	4.0 3.1		*Micturitis*

For detailed description, see "Mikro 188e."

*) In double folding magnifier No. 11 60 40, an improved 10× aplanatic magnifier is combined with 20× anastigmatic magnifier No. 11 60 21.

b) Aplanatic Magnifiers

Aplanatic magnifiers are two-component lens systems characterized by large field of view and relatively long free working distance. This field of view is clearly defined up to the edge and free from colour defects. We supply these magnifiers for 6×, 8×, and 10× magnification in the shape of folding magnifiers, focusing glasses, measuring magnifiers, dissecting stand lenses, and magnifiers with handles.


7979

Fig. 55 About 1/2 actual size
6×, 8×, and 10× aplanatic magnifiers

Folding Magnifiers. This is a convenient pocket form for hand use in a variety of work. In addition to the 6×, 8×, and 10× aplanatic magnifiers, we make an *aplanatic double folding magnifier* with 3- and 6-power lenses, giving a total magnification of 9×; and a $2^1/_2\times$ *folding magnifier for general survey*, at low magnification, of objects such as coins, medals, specimens of writing, and the like.

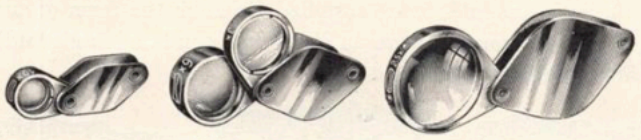

8001

Fig. 56 About 1/2 actual size
10× folding magnifier — 3×, 6×, and 9× double folding magnifier — $2^1/_2\times$ folding magnifier

Focusing Magnifiers. 6×, 8×, and 10× aplanatic focusing magnifiers are used to advantage in sharply focusing the image on the ground-glass screen and for examining negatives. With transmitted light, they are used in the *sliding sleeve* of Fig. 57, or in a mount with focusing collar and clamping ring, Fig. 58. For work in incident light, the magnifier is used in the *tripod* mount, Fig. 58, or in the *ring with handle* of Fig. 61. The tripod magnifiers are, of course, also suited to many other purposes.


7981

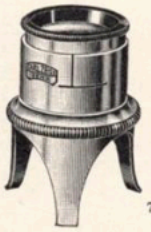

7980

Fig. 57 About 1/2 actual size
6× focusing magnifier in sliding sleeve — 6× focusing magnifier in tripod mount


8115

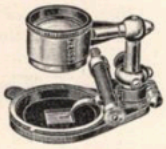

8116


7998

Fig. 58 About 1/2 actual size
6× focusing magnifier with focusing collar and clamping ring — 10× focusing magnifier with focusing collar and clamping ring — Small 5× and 10× double magnifier

For detailed description, see "Med 43e."

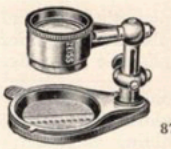
Measuring Magnifiers. Due to their clear and large image and their freedom from colour fringes, aplanatic magnifiers are ideal for measuring. Our measuring magnifiers are suited to a wide range of uses, and various accessories adapting them to the purposes of the textile and metal industries are available.


8784

Thread counter
with 6× aplanatic magnifier


7974

Interchangeable 8× and 10× aplanatic magnifiers, in lens ring with pin


8783

Measuring magnifier
with 6× aplanatic magnifier

Fig. 59 About 1/2 actual size

The textile industry still makes shift with optically very inadequate thread counters, in spite of the fact that a very great deal depends upon accuracy of measurement, and that a small error is liable to produce serious discrepancies in the finished piece.



Fig. 60 About 1/2 actual size 13637
Illuminating Magnifier, with 6× aplanatic magnifier, showing base plate A and insets for counting threads

Illuminating Magnifier. The Illuminating Magnifier combines a 6× magnifier giving a perfect image, with an electric illumination of high intensity rendering the observer independent of existing light conditions. This makes the Illuminating Magnifier pre-eminently suited to the examination of the surface condition of raw material and finished goods of every description, and for use as a textile magnifier and thread counter. The Illuminating Magnifier is set directly on the object to be examined.

For detailed description, see Med "259e" and Med "265e."

Magnifiers with Lens Ring and Handle, and Dissecting Stand Magnifiers. With the aid of a lens ring and pin, the 6×, 8×, and 10× aplanatic magnifiers (Fig. 55), the Survey Lens (Fig. 62), and the small 5× and 10× magnifiers (Fig. 58), may be attached either to the handle of Fig. 61, or to the magnifier stands illustrated on page 87.

For detailed description, see "Med 43e."

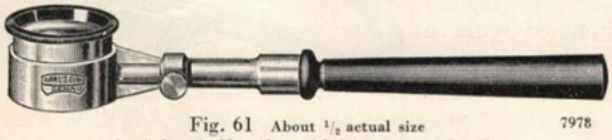

7978

Fig. 61 About 1/2 actual size
6× Aplanatic Magnifier, with lens ring and handle


500

Fig. 62 About 1/2 actual size
2 1/2× Survey Lens, in ring mount with pin for attachment to a handle or magnifier stand

List of Aplanatic Magnifiers

	Fig.	Diameter of lenses mm.	Magnification	Free working distance mm.	Diameter of field mm.	Code word	Price
Aplanatic magnifier, 6×	55	22	6	32	30	*Eduei*	
Aplanatic magnifier, 8×		18	8	23	21	*Eduim*	
Aplanatic magnifier, 10×		13	10	18	15	*Eduko*	
Folding magnifier, $2^1/_2$×	56	35	$2^1/_2$	97	120	*Eebay*	
Folding magnifier, 6×		22	6	32	30	*Eebca*	
Folding magnifier, 8×		18	8	23	21	*Eebec*	
Folding magnifier, 10×		13	10	18	15	*Eebge*	
Folding magnifier, 3× } 9× {		21	3	70	62	*Eebig*	
Folding magnifier, 6× }		21	6	32	30		
		21	9	20	19		
Focusing mag. with sliding sleeve, 6×	57	22	6	32	30	*Edybb*	
Focusing mag. with sliding sleeve, 8×		18	8	23	21	*Edycc*	
Focusing mag. with sliding sleeve, 10×		13	10	18	15	*Edydd*	
Focusing mag. in tripod mount, 6×	58	22	6	32	30	*Edyff*	
Focusing mag. in tripod mount, 8×		18	8	23	21	*Edygg*	
Focusing mag. in tripod mount, 10×		13	10	18	15	*Edyll*	
Focusing mag. with clamp ring, 6×	58	22	6	32	30	*Edymm*	
Focusing mag. with clamp ring, 10×	58	13	10	18	15	*Edynn*	
Small double magnifier, 5× and 10×	58	7	5	24	24	*Edulp*	
		7	10	10	12		
Lens ring and pin for 6× aplanatic magnifier						*Edvad*	
Lens ring and pin for 8× aplanatic magnifier						*Edveh*	
Lens ring and pin for 10× aplanatic magnifier						*Edvil*	
Handle for lens rings with pin						*Edwor*	
Survey lens with pin, $2^1/_2$×	62	35	$2^1/_2$	97	120	*Edubf*	
Measuring magnifiers and thread counters with							
6× aplanatic magnifier	59	22	6	32	30	*Edypp*	
8× aplanatic magnifier		18	8	23	21	*Edyrr*	
10× aplanatic magnifier		13	10	18	15	*Edyss*	
Illuminating magnifier, 6×	60	22	6	32	30	*Efdax*	
6× illuminating magnifier for textile purposes, with base for thread counting insets		22	6	32	30	*Efcus*	

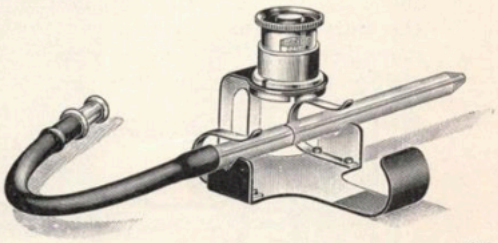
See folders "Med 243e," "Med 259e," and "Med 265e."

Measuring insets, graduated in centimetres or inches as ordered.

No. 12 73 29. Pipette Reading Magnifiers

Magnification: 5×

In conjunction with the holder furnished with it, this magnifier serves for accurately adjusting the position of the column of liquid in pipettes, especially when counting blood corpuscles by the Bürker method.



7878

Code word: *Militeris* Fig. 63 About $^1/_2$ actual size

For detailed description, see "Mikro 298e."

c) Magnifier Stands

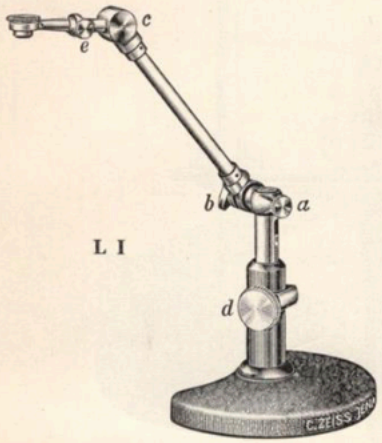


Fig. 64 About 1/4 actual size 11657

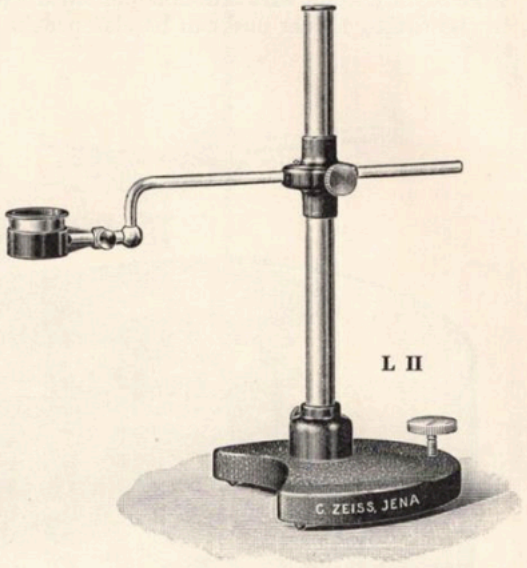


Fig. 65 About 1/4 actual size 8360

No. 12 58 01. Magnifier Stand L I (without magnifier and lens ring) (Fig. 64)

Code word: *Micuisse*

The jointed arm for carrying the magnifier is mounted on a heavy crescent-shaped pedestal, in which it is vertically adjustable by a rack-and-pinion motion. The arm can be swung around the vertical axis, and turned around the horizontal axes of joints *b* and *c*, which are simultaneously clamped by screw *a*.

(See Zeitschrift für Instrumentenkunde, Vol. **15**, 1895, pp. 322 to 323; Zeitschrift für wissenschaftliche Mikroskopie, Vol. **12**, 1895, p. 318.)

No. 12 58 11. Magnifier Stand L II (without magnifier and lens ring) (Fig. 65)

Code word: *Micuissent*

Heavy crescent-shaped metal foot with brass standard and a sliding holder which can be clamped in any position of adjustment. The holder carries a horizontal arm with the lens ring and magnifier at the end. A footscrew in the base serves for tilting the stand for the fine focusing of magnifiers of higher powers after the arm has been brought to the desired position.

No. 12 58 13. Magnifier Stand III (without magnifier and lens ring)
Code word: *Minutare*

Like Stand II, but with a double jointed arm (Fig. 66), which is adjustable endwise in the sliding holder and can be clamped in any position by means of screw *a*.

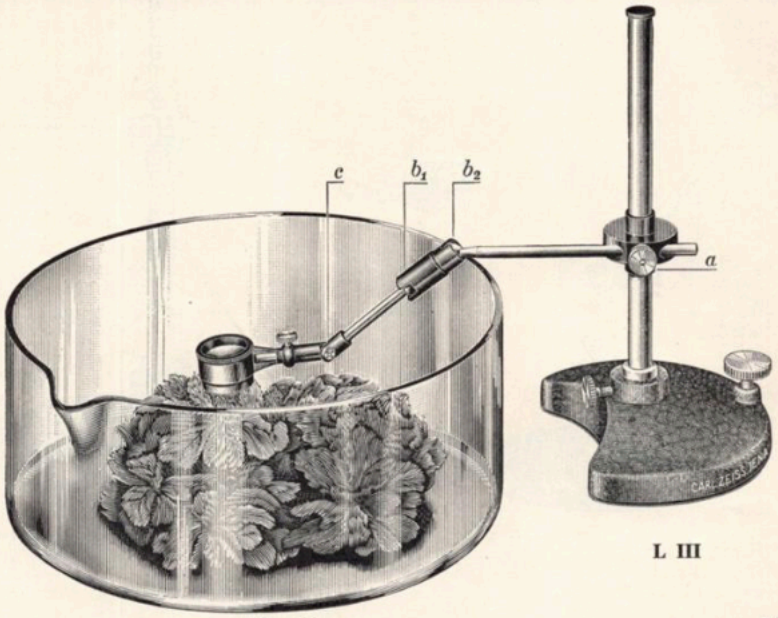


Fig. 66 About 1/4 actual size 13517

An intermediate piece with two ball joints b_1, b_2, permits the magnifier to be conveniently raised, lowered, or turned, and thereby quickly set to any desired position. A further joint *c* is provided for tilting the magnifier to the desired angle.

The jointed arm just described may be used with Magnifier Stand II in place of the rigid arm:

No. 12 54 04. Jointed Arm for Magnifier Stand II
Code word: *Minutaras*

For detailed description, see "Mikro 188e."

No. 12 54 10. MAYER Dissecting Stand (Fig. 67),
with magnifier standard with rack-and-pinion motion (without magnifiers), and arm rests in cabinet
Code word: *Kegco*

For use with above:

No. 12 60 30. Drawing Apparatus for Dissecting Stand of Fig. 67, with case and drawing board
Code word: *Polergal*

The 6× and 10× magnifiers, page 84, are particularly recommended for use with the Dissecting Stand.

No. 12 54 15. Dissecting Stand with double tube X and arm, on bridge frame with slide, microscope carrier with rack-and-pinion motion, hand rests, paired objectives 2 and 4, 5× and 10× eyepieces, in cabinet.
Code word: *Mimulama*

For detailed description, see "Mikro 270e."

MAYER Dissecting Stands

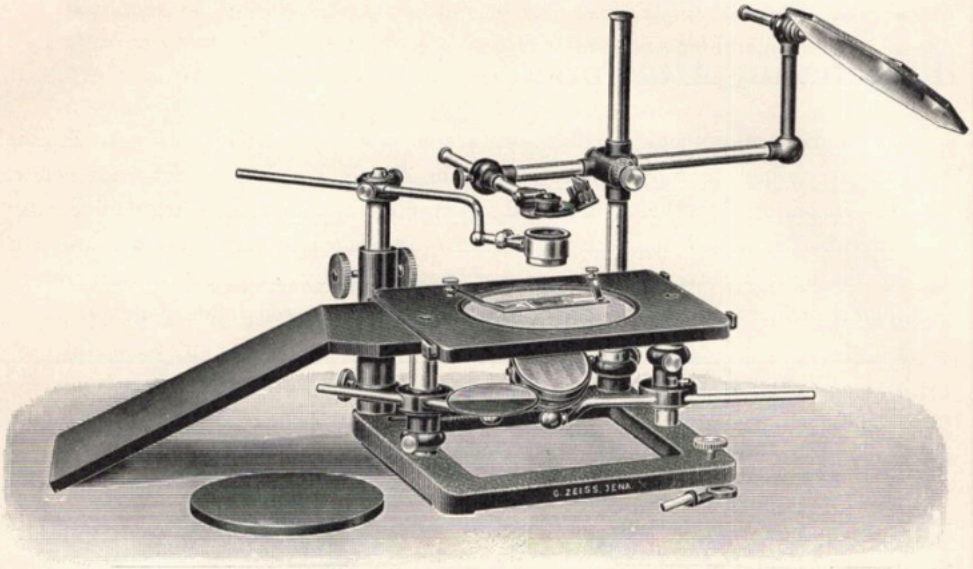


Fig. 67 About 1/4 actual size 8723

Dissecting Stand, with magnifier and drawing apparatus

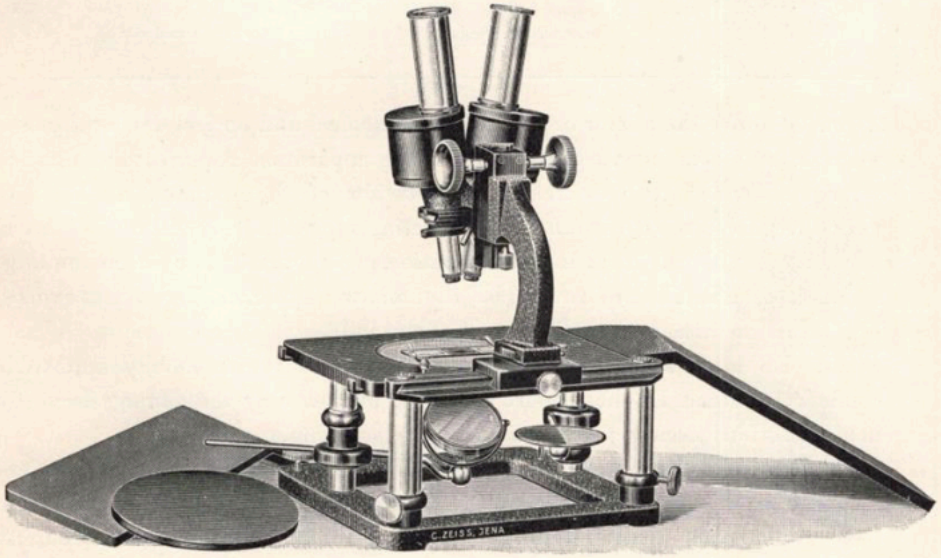


Fig. 68 About 1/4 actual size 11559

Binocular Dissecting Microscope

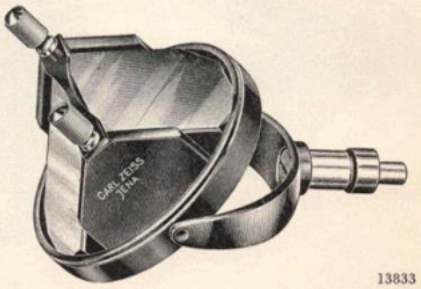
Illuminating Attachments

Ordinarily, microscopic preparations are observed in transmitted light. Stands are accordingly equipped with means for illuminating the object from below, the incoming light being deflected upward by a mirror held in a universally movable frame. Where the requirements in regard to regulation of the path of the light are exacting, this mirror is replaced by a prism with accurately plane surfaces, illustrated below and previously referred to on page 7.

No. 12 01 10. Illuminating Prism

A rectangular prism, universally movable in the mirror frame, for insertion into the tailpiece of the illuminating apparatus in the place of the regular mirror. For exactly regulating the illumination in connection with aplanatic condensers (pp. 93, 94), especially where the light source is rigidly connected to the microscope.

Code word: *Keger*



13833

Fig. 69 About 2/3 actual size

Arranged above the mirror or prism are mechanical and optical devices forming the remaining components of the illuminating apparatus. A perfect illuminating arrangement permitting extensive adaptation of the illuminating light to varied requirements is the *ABBE illuminating apparatus* (see "Mikro 15e") introduced by our Works in 1872. This illuminating apparatus is used on the large stands and on Stands EC. The *ABBE* illuminating apparatus is not *sold by itself* but forms an integral constituent of the stands.

Stands ES have a *simplified illuminating apparatus* with axially adjustable condenser. Stand EB has, apart from the mirror, only the sliding sleeve for holding *various devices for illuminating the preparation.*

These devices consist, first, of *stops for limiting the illuminated field* (for low magnifications and small apertures, at the most up to objective 40, N.A. 0.65) and, second, *condensers* of a number of different optical and mechanical types, for *bright field* and *dark field illumination*, or *special devices* for certain purposes.

Observation of opaque objects requiring incident light is effected by means of *vertical illuminators* and by incident-light devices and Epi-condensers. Vertical illuminators are placed in the microscope tube above the objective, which thus serves both for illuminating and for forming the image of the object. The objectives used must have short mounts, and from numerical aperture 0.65 on, demand a special correction. Special objectives are therefore required in these cases. (See p. 60, and "Mikro 89e.") Incident-light devices and Epi-condensers intended for furnishing dark field illumination in incident light have their illuminating system outside of the objective, which is thus used only for observation. The light regularly reflected from the object is also kept out, and refracted light only allowed to participate in forming the image. To some extent, the regular objectives may be used with these devices, though in many instances the special objectives designed expressly for the purpose will have to be employed. (See p. 56, and "Mikro 476e.") In all cases from aperture 0.4 on, it is necessary to make a distinction between covered and uncovered objects and to select the objective accordingly.

a) For Bright Field Observation

No. 11 41 00. Cylinder Diaphragm

with three inset stops of 1 mm., 3 mm., and 6 mm. aperture for all Stands except FZ, HZ, LZ, and SZ.

Code word: *Miaria*

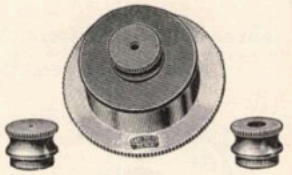


Fig. 70 About 1/2 actual size 7924

No. 11 41 05. Iris Cylinder Diaphragm

For all Stands except FZ, HZ, LZ, and SZ

Code word: *Miariais*

The diaphragm serves for gradually expanding or contracting the illuminated area. When the diaphragm is closed, its dome-shaped leaves nearly touch the lower surface of the object slide.

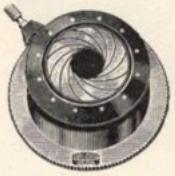


Fig. 71 About 1/2 actual size 7917

No. 11 41 08. Z Iris Cylinder Diaphragm

on slide. For Stands FZ, HZ, LZ, and SZ.

Code word: *Miniatura*

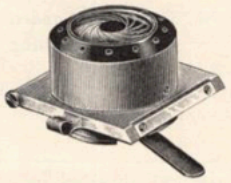
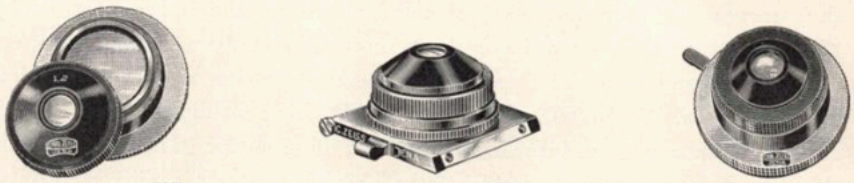


Fig. 72 About 1/2 actual size 11548a

Two-lens Condensers, N.A. 1.2

Focal length 11 mm.*)



a 7931 a *b* 11656 a *c* 7919 a

Fig. 73 About 1/2 actual size

a) **No. 11 41 20.** For Stands with **illuminating apparatus C** or **T.** ... Code word: *Miaron*

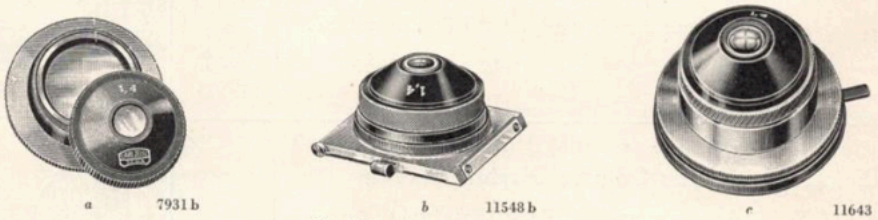
b) **No. 11 41 24. Z-condenser on slide,** for Stands FZ, HZ, LZ, and SZ ..... Code word: *Miniatures*

c) **No. 11 43 20. Condenser with iris diaphragm.** For Stands with **simplified illuminating apparatus,** such as EB and ES ..... Code word: *Miasmatico*

With the upper lens screwed off, these condensers form an illuminator of 32 mm. focal length and small aperture (about 0.4 mm.) for use with objectives of corresponding aperture.

Three-lens Condensers, N.A. 1.4

Focal length 8 mm.*)



a 7931 b *b* 11548 b *c* 11643

Fig. 74 About 1/2 actual size

a) **No. 11 41 30.** For Stands with **illuminating apparatus C** or **T** ... Code word: *Miascite*

b) **No. 11 41 34. Z-condenser on slide,** for Stands FZ, HZ, LZ, and SZ Code word: *Miniatuse*

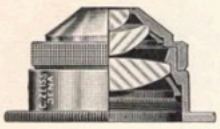
c) **No. 11 43 30. Condenser with iris diaphragm,** for Stands with **simplified illuminating apparatus, such** as EB and ES ..... Code word: *Ministro*

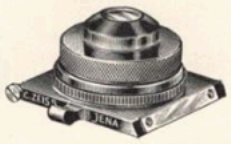
The two upper lenses, called the "duplex front," may be screwed off, giving an illuminator of 38 mm. focal length and about N.A. 0.3, for use with low-power objectives.

*) The focal lengths apply to small or moderately large apertures. Numerical apertures over **1** will result only when condensers are used with immersion between the condenser and object slide.

Aplanatic Condensers, N. A. 1.4

Focal length 10.5 mm.


a 8086


b 11656 c

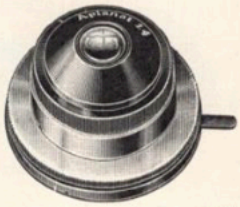

e 11644

Fig. 75 About 1/2 actual size

a) **No. 11 41 40.** For Stands with **illuminating apparatus C** or **T** .. Code word: *Micropus*

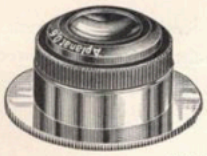
b) **No. 11 41 44. Z-condenser on slide,** for Stands FZ, HZ, LZ, and SZ ..... Code word: *Miniavere*

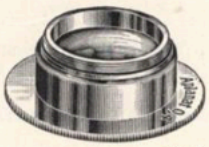
c) **No. 11 43 40. Condenser with iris diaphragm,** for Stands with **simplified illuminating apparatus** B or S ..... Code word: *Ministrone*

With the upper portion with the two top lenses removed, the lower lens forms an aplanatic condenser of 37 mm. focal length and about N.A. 0.4.

Aplanatic Condenser, N. A. 0.6

d) **No. 11 41 43.** For Stands with **illuminating apparatus C** or **T** .. Code word: *Pagfi*


d 13810


e 13809

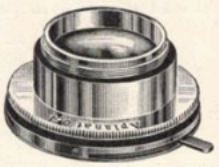

f 13806

Fig. 76 About 1/2 actual size

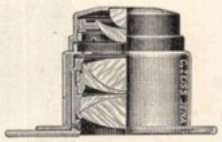
Aplanatic Single Lenses, N. A. 0.4

e) **No. 11 41 47.** For Stands with **illuminating apparatus C** or **T** .. Code word: *Profanator*

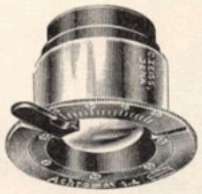
f) **No. 11 41 42.** Aplanatic Lens with iris diaphragm. For Stands with **simplified illuminating apparatus B** or **S** ..... Code word: *Profanavam*

Achromatic Condensers

with iris diaphragm between lenses



a 13267



b 13268

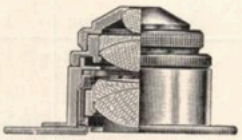
Fig. 77 About 1/2 actual size

No. 11 42 24. Achromatic Condenser, N.A. 1.4 (Fig. 77)

Focal length 9.5 mm., in case ..... Code word: *Minutais*

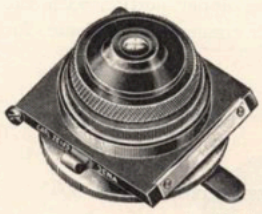
For object slides of up to 1.2 mm. thickness, when distance between iris diaphragm of lamp and condenser, measured by way of the mirror, is not over 30 cm. If the condenser is used for a greater distance on the optical bench, then a negative lens of three diopters must be placed into the diaphragm carrier.

No. 11 43 94. Correction lens: — 3 diopters ..... Code word: *Kepad*



8252

Fig. 78



11645

Fig. 79

About 1/2 actual size

No. 11 42 30. Achromatic Condenser, N.A. 1.0 (Fig. 78)

Focal length 12 mm., in case ..... Code word: *Militeremo*

Screwing off the upper portion reduces the condenser to an illuminator for low-power objectives, of a focal length of 26 mm. and about N.A. 0.45.

To use the condensers as Z condensers, Fig. 79, with stands FZ, HZ, and LZ, add:

No. 11 42 32. Slide fitting

with sliding sleeve for using condensers as Z condensers.

Code word: *Minon*

When using achromatic condensers on stands with illuminating apparatus C or T, the iris diaphragm of the illuminating apparatus should be fully opened.

Condensers of N.A. 1.4 are longer than other condensers. For this reason, the illuminating apparatus must not be run up to the limit, but only far enough to bring the achromatic condenser close up to the preparation.

Swing-out Condensers*)

with **iris cylinder diaphragm,** for Stands with illuminating apparatus C or T.

a) **No. 11 41 27. Two-lens condenser, N.A. 1.2**

Code word: *Migrating*

b) **No. 11 41 37. Three-lens condenser, N.A. 1.4**

Code word: *Migratio*

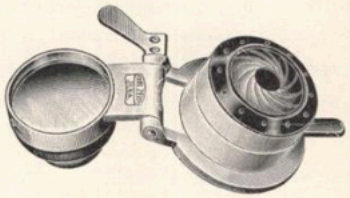


Fig. 80 About 1/2 actual size 11589

with **iris diaphragm and iris cylinder diaphragm,** for Stands DS, EB, ES.

a) **No. 11 41 28. Two-lens Condenser, N.A. 1.2**

Code word: *Migratione*

b) **No. 11 41 38. Three-lens Condenser, N.A. 1.4**

Code word: *Migratiora*

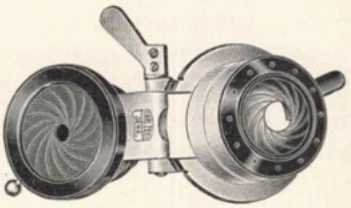


Fig. 81 About 1/2 actual size 11588

No. 12 01 32. Stereoscopic Stop

for stereoscopic photography with objectives of an aperture of over 0.1.

For Stands with ABBE illuminating apparatus, especially the older Stands B, C, and I to IV

Code word: *Minabird*

The stereo stop is attached to the flange of the condensers without iris diaphragm.

For detailed description, see "Mikro 386e."

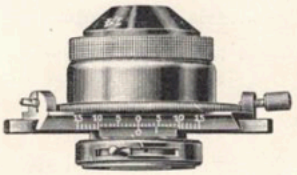


Fig. 82 About 2/3 actual size 8262

Condenser with Stereo Stop

No. 12 38 10. Filter Holder

Code word: *Miraculis*

The filter holder is used with the ABBE illuminating apparatus, to permit the employment of filters thicker than those which can be accommodated in the diaphragm carrier itself, and for changing filters without swinging out the carrier and opening the iris diaphragm. The filter holder is inserted into the diaphragm carrier from below.



13811

Fig. 83 About 2/3 actual size

*) Swing-out condensers offer the advantage of combining the condenser and iris cylinder diaphragm in a single element. By swinging the condenser portion out from the diaphragm mount, rapid transition to illumination with the mirror only becomes possible.

No. 11 42 41. Centring Device

for microscope objectives which are to be used as condensers.

Code word: *Miaskite*

The illustration shows an objective in the centring device, and below a correction lens for large working distance.

This centring device is employed with all objectives from 8 (0.20) on, when they are used as condensers.

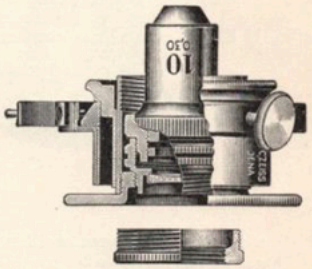


Fig. 84[1] About $^{2}/_{3}$ actual size 8260

No. 11 21 90. Correction Lens

for objectives used as condensers.

Code word: *Minabitis*

No. 11 42 50. Quartz Condenser with Iris Diaphragm

and two interchangeable front lenses for apertures 0.85 and 1.25.

Code word: *Miasm*

This condenser serves for the illumination, in ultra-violet light, of microscopic objects placed on a quartz object slide.

It fits the sliding sleeve of centring device No. 11 42 11, which is required for use with it.

To convert the quartz condenser into a Z condenser, a special centring device, Fig. 86, is required.

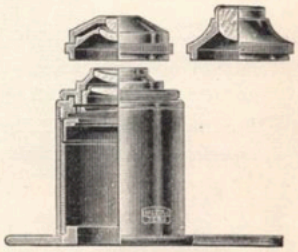


Fig. 85 About $^{1}/_{2}$ actual size 8311

No. 11 42 52. Slide Fitting

with tube for using the quartz condenser on Stands FZ, HZ, LZ, and SZ.

Code word: *Miniscor*

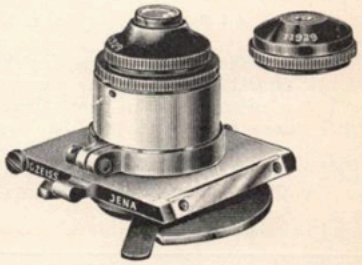


Fig. 86 About $^{1}/_{2}$ actual size 11675

b) Dark Field Observation

For general microscopic observation and instantaneous photography of living, or faintly and especially luminously stained bacteria by the dark field method, we make three condensers differing in their manner of use and each having advantages of its own. The *Cardioid Condenser* has a special centring device. It gives a sharp, accurately centred image of the source of light in the preparation, and hence images of the greatest attainable brightness. This condenser can be used with objectives of up to aperture 1.05 and with slides of a thickness not exceeding 1.2 mm. Its management is, however, somewhat more difficult than that of the other two types, the *Paraboloid* and *Change-over Condensers*. Neither of these yields as sharp an image of the source of light nor admits of the same precision in centring. Except in the case of Stands FZ, LZ, and HZ, such accurate centring, if it becomes necessary, must be effected with a centring device on the objective. Either of these condensers, however, is suitable for examining preparations on slides of widely varying thickness, a circumstance of great advantage where the preparations are derived from different sources. The change-over condenser, in addition, permits of rapidly examining the object alternately in the dark field and bright field without sensible variation in light intensity, although this does not imply that it can replace the bright-field condenser for ordinary observation. With either condenser, the numerical aperture must not exceed 0.85. For this reason, the immersion objectives designed for use with these condensers are provided with an iris diaphragm between the lenses, for restricting the aperture as required at the correct point of the objective. These condensers are also suitable for photomicrographs of moving bacteria.*)

The other dark field condensers are intended for special purposes and are limited in their application. Thus, while the Luminous Spot Ring Condenser described in "Mikro 406e" permits unrestricted observation with objectives of up to numerical aperture 1.3, it is not suitable for aqueous preparations but calls for an embedding medium of a refractive index higher than 1.4.

On the optical bench, where the source of light is at some distance, the cardioid and luminous spot ring condensers must be used with the correction lens No. 11 43 93 described on page 94 whenever object slides of thicknesses between 1 and 1.2 mm. are employed.

*) Cf. Dr. Neumüller, Bemerkung zu der Arbeit von Dr. Neumann: Die Sichtbarmachung von Bakteriengeißeln am lebenden Objekt im Dunkelfeld. Zentralblatt für Bakteriologie Abt. 1, Vol. 102, 1927, pp. 90 to 92.

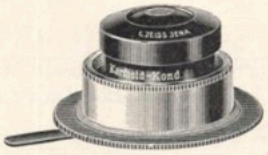


Fig. 87 About 1/2 actual size 11679

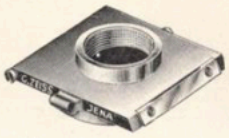


Fig. 88 About 1/2 actual size 11653

No. 11 45 45. SIEDENTOPF 1.0 Cardioid Condenser

with centring device, in case — Code word: *Mineirako*

For general microscopic observation and photomicrography, especially of aqueous subjects. Observation objectives up to N. A. 1.05. Thickness of object slide up to 1.2 mm.*). Also for ultra-microscopic observation of colloidal solutions.

For details, see "Mikro" folders 230e, 407e, and 306e.

No. 11 45 43. Slide Fitting

for use of cardioid condenser with Stands FZ, HZ, LZ, and SZ.

Code word: *Minibus*

When the condenser is to be used on Stands Z, the upper part of the condenser is unscrewed from the centring mount and screwed into the slide fitting.

*) For correction lens for use with optical bench, see p. 94.

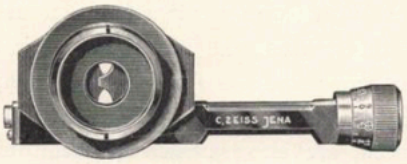


Fig. 89 About 1/2 actual size 8515 a
Top view, without condenser

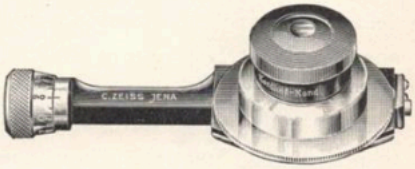


Fig. 90 About 1/2 actual size 11692
Side view, showing condenser in place

No. 11 45 32. SZEGVARI Azimuth Diaphragm

with condenser sliding sleeve, in case — Code word: *Minable*

A supplementary attachment to the cardioid condenser. It serves for bringing into view regularly grouped regions of rodlet sols, and for the suppression of undesirable detail in the dark field image.

References: H. Siedentopf, Zeitschrift für wissenschaftliche Mikroskopie, 1908, Vol. 25, pp. 424 to 431; Vol. 29, 1912, pp. 1 to 47. Szegvari, Physikalische Zeitschrift, Vol. 24, 1923, pp. 91 to 94.

The cardioid condenser must be unscrewed from its centring mount and screwed into the sliding sleeve of the diaphragm. Except with Stands FZ, HZ, LZ, and SZ, centring is done with the objective, which should be screwed to the tube by centring device No. 12 92 11 (p. 107).

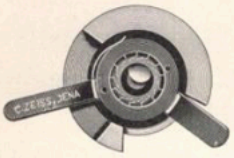
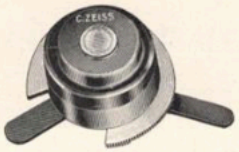


Fig. 91 About $^1/_5$ actual size 7806



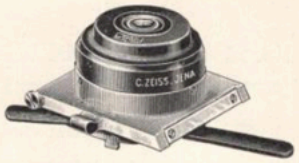


Fig. 92 About $^1/_2$ actual size 11548c

No. 11 45 15. SIEDENTOPF **Change-over Condenser,**
in case Code word: *Miette*
A dark field condenser permitting rapid and continuous transition from dark field to bright field illumination, and vice versa, at constant light intensity. The change-over is effected by means of the lever at the left. The handle on the right is for adapting the focal intercept of the condenser to object slides varying in thickness between 0.7 and 1.7 mm.
For observation objectives up to N.A. 0.85. Is not a substitute for a bright field condenser.

No. 11 45 17. Z Change-over Condenser on slide,
for use with Stands FZ, HZ, LZ, and SZ (Fig. 92),
in case Code word: *Miniavi*

For details, see "Mikro" 365e and 230e.



Fig. 93 About $^1/_2$ actual size 13812

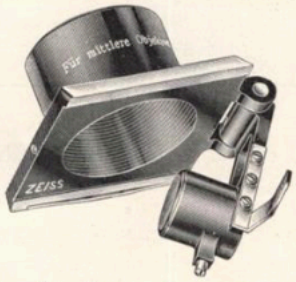


Fig. 94 About $^1/_2$ actual size 13813

No. 11 45 20. Dissecting Change-over Condenser, N.A. 0.4 to 0.5.
Focal intercept 10 mm., for objectives to N.A. 0.3,
in case Code word: *Mingo*

No. 11 45 22. Dissecting Change-over Condenser, N.A. 0.7 to 0.8.
Focal intercept 4.5 mm., for objectives up to N.A. 0.6,
in case Code word: *Mingoal*
Both of above condensers **with** iris diaphragm and colored-glass holder.

No. 11 45 23. Z Dissecting Change-over Condenser, N.A. 0.4 to 0.5, on slide,
for use with Stands FZ, HZ, and LZ, in case Code word: *Minurriet*

No. 11 45 24. Z Dissecting Change-over Condenser, N.A. 0.7 to 0.8, on slide,
for use with Stands FZ, HZ, and LZ, in case Code word: *Minurrio*
Both of above condensers **without** iris diaphragm and colored-glass holder.

These are "dry" condensers. They are intended for observation of tissue cultures and in a hanging drop, and particularly for use with the Micromanipulator (p. 133). They can be used as bright field condensers, provided an illumination of adequate intensity is employed.

No. 11 45 37. SIEDENTOPF **Paraboloid Condenser,**
in case

Code word: *Minianto*

Like the change-over condenser shown on page 99, this condenser is equipped with a device for adjusting the focal intercept to object slides of thicknesses between 0.7 and 1.7 mm.

Suitable for general microscopic work, and for viewing aqueous preparations (living bacteria). Observation objectives up to N.A. 0.85.

For directions for use, see "Mikro" 230e.



Fig. 95 About 1/2 actual size 11591

No. 11 45 38. Z Paraboloid Condenser on Slide
for use on Stands FZ, HZ, LZ, and SZ.
In case

Code word: *Miniavimus*

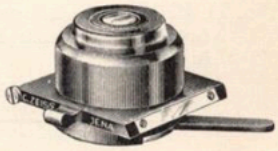


Fig. 96 About 1/2 actual size 11656 b

No. 11 45 40. Luminous Spot Ring Condenser,
in case

Code word: *Minebamus*

Owing to the high minimum aperture of its illuminating pencil, this condenser is not adapted to aqueous preparations, but can only be used for smear preparations and embedding media of high refractive indices. Objectives up to N.A. 1.3 can be employed without stopping down. The condenser can be centred like the cardioid condenser, and like the latter, requires the slide fitting No. 11 45 43 described on page 98 when it is to be used with Z Stands.

For details, see "Mikro 406e."

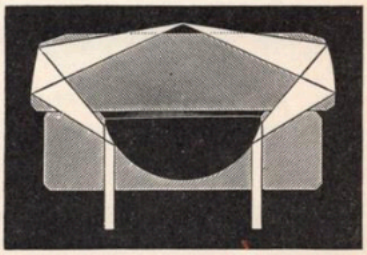


Fig. 97 About 1 1/2 actual size 11000 a

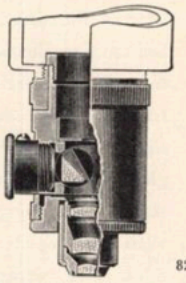
Path of light through Luminous Spot Ring Condenser

For use on the optical bench, this condenser requires the correction lens listed on page 94.

c) Observation in Incident Light

No. 12 04 10. NACHET **Vertical Illuminator**

with iris diaphragm. For low and medium magnifications.
In case Code word: *Middelding*

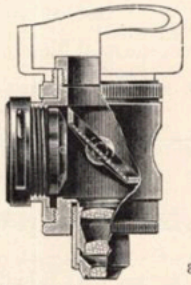


8257

Fig. 98 About 4/5 actual size

No. 12 04 50. BECK **Vertical Illuminator**

with iris diaphragm. For completely utilizing the resolving power of objectives of high numerical aperture.
In case Code word: *Middelen*



8258

Fig. 99 About 4/5 actual size

The illustrations show the vertical illuminators with *objectives in short mounts* from the list on page 60. Vertical illuminators can not be used with standard objectives.

For detailed information on use of vertical illuminators, see "Mikro 89e."

No. 11 46 06. Epi Lamp 8

for the observation of objects of any size in incident light from one side. The direction of incidence of the light may be varied within a range of from 200 to 300°. Any angle of incidence between 22° and 45° can be set. Attachment independent from objective. For use with objectives to about 40, N.A. 0.65.
In case Code word: *Miope*

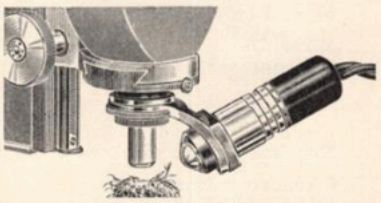


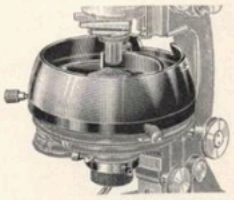
Fig. 100 About 1/3 actual size 13911

No. 11 46 25. Twin Epi Lamp 8, for illumination from two sides.
Code word: *Mirken*

No. 11 46 10. Epi Mirror

for the illumination from all sides of objects of limited size. Consists of an annular mirror designed to be set on the microscope stage and receiving light from a lamp accommodated in the condenser sliding sleeve. Object readily accessible on a Uro glass disk serving at the same time as a heat screen. Revolving azimuth stop. Suitable for use with any objective. Objectives from N.A. 0.4 on must have correction mounts to adapt them to covered or uncovered objects.

In case Code word: *Miopismo*



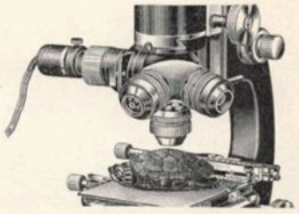
22058

Fig. 101 About 1/5 actual size

No. 11 46 05. Epi Condenser W

for the dark field illumination from all sides of objects of any size. Consists of a lamp with condenser and change-over slide for bright field illumination, a housing with an annular plane mirror inclined at 45°, and a triple revolving nosepiece for rapidly and conveniently changing the objectives with their surrounding concave-mirror condensers. Can be used only with the special objectives listed in Mikro 476e.

In case Code word: *Miotomia*



22013

Fig. 102 About 1/5 actual size

Required for use with above
3 concave mirrors

Code word: *Katea*

For detailed description of "Epi" accessories, see "Mikro 476e."

Object Stages

All of our Stands, as supplied by us, are equipped with an object stage. The various combinations of stands and stages are shown in Plates 1 to 6 inclusive. Within certain limits, simpler stages may subsequently be replaced by stages equipped with additional motions, or several stages may be used interchangeably with the same stand. In this connection, the following points should be noted:

The simplest type is the "fixed" stage, which is furnished either in circular or in square form, with a diameter or side of 12 cm. (Stands EB, EBC, ES, ESC). The place of the fixed stage may be taken by the simplified mechanical stage, a revolving stage, or a large compound stage. By the employment of one of the attachable mechanical stages (p. 105) on the fixed stage, the object may be imparted the same motions as with a compound stage. In view of the low price of the simplified attachable mechanical stage, its combination with a fixed stage is particularly to be recommended. Movable stages generally comprise an inserted stage plate and a centring piece within which the plate is adjustable. In revolving stages, the centring piece serves for centring the axis of rotation of the stage relatively to the optical axis of the microscope. In the case of the simplified mechanical stage, the centring piece furnishes a means of displacement, although only by 8 mm. In stages having identical centring pieces, the stage plates are mutually interchangeable.

To replace a fixed stage by another stage, the stand is inclined by 90°, the mirror withdrawn, and the illuminating apparatus run down all the way and slipped off the rack. The four screws holding the stage to the carrier and seen in Fig. 104 are then turned out, and the centring piece of the new stage is attached to the carrier by the same screws. In the case of the rectangular compound stage (p. 105), the two shorter screws sent with this stage must be used.

For the fixed stage of the first basic form of Stand E, the following stages may be substituted:

No. 12 06 34. Simplified Mechanical Stage A
with centring piece.

Code word: *Miauler*

Range of motion about 10 mm. each way.
Diameter 12 cm.

The motion towards and from the observer is effected by simultaneously turning the screws in the same sense. Transverse motion is obtained by simultaneously turning the screws in the opposite sense. In Stand EB, the centring piece is furnished with sliding sleeve for the condenser, while in Stand ES it is without sliding sleeve (Fig. 104).

Attachable mechanical stages Nos. 12 08 05 to 12 08 08, page 105, may be used.

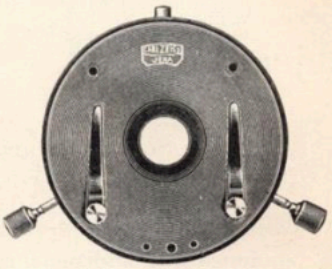
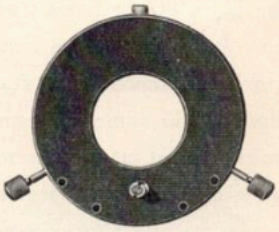


Fig. 103 About 1/3 actual size 7967

No. 12 06 43. Revolving Simplified Mechanical Stage B with centring piece

Code word: *Miaulera*

The rotary motion is required for work in polarized light. In all other respects, the stage is used like A. Stages A and B have the same centring piece, and their stage plates are therefore mutually interchangeable. Any of the attachable mechanical stages listed on page 105 may be employed.



8514

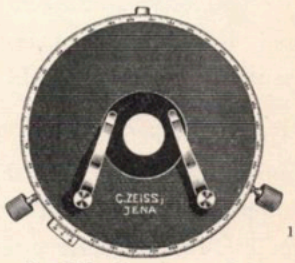
Fig. 104 (rear view)
About 1/3 actual size

No. 12 06 44. Revolving Simplified Mechanical Stage B with Graduated Rim
and vernier, with centring piece

Code word: *Ministror*

For determining angles when observing doubly refracting objects in polarized light.

In ordering this stage at any later time, the centring piece on the stand must be sent in for fitting.



11641

Fig. 105 About 1/3 actual size

No. 12 07 04. Rectangular Mechanical Stage G

Code word: *Miracobi*

The stage plate measures 10 × 12 cm., and has a front-to-back range of movement of 50 mm. The preparation may be laterally shifted on the stage by 75 mm. The displacements are read from scales and verniers. The stage is non-revolvable.

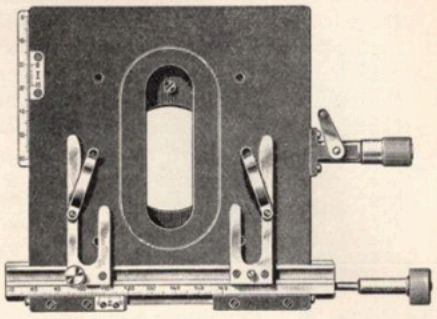


Fig. 106 About 1/2 actual size 22395

A range of movement of the preparation equal to that of the rectangular mechanical stage may be obtained with fixed and simplified mechanical stages by adding an attachable mechanical stage.

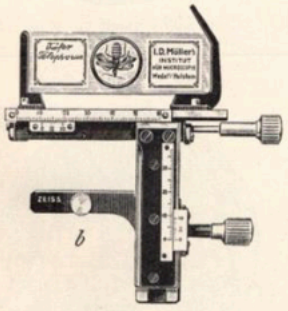


Fig. 107 About 1/2 actual size 7995

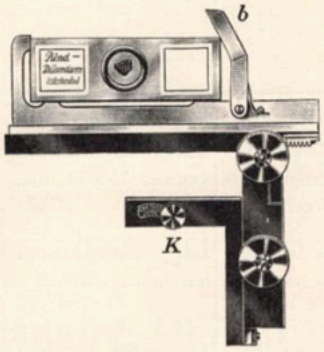


Fig. 108 About 1/2 actua size 13455

No. 12 08 05. Attachable Mechanical Stage
(Fig. 107), in case. With scales and verniers. Range of movement and measurement 50 × 26 mm. Code word: *Migrateur*

No. 12 08 06. Simplified Attachable Mechanical Stage
(Fig. 108). Range of movement 75 × 25 mm. Requires the use of an object slide of a length between 62 and 78 mm. Code word: *Minuebare*

This mechanical stage is attached to the main stage in a simple manner by means of screw **K**. It fits all stage plates having the necessary three holes for the screw and dowels, visible in Fig. 103.

Attachable mechanical stages can also be supplied for left-handed operation:

No. 12 08 08. Simplified Attachable Mechanical Stage, for use with left hand Code word: *Miradore*

No. 12 08 07. Attachable Mechanical Stage,
same as 12 08 05, but **for use with left hand** Code word: *Miradoras*

The second basic form of our Stands U, V, and E has a fixed, non-interchangeable stage carrier in the shape of a *centring piece for the reception of revolving and centring vulcanite stage D or large mechanical stage E.* Stands G, F, H, L, and S may be furnished with the same centring piece, or else with photomicrographic stage F. Vulcanite stage D and large mechanical stage E are mutually interchangeable (see p. 30, paragraph 2), and are largely used in alternation. Where one of these stages is on hand, the other may be ordered without centring piece. The large mechanical stage is now made with an increased range of motion, of 75 mm. sideways and 50 mm. forward and back.

No. 12 06 70. Revolving and Centring Vulcanite Stage D
without centring piece
Code word: *Micaremus*

No. 12 06 75. Revolving and Centring Vulcanite Stage D,
with graduated rim and vernier, without centring piece. Code word: *Minctio*



Fig. 109 About 1/3 actual size 7915 a

No. 12 06 84. Large Mechanical Stage E
Range of movement 75 × 50 mm., without centring piece Code word: *Minuira*

No. 12 06 85. Large Mechanical Stage E
for use with left hand, without centring piece
Code word: *Kegiv*

No. 12 06 89. Large Mechanical Stage E with Graduated Rim,
without centring piece
Code word: *Minurritur*

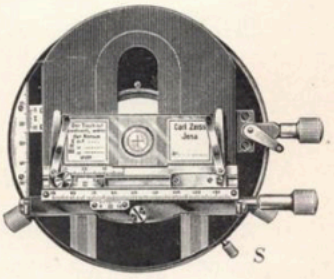


Fig. 110 About 1/2 actual size 13424

The lateral motion may be taken off, leaving a smooth surface capable of a range of movement of 50 mm. in one direction by a rack-and-pinion motion.

No. 12 06 64. Centring Piece
for stages **without** graduated rim Code word: *Minimael*

No. 12 06 66. Centring Piece
for stages **with** graduated rim Code word: *Kegly*

When a graduated stage is ordered at any time after shipment of the microscope, the centring piece (or the stand) must be sent in to our Works for milling the necessary recesses for the verniers.

No. 12 06 90. Photomicrographic Mechanical Stage F

Code word: *Ministrum*

This stage is designed specifically for photomicrographic work. It permits the preparation to be moved through a range of 13 mm. in two directions at right angles to each other. The displacement can be read to 0.2 mm. This stage is rotatable but cannot be centred.

The face of the stage is entirely free from obstructions.

For detailed description, see "Mikro 418e."

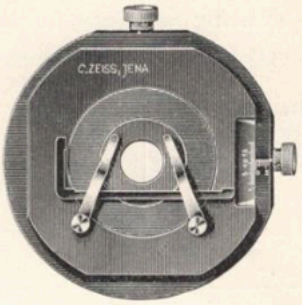


Fig. 111 About 1/3 actual size 11683

The new mechanical stage E does not fit old Stands I, III, and IV, because they have a centring piece of different design. With these stands, the old design of stage E must be used:

No. 12 06 80. Large Mechanical Stage

without centring piece, for Stands I, III, and IV. Code word: *Miaulerent*

Before placing the large mechanical stage on any of these old stands, the screw *s* serving for the arrest of the revolving motion, Fig. 110, must be removed, and replaced through the opening in the stage carrier only after the stage has been fixed in position.

In ordering a large mechanical stage, it is advisable to state the serial number of the stand, which will be found engraved on the tube underneath the firm's name.

Devices for Centring and Changing Objectives

No. 12 92 11. Centring Device

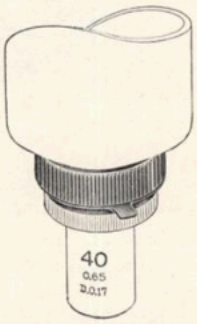
for microscope objectives attached to the tube.

This device serves for lining up the optical axes of the illuminating apparatus (condenser) and of the observation tube, or for bringing the axis of observation into coincidence with the axis of rotation of the stage.

This centring device is not needed when a sliding objective changer is used.

Code word: *Ministrans*

For centring device for Stand L, see Plate 5, p. 3.



11650

Fig. 112 About 4/3 actual size

Revolving Nosepieces for Changing Objectives

No. 12 12 04. For 4 objectives
Code word: *Miasmology*

No. 12 12 06. For 3 objectives
Code word: *Miluamor*

No. 12 12 05. For 2 objectives
Code word: *Miluam*

For revolving nosepiece on slide for Stand L, see Plate 5, p. 3.

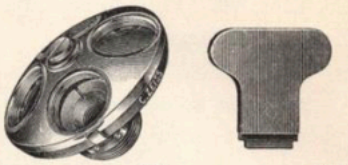


Fig. 113 About 1/2 actual size

Sliding Objective Changers, consisting of:

a) **No. 12 12 10. Tube Slide**
RM **8.50** Code word: *Miasms*

b) **No. 12 12 11. Objective Slide**
(with watch key for centring)
RM **13.00** Code word: *Miassemos*

A separate slide is required for each objective. In subsequent orders, the designation of the objective should be mentioned if it is desired to have it engraved on the slide.
For details, see "Mikro 82e."

For the **safe-keeping of objectives** with screwed-on slides:

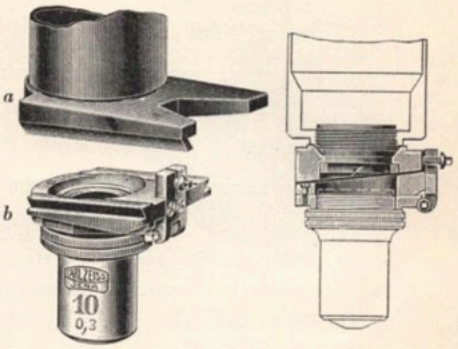
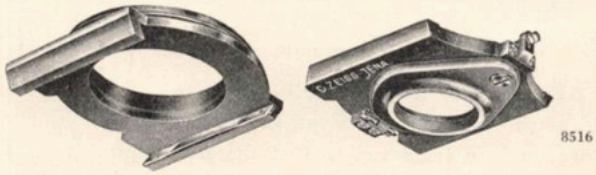


Fig. 114 About 2/3 actual size

No. 12 14 13. Case for 3 Objectives Slides Code word: *Miastenia*
No. 12 14 18. Mahogany Case for 6 Objective Slides Code word: *Minderel*

Large Sliding Objective Changer

for the wide tube of Stands G, H, and S. Permits alternative use of revolving nosepiece, small objective slide changer, vertical illuminator, or any other device having an objective thread. Consists of:



a Fig. 115 About 2/3 actual size b

a) **No. 12 12 20. Large Tube Slide** (a) Code word: *Procazava*

b) **No. 12 12 21. Large Slide Fitting** (b), **Centring,**
for the reception of a revolving nosepiece or the like; Code word: *Procazes*
or:
No. 12 12 24. Large Slide Fitting, Non-centring,
for the reception of a small tube slide or a similar part Code word: *Procludito*

Drawing Apparatus

For detailed description, see "Mikro 118e"

No. 12 60 00. Drawing Prism
(Camera lucida) in case (Fig. 116)
Code word: *Micantes*

The eyepiece is taken off, and the clamp ring H of the drawing prism slipped over the tube. The clamp ring is adjusted for height to bring the edge of the prism into the plane of the exit pupil, and the screw S drawn up. By swinging the drawing prism out of the way, the object may be viewed directly. The drawing must be done on a slanting board.

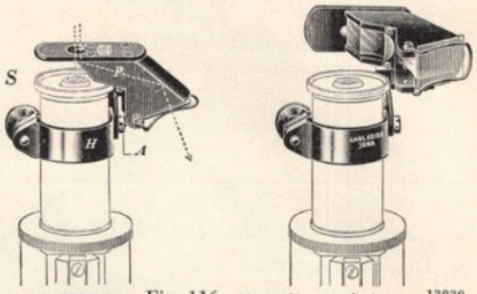


Fig. 116 About 1/3 actual size 13830

No. 12 60 60.
Slanting Drawing Board (Fig. 117)
for use with drawing prism.
Code word: *Micationis*

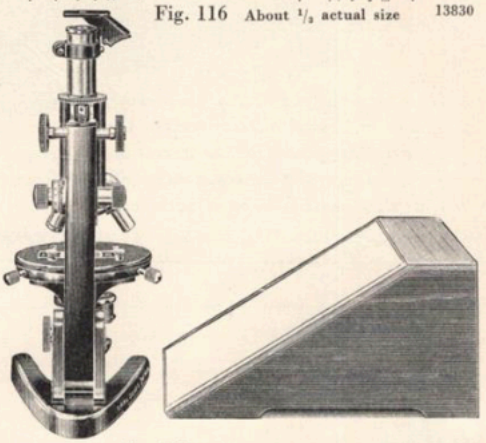


Fig. 117 About 1/6 actual size 13860
Stand ESA with **Drawing Prism and Drawing Board**

No. 12 60 21.
ABBE **Drawing Apparatus,**
in case (Fig. 118)
Code word: *Milter*

Attached in the same manner as the drawing prism. Length of arm 140 mm. Size of mirror 125 × 70 mm. By sliding the graduated intermediate piece, a slit in the silver coating on the cube can be set level with the exit pupil of the microscope. The centring of the apparatus can, in addition, be corrected by turning screw S with a watch key. The casing, together with the cube and the mounts for the moderating glasses, can be swung back about hinge Z. Two interchangeable cubes, for large and small exit pupils, are supplied with the apparatus.

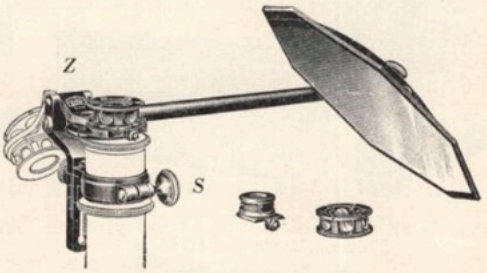


Fig. 118 About 1/3 actual size 8255

No. 12 60 24. Right-angle Prism on Slide
for use with above drawing apparatus in tracing projected images

Code word: *Minctura*

or

No. 12 60 26. Roof Prism on Slide,
for tracing with subjective and projected images in same position.

Code word: *Mintriendo*

The above prisms are interchangeable with the ABBE cubes.

No. 12 60 22. Simplified ABBE Drawing Apparatus, in case

Code word: *Miltersa*

The revolving cap with moderating glasses is absent in this model. The moderating glasses for the mirror are replaced by slip-in squares. Only one fixed ABBE cube is furnished.

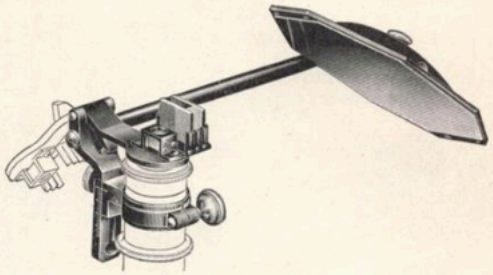


Fig. 119 About 1/3 actual size 8256

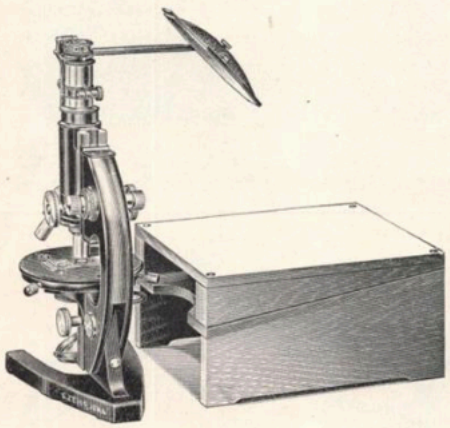


Fig. 120 About 1/6 actual size 11981

Drawing Table No. 12 60 65 with Horizontal Board

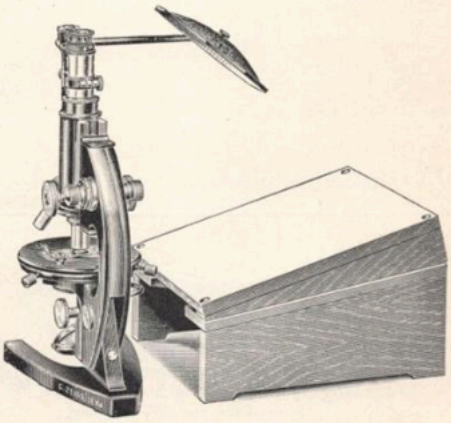


Fig. 121 About 1/6 actual size 11980

Drawing Table No. 12 60 65 with Slanting Board

No. 12 60 65. Two-part Drawing Table
for use with ABBE drawing apparatus

Code word: *Minted*

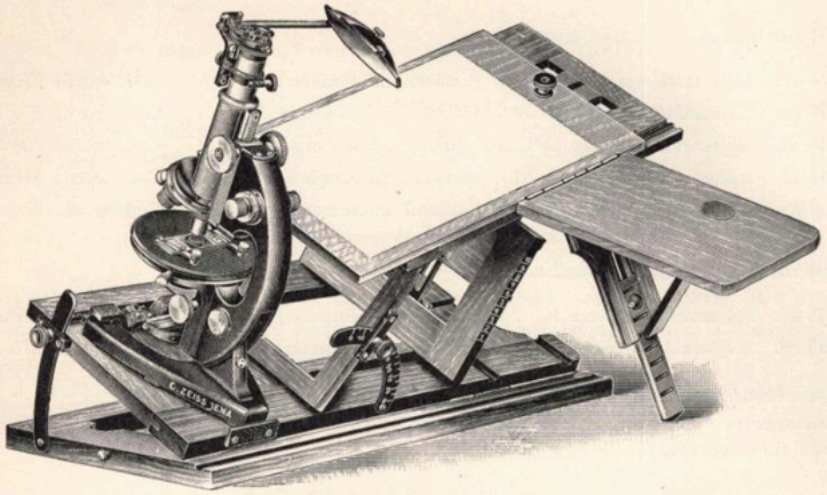


Fig. 122 About 1/6 actual size 11096
ABBE **Drawing Apparatus** and BERNHARDT **Drawing Table**

No. 12 60 50. BERNHARDT **Drawing Table** for drawing with microscope in tilted position
Code word: *Micatione*

Measuring Devices

Microscopic objects are usually measured with the aid of *eyepiece micrometers*. These are glass disks of a diameter of 19 mm., bearing a graduation of 5 or 10 mm. divided into $^1/_{10}$ or $^1/_{20}$ mm. These disks are placed upon the stop of the eyepiece, which must be capable of being sharply focused upon the graduation. The resultant focusing eyepieces with scale micrometer are called *Micrometer Eyepieces*. Of themselves, they give no indication as to *absolute* measurements: for these, the necessary factor must be determined for each objective and each tube length with the aid of a stage micrometer.

See "Mikro 273e."

The following **adjustable eyepieces** are regularly made by us:

a) for *achromatic* objectives

No. 11 36 07. **Adjustable eyepiece H 7×** (without micrometer) ..... Code word: *Mincturus*
No. 11 36 10. **Adjustable eyepiece H 10×** (without micrometer) ..... Code word: *Kegna*
No. 11 36 12. **Adjustable eyepiece O 12.5×** (without micrometer) ..... Code word: *Kegob*
No. 11 36 17. **Adjustable eyepiece O 17×** (without micrometer) ..... Code word: *Mindaros*
No. 11 36 28. **Adjustable eyepiece O 28×** (without micrometer) ..... Code word: *Kegse*

b) for *apochromatic objectives*

No. 11 33 07. **Adjustable eyepiece K 7×** (without micrometer) ..... Code word: *Minded*
No. 11 33 20. **Adjustable eyepiece K 20×** (without micrometer) ..... Code word: *Midasohr*

The lower portion **b**, Figs. 123 and 126, unscrews for inserting the micrometer. The upper lens portion can be adjusted by turning the threaded cell.

When provided with an eyepiece micrometer having a 5 mm. scale divided into 50 tenth-millimetre intervals, these eyepieces form the **micrometer eyepieces:**

a) for *achromatic* objectives

No. 11 53 11. **Micrometer eyepiece H 7×** ..... Code word: *Miliorum*
No. 11 53 21. **Micrometer eyepiece H 10×** ..... Code word: *Minutus*
No. 11 53 31. **Micrometer eyepiece O 17×** ..... Code word: *Militabam*

b) for *apochromatic* objectives

No. 11 53 01. **Micrometer eyepiece K 7×** ..... Code word: *Miliolim*
No. 11 53 10. **Micrometer eyepiece K 20×** ..... Code word: *Minnig*

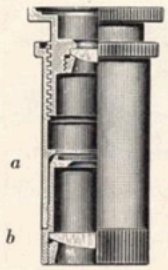


Fig. 123 8121
Micrometer eyepiece H 7×
About 3/2 actual size



Fig. 124 7903
Scale micrometer No. 11 51 00
About 4× actual size

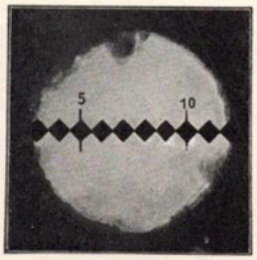


Fig. 125 8614
Contrast micrometer No. 11 51 30
About 30× actual size

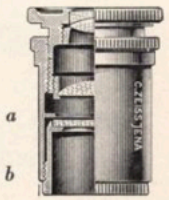


Fig. 126 11724
Micrometer eyepiece O 17×
About 2/3 actual size

For special purposes, *other scale micrometers* may be inserted. They are supplied in flat round boxes

No. 11 51 00. **Eyepiece micrometer,** 5 mm. divided into 50 parts (tenths) Code word: *Micatote*
No. 11 51 01. **Eyepiece micrometer,** 5 mm. divided into 100 parts (twentieths) ..... Code word: *Micatuum*
No. 11 51 02. **Eyepiece micrometer,** 10 mm. divided into 100 parts (tenths) . Code word: *Micatus*
No. 11 51 03. **Eyepiece micrometer,** 6 mm. divided into 100 parts (0.06) .. Code word: *Minitabam*
No. 11 51 30. **Contrast micrometer,** black, 5 mm. divided into tenths and twentieths ..... Code word: *Micchetto*
No. 11 51 31. **Contrast micrometer,** red, 5 mm. divided into tenths and twentieths ..... Code word: *Kegug*

In *contrast micrometers*, the scale consists of black or red squares of a diagonal length of $^1/_{10}$ mm. arranged as in Fig. 125, the alternate outer and adjacent corners serving in place of line graduations.
(Cf. Prof. GEBHARDT, "Über neue leicht sichtbare Mikrometerteilungen." Zeitschrift für wissenschaftliche Mikroskopie, Vol. **24**, 1907, pp. 336 to 369.)

Eyepiece Screw Micrometer

Accuracy of measurement is increased by the use of an *eyepiece screw micrometer*. These are eyepieces having a scale plate capable of being traversed by means of a micrometer screw. The movement of the screw is read in hundredths of a millimeter from a drum on one side.

Evaluation of the micrometer scale is also in this case effected by means of stage micrometers. The micrometer value is governed by the objectives used and by the tube length.

No. 11 55 60. **Eyepiece Screw Micrometer** with RAMSDEN **eyepiece,** for *achromatic objectives*, in case Code word: *Miccinina*

Factorial eyepiece magnification: about 10×

No. 11 55 66. **Eyepiece Screw Micrometer** with 7× **compenpensating eyepiece,** for *apochromatic objectives*, in case Code word: *Miccinino*

No. 11 55 72. **Eyepiece Screw Micrometer,** with 15× **compensating eyepiece,** for *apochromatic objectives*, in case Code word: *Minutalia*

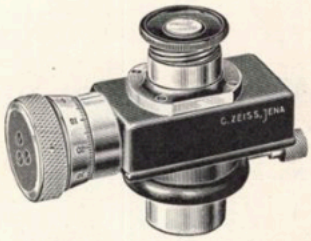


Fig. 127 About $^1/_2$ actual size 8259

By the employment of eyepiece screw micrometers, the tube length is increased by 25 mm. This renders it necessary to use shorter tubes, if the total computed magnification resulting with the objective and eyepiece magnifications is to remain unchanged. With the standard tube length, the eyepiece magnification should be assumed as slightly higher, at about 1.15× the normal with medium and high-power objectives.

Calibrating Standards

Micrometer eyepieces and cross line micrometer eyepieces are *calibrated* with the aid of stage micrometers. Stage micrometers also serve as comparison objects in determining the magnification of a microscope, of drawings made with the aid of a drawing apparatus and of projected images or photomicrographs, and for measuring the diameter of the field of view.

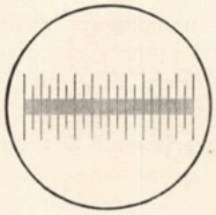


Fig. 128 7902
Scale about 24× actual size

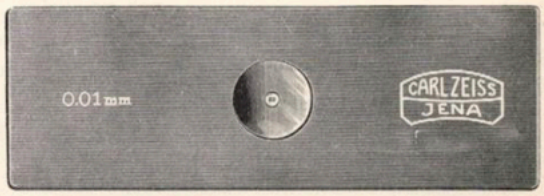


Fig. 129 Actual size 8329

Stage Micrometer, 1 mm. divided into 100 parts

No. 12 63 00. Stage Micrometer, 1 mm. divided into **hundredths** ..... Code word: *Micciades*

No. 12 63 03. Stage Micrometer, 3 mm. divided into **tenths,** and **0.1 mm.** divided into **hundredths** ..... Code word: *Miccianza*

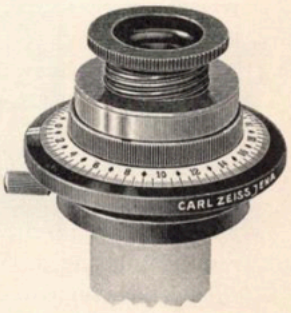
No. 12 63 10. Stage Micrometer, 1 cm. divided into **millimetres, 1 mm.** divided into **tenths** ..... Code word: *Miccichino*

No. 12 64 54. Scale on plate glass, 10 cm. divided into **half-millimetres** ... Code word: *Miltonie*

Measurement of Angles

No. 11 55 85. Goniometer Eyepiece

Adjustable H 7× eyepiece with graticule and revolvable graduated circle for reading angle of rotation. The graduated circle is seated in a disk carrying an index and fastened to the eyepiece sleeve. Angles in microscopic objects are measured by successively turning the graticule lines into coincidence with the two legs of the angle to be measured.



Code word: *Kegyk* Fig. 130 About ¾ actual size 13436

Counting Devices

Particles in *microscopic dry preparations* are counted with the aid of *Eyepiece Squared Micrometers*. These are also used in the adjustable eyepieces referred to on page 112, the resultant combination being termed *Counting Eyepieces*. As in the case of ordinary micrometers, calibration is made by reference to stage micrometers, the absolute value being governed by the objective, eyepiece and tube length (see "Mikro 273e").

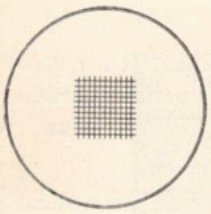


Fig. 131 8534
About 1½ actual size

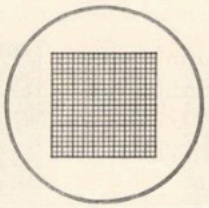


Fig. 132 8533
About 1½ actual size

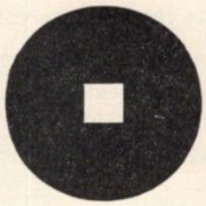


Fig. 133 13875
About 1½ actual size

No. 11 51 65. Eyepiece Squared Micrometer, 5 mm. square, divided into squares with 0.5 mm. sides (Fig. 131) ..... Code word: *Michaelia*

No. 11 51 67. Eyepiece Squared Micrometer, 10 mm. square, divided into squares with 0.5 mm. sides (Fig. 132). The whole millimetre lines are accentuated by being made heavier ..... Code word: *Minderdeel*

No. 11 51 80. EHRLICH **Eyepiece Stops** (Fig. 133)
Square-hole stops designed for insertion into adjustable eyepieces to obtain a field of view of a certain size suitable for counting without subdivision. A set includes 7 stops of from 1 to 8 mm. side length, with aperture areas increasing at the ratio of 1:2. ..... Code word: *Michaelis*

No. 11 59 05. EHRLICH Counting Eyepiece

A 10× Huygens eyepiece with **adjustable** square-hole diaphragm, allowing any aperture area, from the smallest to the largest within the capacity of the eyepiece, to be produced. Four positions, in which the apertures have sides of a ratio of 1:2:3:4 and corresponding areas of a ratio of 1:4:9:16, are denoted by marks. The absolute areas are determined as previously explained.

Code word: *Kehal*

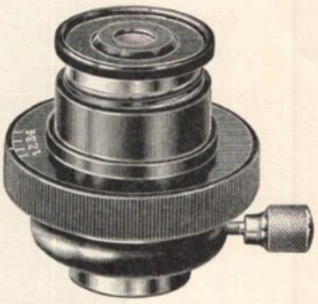


Fig. 134 About ¾ actual size 13858

Eyepiece stops are particularly used for finding the numerical ratio between different kinds of blood corpuscles.

In counting particles in *liquid preparations*, it becomes necessary, not only to *limit the area*, but also to *divide off a standard volume*. Such counts are made in special chambers, while the requisite dilution of the liquid is obtained by means of mixing pipettes. The chambers have an exact predetermined depth fixing the thickness of the liquid stratum to be counted. These chambers are either used in conjunction with eyepiece squared micrometers or stops to limit the area required for the count, or the chamber itself is provided with a ruling and so becomes a counting chamber.

Counting chambers are stage squared micrometers and therefore directly indicate the absolute values corresponding to the ruling.

Counting chambers are used in *chemistry* (see Kurt Kühn, "Über den Wert der Zählung feinkörniger Substanzen," Zeitschrift für angewandte Chemie, Vol. **28,** 1915, pp. 126 to 128; Vol. **30,** 1917, pp. 145 to 147; W. Porstmann, "Von der Mikrozählung," Prometheus, Vol. **29,** 1917, pp. 25 to 28).

In addition, counting chambers are of great importance in medical practice for counting blood corpuscles.

Haemacytometers

(*See price lists "Mikro 351e" and "Mikro 298e."*)

The counting chambers are generally made of one piece, to prevent the ruling from becoming detached. The scale lines are distinctly visible. The open form of the chamber facilitates placing the sample of fluid, inasmuch as the cover glass can first be applied to show the required perfect contact by the appearance of the NEWTON colour rings. The two edges of the cover glasses coming into contact with the blood must be polished.

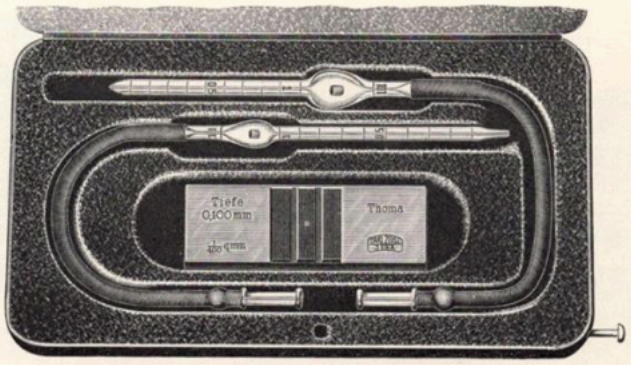
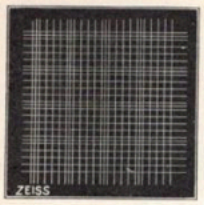
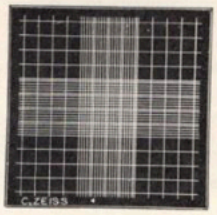


Fig. 135 About 1/2 actual size 11655
THOMA Haemacytometer



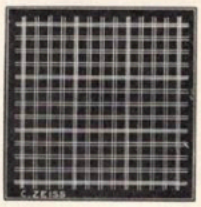
8498

Fig. 136 About 20× actual size
THOMA ruling



8489

Fig. 137 About 8× actual size
NEUBAUER ruling
Thoma ruling in centre



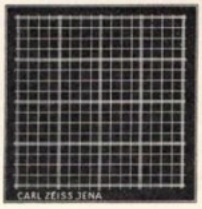
11069

Fig. 138 About 8× actual size
BÜRKER ruling



22078

Fig. 139 About 8× actual size
BRANDT ruling



13261

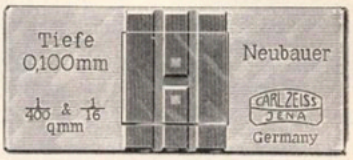
Fig. 140 About 6× actual size
FUCHS-ROSENTHAL ruling

No.		Code word
	Haemacytometers, in case for counting red and white blood corpuscles	
12 66 64	with **THOMA chamber** No. 12 66 60 } with mixing pi-	*Minerala*
12 66 83	with **NEUBAUER chamber** No. 12 66 82 } pettes Nos. 12 73 00	*Minuare*
12 70 04	with **BRANDT chamber** No. 12 70 00 } and 12 73 10	*Miraculos*
	for counting elements of cerebro-spinal fluid	
12 67 73	with **FUCHS-ROSENTHAL chamber** No. 12 67 70 and mixing pipette No. 12 73 10	*Mingones*
	The above haemacytometers are also supplied in nickel-plated metal cases, at an additional price of RM **1.00** Additional Code word:	*Mingosmet*
	Single Counting Chambers, in case with two 0.4 mm. cover glasses	
12 66 60	with **THOMA ruling** without spring clips	*Minelesi*
12 66 65	with **THOMA ruling,** with spring clips	*Mintrient*
12 66 82	with **NEUBAUER ruling,** with spring clips	*Mintrietis*
12 70 00	with **BRANDT ruling,** without spring clips	*Mirabole*
12 67 70	with **FUCHS-ROSENTHAL ruling,** without spring clips....	*Mingitis*
12 67 75	with **FUCHS-ROSENTHAL ruling,** with spring clips	*Mintrio*
	For bright field and dark field observation (thin object slides)	
12 66 70	with **NEUBAUER ruling,** without spring clips	*Minum*
12 66 75	with **BÜRKER ruling,** without spring clips	*Minumus*

Besides single chambers, *double chambers* after BÜRKER are extensively used. We carry the following:

No. 12 66 85. Double Chamber with NEUBAUER ruling, without spring clips, with two cover glasses, in case

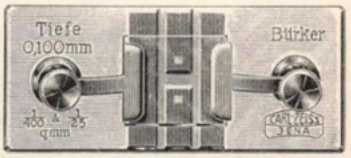
Code word: *Minellar*



8981

No. 12 69 20. BÜRKER Counting Chamber, with spring clips, with two cover glasses, in case

Code word: *Mineon*



8979

No. 12 69 30. BÜRKER Counting Chamber with **Türk ruling,** with spring clips and two cover glasses, in case

Code word: *Minerado*



11659

The Neubauer and Türk rulings contain a Thoma ruling in the middle.

No. 12 70 20. Quadruple Chamber with BRANDT ruling, without spring clips, with two cover glasses, in case

Code word: *Mirabund*



22052

Figs. 141 to 144 About 2/3 actual size

No.	Haemacytometers with Double Chambers			Code word
12 66 89	with **NEUBAUER ruling,**	No. 12 66 85	and mixing pipettes Nos. 12 73 00 and 12 73 10, in case	*Minerales*
12 69 24	with **BÜRKER ruling**	No. 12 69 20		*Mineralia*
12 69 34	with **TÜRK ruling**	No. 12 69 30		*Mineralien*
12 70 24	with **quadruple BRANDT ruling**	No. 12 70 20		*Miraculum*
	The above haemacytometers will also be supplied in nickel-plated case, at an additional price			
		Additional Code word:		*Mingosmet*

No.		Code word
	Mixing Pipettes	
12 73 00	1:100 **Mixing Pipette,** for counting red blood corpuscles ..	*Midianiter*
12 73 03	Same, but with Pappenheim suction device	*Minutons*
12 73 10	1:10 **Mixing Pipette,** for counting white blood corpuscles ..	*Midias*
12 73 13	Same, but with Pappenheim suction device	*Minutor*
12 73 21	**Mixing Pipette,** for diluting to 1:30 for counting blood disks, and for diluting to 1:20	*Miellatum*
	Upon order, mixing pipettes Nos. 12 73 00 and 12 73 10 will be furnished with certificates of the Physikalisch-Technische Reichsanstalt, of Berlin. Additional price:	
12 73 50	**Sugator** for cleaning pipettes	*Mindern*



Fig. 145 About $^1/_2$ actua size 13593

No. 12 73 03. Pipette with Pappenheim suction device

Very exact results are ensured by the *counting method with separate measuring pipettes and mixing vessels* recommended by BÜRKER. For this purpose we supply:

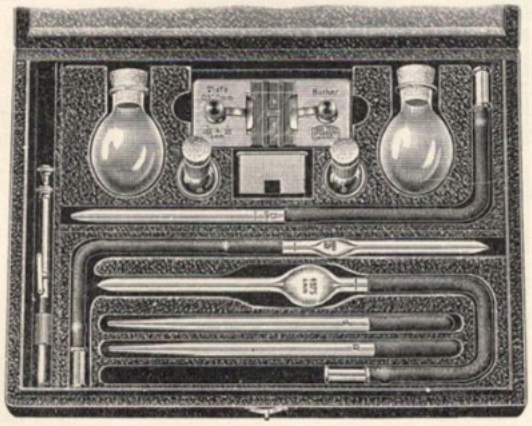


Fig. 146 About $^1/_3$ actual size 11654

No. 12 69 90. BÜRKER Haemacytometer for counting red and white blood corpuscles. With separate mixing vessels and measuring pipettes, in case, with complete directions for use

Code word: *Mineralium*

Polarizing Attachments

Polarized light is produced by means of the *Polarizer*, which is attached above the mirror below the condenser. The effects of polarization are rendered visible by the *Analyser*, which is placed on the eyepiece.

The direction of vibration of the light in the polarizer and analyser is marked on the mount by arrows and the letters "S-S."

As a rule, the introduction of a gypsum or mica plate affords a special criterion. *Observation in polarized light requires the presence of a revolving stage* (pp. 104 and 106).

No. 12 78 01. Polarizer No. I

(with dish and cover for gypsum and mica plates). Designed to drop into the diaphragm carrier of the ABBE illuminating apparatus in large Stands F, G, H, L, and S.

Code word: *Michele*

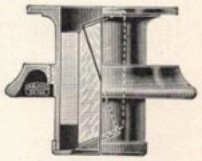


Fig. 147 8316
About $^2/_3$ actual size

No. 12 78 05. Polarizer No. III

(with dish and cover for gypsum and mica plates). Designed to drop into the diaphragm carrier of the ABBE illuminating apparatus in Stands EC and UC, and into the ring of the illuminating apparatus of Stands ES and DS.

Code word: *Mint*

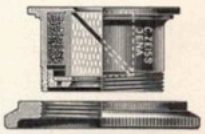


Fig. 148 11994
About $^2/_3$ actual size

Because of the low height of the illuminating apparatus in Stands D, E, U, and V, the short polarizer No. III must be used with these stands in place of No. I. The polarizers are dropped into the diaphragm carrier from above, and are lined up and if necessary screwed fast from below by means of the ring. The gypsum and mica plates are inserted into the diaphragm carrier underneath the polarizer.

No. 12 78 08. Polarizing Condenser N.A. 1,

three-lens, with iris diaphragm and removable front lenses.

Code word: *Mintage*

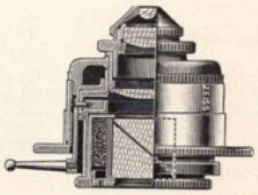


Fig. 149 11993
About $^2/_3$ actual size

The front lens is removed for use with objectives N.A. 0.4 to 0.7, and both front lenses for objectives below N.A. 0.4. The polarizing condenser is substituted for the regular condenser on Stands AB and EB for observation in polarized light. It may also be employed with Stands ES and DS. When it is used with other stands, the diaphragm carrier must be swung out. Gypsum and mica plates are placed between the analyser and the eyepiece.

No. 12 80 21. Analyser No. 1, to rest on eyepiece

Code word: *Mimadoru*

The analyser prism is mounted in a small tube which may be inserted into the sleeves of various mounts, including that of 12 80 23.

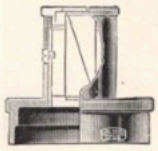


Fig. 150 8313
About $^2/_3$ actual size

No. 12 80 20. Analyser Prism in small tube

Code word: *Mimaret*

No. 12 80 23. Analyser No. III with graduated circle

Code word: *Mimaient*

The graduated circle permits any rotation of the plane of polarization in the object to be measured by rotating the analyser. The circle is movable in a ring bearing an index, the same as that used in the goniometer eyepiece described on page 114.

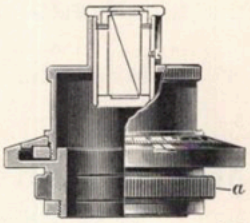


Fig. 151 8254
About $^2/_3$ actual size

Gypsum Plates (Fig. 152a), in metal mount

No. 12 80 62	Red I	Code word:	*Milzener*
No. 12 80 63	Red II	Code word:	*Minadora*
No. 12 80 64	Red III	Code word:	*Minadores*
No. 12 80 65	Red IV	Code word:	*Minae*

Mica Plates, in metal mount

No. 12 80 66	$^1/_8$ w. l.	Code word:	*Milzour*
No. 12 80 67	$^1/_4$ w. l.	Code word:	*Minage*
No. 12 80 68	$^3/_8$ w. l.	Code word:	*Minageur*
No. 12 80 69	$^1/_2$ w. l.	Code word:	*Minahbird*

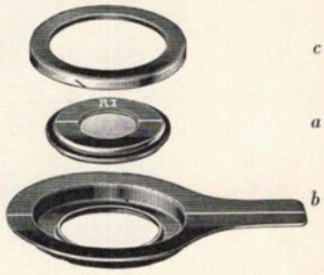


Fig. 152 8261
About $^5/_6$ actual size

No. 12 80 70 MOHL Set, consisting of the above eight plates ..... Code word: *Mima*

The compensating plates *a* in metal mount may either be used by themselves, above the eyepiece between the eye lens and the analyser (for instance in Stands AB and EB), or they may be placed above the polarizer into the diaphragm carrier in the ABBE illuminating apparatus with the aid of dish *b*. In the horizontal position of the microscope, the plate must be secured in the dish by ring *c*.

No. 12 80 58. Holder (dish and ring) for holding gypsum and mica plates

Code word: *Milza*

No.		Code word
	Complete Polarizing Sets	
12 80 54	**For Stands EB and ES**	
	Polarizing condenser, Analyser No. I, Gypsum plate RI, in case	*Minuer*
12 80 55	**For Stands ES, EC, and U**	
	Polarizer No. III, Analyser No. I, Gypsum plate RI with holder, in case	*Minuenti*
12 80 51	**For Stands G, F, H, L, and S**	
	Polarizer No. I, Analyser No. I, Gypsum plate RI with holder, in case	*Minantem*

Micro-Spectroscopic Apparatus

No. 12 81 02. Micro-Spectroscopic Condenser
(simplified ENGELMANN micro-spectroscopic objective)

Code word: *Minahouet*

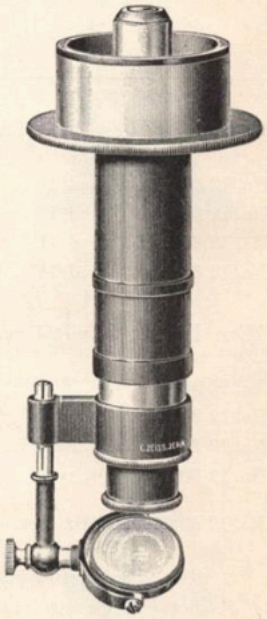


Fig. 153 8626
About ²/₃ actual size

The microscopic object is illuminated by spectrum light. The effect of the various colours upon adjacent portions of the object may be studied, or a suitable narrow object or strip of a preparation may be successively brought into the different regions of the spectrum. The spectrum is projected into the plane of the preparation by means of a three-lens objective forming part of the condenser. By using either the entire condenser or removing the first or both top lenses, the spectrum produced in the plane of the object may be adapted to observation with microscope objectives 40, N.A. 0.65, 20, N.A. 0.4 or 8, N.A. 0.20.

The instrument is particularly suited for finding the colour of filters in photomicrography, as for instance with the "Phoku," where it furnishes a means of determining beforehand which colour region should be transmitted by the filter in order to obtain the best possible contrast in the photographic record.

No. 12 81 30. ABBE Spectroscopic Eyepiece

(Micro-spectroscope), in case

Code word: *Micidiare*

This eyepiece is intended for observing the absorption spectra of microscopic objects. It is, however, equally suitable for the spectroscopic examination of larger objects, such as light filters, and of the emission spectra of sources of light.

It is inserted into the eyepiece tube in place of the regular eyepiece.

For detailed description, see "Mikro 125e."

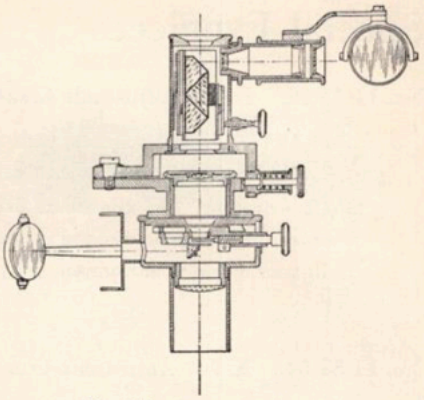


Fig. 154 About 1/2 actual size 7939

For use with above:

No. 12 81 35. $6 \times 4^1/_2$ cm. Spectrum Camera

A handy supplement to the ABBE spectroscope. It serves for photographically recording what has been observed through the spectroscopic eyepiece.

Spectroscopic camera with two $6 \times 4^1/_2$ cm. plate holders, wire release, clear-glass screen, and focusing magnifier, in case

Code word: *Mimoseasse*

For details, see "Mikro 125e."

The spectroscopic eyepiece is set for photographing with the aid of a telescope focused for infinity. The "Tellup" is well adapted for this purpose. This is a small combination pocket telescope and magnifier giving magnifications of 2.5× and 6×, respectively, in its two capacities.

Tellup

Code word: *Medvexatum*

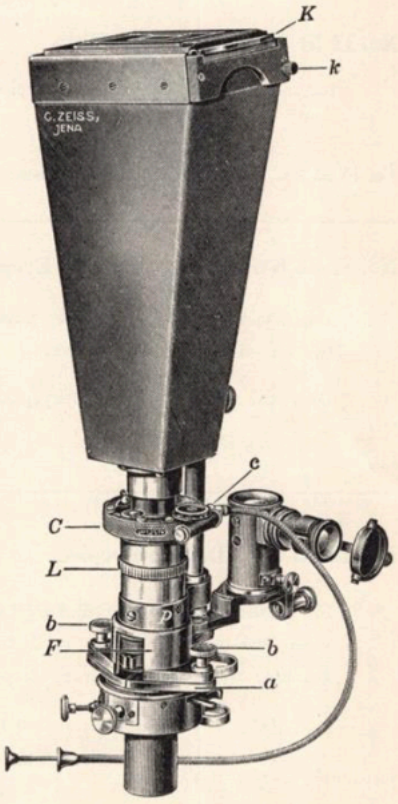


Fig. 155 About 1/2 actua size 8420

Special Eyepieces

No. 11 53 14. H 7× Adjustable Cross Line Eyepiece

A 7× HUYGENS eyepiece with cross line disk for centring revolving stages and indicating the planes of vibration in the polarizing microscope. The cross line disk may either be permanently mounted, or it may be dropped in place ready for being exchanged against an eyepiece micrometer.

Code word: *Militabano*

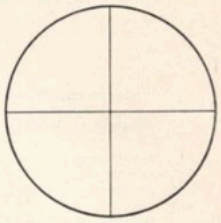


Fig. 156 7901
About 1 1/2 actual size

No. 11 53 04. K 7× Adjustable Cross Line Eyepiece

A 7× compensating eyepiece with cross lines ..... Code word: *Milionis*

The illustration shows the cross lines in the field of view of the microscope. The cross line disk may be separately ordered and can be used in the other adjustable eyepieces listed on page 112.

No. 11 51 90. Cross Line Disk

for insertion into adjustable eyepieces, 19 mm. diameter, in box

Code word: *Micolino*

No. 11 55 85. For Goniometer Eyepieces for the measurement of angles, see page 114.

No. 11 58 04. H 10× Pointer Eyepiece

For directing attention to any particular element in the preparation with the aid of a movable pointer.

Only the 10× HUYGENS eyepiece is arranged in this way.

Code word: *Mickknopf*



Fig. 157 8002
About 1/2 actual size

No. 12 85 05. Double Eyepiece

for simultaneous observation by two observers with one microscope. Is used to advantage together with the pointer eyepiece.

In case

Code word: *Mieteranno*

For details, see "Mikro 360e."

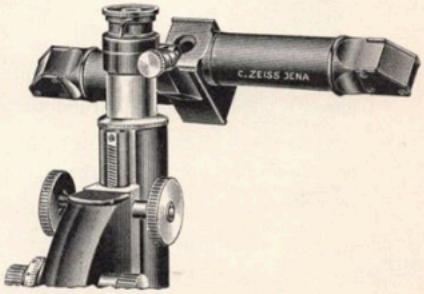


Fig. 158 About 1/4 actual size 11787

No. 12 85 07. Comparison Eyepiece

for comparing two different objects set up under two identical microscopes (for instance for the detection of forgeries and the comparison of delivered goods with samples) or for comparing the optical equipments of two microscopes by viewing two like objects.
In case

Code word: *Mietendo*

For details, see "Mikro 361e."

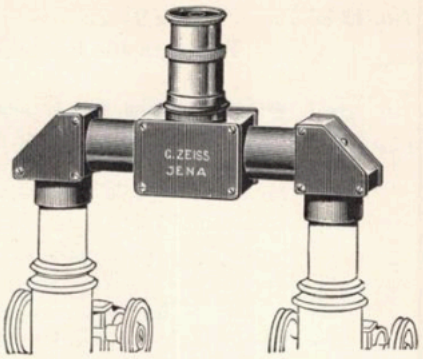


Fig. 159 About 1/4 actual size 7947

No. 12 85 30. SIEDENTOPF "Phoku 6×4½" Photographic Eyepiece

for taking photomicrographs on 6×4½ cm. plates during observation.

This attachment is adapted, not only for making photographic records of sections and other permanent preparations, but also for photographing living and moving objects at any appropriate instant during observation.

The "Phoku 6×4½" is screwed by an intermediate ring into the lower portion of the tube in place of the draw tube. Convenient observation from the side through inclined eyepiece. Two negative systems, of 4.7× and 6.2× factorial magnifications, for low-power and high-power objectives. Simple shutter for time and instantaneous exposures.

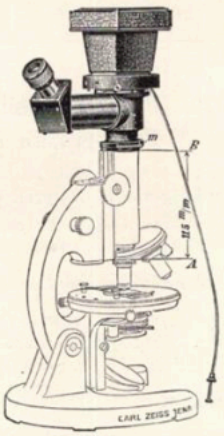


Fig. 160, About 1/7 actual size 11649

Phoku, 6×4½ cm., with two plate holders, Goldberg wedge in frame, wire release, and two negative lenses L and H, in case

Code word: *Miliarius*

Same, but with self-winding Ibsor shutter for instantaneous photographs, in case

Code word: *Minuisci*

For details, see "Mikro 373e."

No. 12 85 76. "Phoku 9×12" Photographic Eyepiece



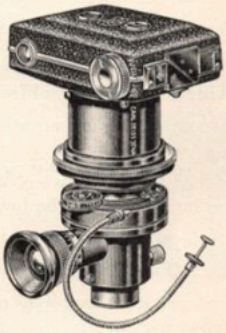
Like the $6\times4^1/_2$ Phoku, this eyepiece is intended for taking photomicrographs during observation. The large plate size is particularly advantageous in general survey photographs with low-power objectives (Apochromat 10). The magnification obtained on the plate equals 10× the factorial magnification of the objective. The 9×12 Phoku is inserted into the eyepiece tube in place of the regular eyepiece. The observation tube is at right angles to the optical axis of the microscope. Self-winding Ibsor shutter for instantaneous exposures.

Phoku, 9×12 cm., with two metal plate holders and focusing screen in frame, in case

Code word: *Miolas*

Fig. 161 About $^1/_3$ actual size 13797

No. 12 85 72. "Kolibri Phoku" Photographic Eyepiece



For taking single or serial photos on roll film. Especially recommended for serial examinations.

Size of individual pictures 3×4 cm.

"Phoku" Photographic Eyepiece with self-winding Ibsor shutter with wire release, and **"Kolibri" Attachment Camera,** in case

Code word: *Kagem*

Fig. 162 About $^1/_3$ actual size 22324

The "Phoku 9×12" and the "Kolibri Phoku" have the same head. If either of these eyepieces is on hand, therefore, it is only necessary to order the camera attachment required for the other. By the use of a special adapter, the "Contax" miniature camera made by the Zeiss-Ikon A. G. may also be employed.

No. 12 85 79. 9×12 Attachment Camera ..... Code word: *Kaggo*
No. 12 85 80. "Kolibri Phoku" Attachment Camera ..... Code word: *Kails*
No. 12 85 90. Adapter for "Contax" Camera ..... Code word: *Kaikr*
No. 12 85 73. "Phoku" Attachment (head with Ibsor shutter) ..... Code word: *Kaifl*

Inclined Eyepiece Attachments

The earlier forms of microscopes had straight tubes merely capable of up and down motion. In working, the observer was compelled to incline his head forward and downward over the eyepiece, and to use either an extra low table or a high chair to compensate for the height of the stand. These drawbacks were largely eliminated by the introduction of the inclinable body, which has since been employed in all of our microscopes with the exception of the small models. By this means, it became possible to tilt the microscope through whatever angle was required to permit of convenient use with ordinary tables and chairs. This inclination is not, however, practicable in observing fluid preparations, since these run off as soon as the stage leaves the horizontal. Moreover, inclination of the microscope is apt to prove a drawback in working with immersion objectives, in as much as the immersion liquid has a tendency to recede from the upper portion of the field of view or to run off the condenser, as was to be observed in dark field observation.

For these reasons, we have created several tube attachments with an eyepiece section offset at an angle to allow the observer to sit erect in a comfortable attitude in front of the instrument. By the inclusion of the prisms required to deflect the path of the light, the optical and mechanical tube length, and therewith the total magnification of the microscope, are necessarily increased. Since objectives of higher numerical aperture are corrected only for a certain definite tube length, they can be employed to equal advantage with straight and inclined tubes only when the difference in the tube length is optically compensated. With all objectives, however, the use of the inclined tube entails a change of magnification, unless compensation therefore is made by optical means. By the further development of the method first employed with our "Bitukni," our microscopes can now be equipped with inclined eyepiece attachments designed for monocular or binocular observation with the regular eyepieces, and without any change in the adjustment of objectives or in the total magnification of the instrument. In the "Bitukni L," the increase in magnification resulting with the increase in tube length has been retained, the total magnification being 1.5× the product of the objective and eyepiece magnifications. "Bitukni L" and "Monokni L" (Table 5, page 3) will be found described in Folder "Mikro 492e."

No. 12 85 21. Bitukni I Inclined Binocular Tube
(without eyepieces).

In case Code word: *Mirabunta*

No. 12 85 22. Bitukni II Inclined Binocular Tube
(without eyepieces).

In case Code word: *Miracci*

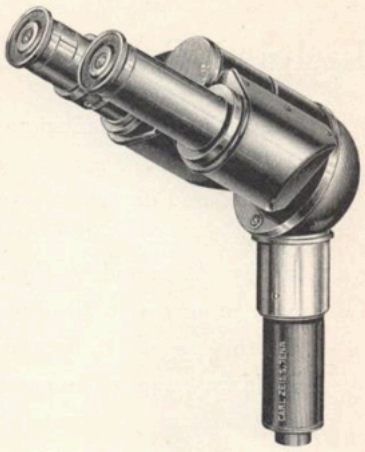


Fig. 163 About 1/3 actual size 13878

Inclined eyepiece body for the **binocular and stereoscopic observation** of microscopic objects with a single objective.

The Bitukni does not call for any particular stand, although it cannot be used on small and metallographic stands with tube diameters under 29 mm., nor on Stand L. To all other stands, it can be applied by the interposition of suitable **adapter sleeves,** while in Stand H it is directly substituted for the draw tube. Model I is intended for our new stands and Model II for the older types of stands. An interchangeable straight eyepiece tube and an adapter sleeve are furnished with each "Bitukni." In ordering, the serial number of the stand should be stated. Eyepieces from 7× up may be used.

For detailed description, see "Mikro 478e."

No. 12 85 28. "Monokni H" Inclined Monocular Tube
(without eyepiece)

Code word: *Kanij*

No. 12 85 29. "Monokni E" Inclined Monocular Tube
(without eyepiece).

Code word: *Kanef*

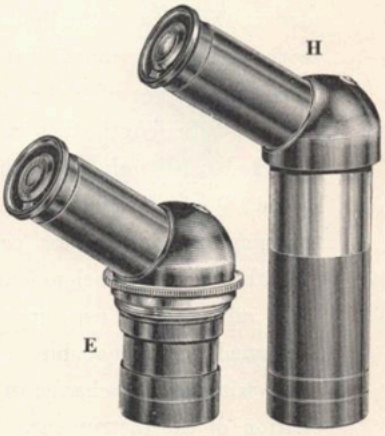


Fig. 164 About 2/3 actual size

Convenient observation from the side is obtained with monocular microscopes by inserting one of these attachments into the body tube. Particularly advantageous for non-inclinable stands with removable eyepiece tube, and for work with fluid preparations. No running off of liquid with immersion objectives. Suitable for use with all eyepieces from 5× on without change in adjustment and magnification. Monokni H, for large stands with wide tube, directly fits the sliding sleeve for the draw tube in Stands H and S (from No. 25 58 21 on), and is adapted to other stands by means of special adapter sleeve No. 12 85 21/4. Monokni E is for medium Stands D, E, U, V, where it is screwed to the body tube without adapter.

In ordering please state Serial No. of Stand.

For details, see "Mikro 278e."

No. 12 85 24. "Monokni II" Inclined Monocular Tube

(without eyepiece) ..... Code word: *Miolada*

For old models of stands with narrow tubes, of not under 29 mm. diameter. Fitted to external tube by adapter sleeve. Readily interchangeable with straight eyepiece tube.

For details, see "Mikro 478e."

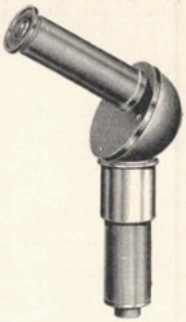


Fig. 165 22408
About 1/4 actual size

Miscellaneous Accessories

No. 12 76 20. ABBE Diffraction Apparatus

This accessory was proposed by ABBE in 1876. It is ideal for practically demonstrating that microscopic images are generated by diffraction in the object, that different objects of the same diffractive properties yield identical images under equal optical conditions, and that the aperture of the objective determines the content of the microscopic image.

The apparatus consists of a diffraction plate, an objective slide with three fine grids, eight objective stops, Fig. 166 b, for achromatic objective 6, N.A. 0.17, and an intermediate fitting with slide, Fig. 166 a, termed the diffraction funnel, for inserting and revolving the stops above the objective.

Detailed information on experiments and demonstrations of the diffraction phenomena will be found in special works on diffraction theory and in larger works on physics. We mention the Monthly Microscopic Journal, Vol. **17**, 1877, pp. 82 to 88; Dippel, Das Mikroskop, Vol. **1**, pp. 147 to 156; Metzner-Zimmermann, Das Mikroskop; and Müller-Pouillets Lehrbuch der Physik, Vol. 2.

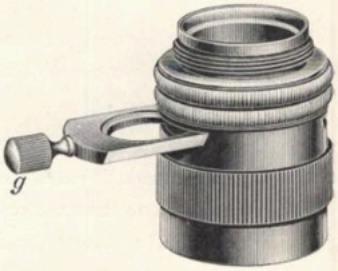


Fig. 166 a About actual size 13865

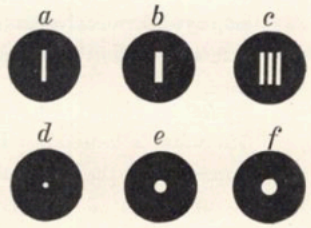


Fig. 166 b About 2/3 actual size 13866

ABBE Diffraction Apparatus, in case ..... Code word: *Miehe*

No. 12 76 21. Diffraction Plate ..... Code word: *Michel*

No. 11 31 90. Binocular Microscope Eyeguard

A spring clamp ring for attachment to the microscope tube carries a lateral jointed arm with a dummy eyepiece for covering the unused eye. A matching eyecup designed to be slipped on the end of the tube guards the eye of the observer against extraneous light reflected from the eye lens. Especially to be recommended for use with the "Monokni" inclined monocular tube.

Code word: *Kehdo*

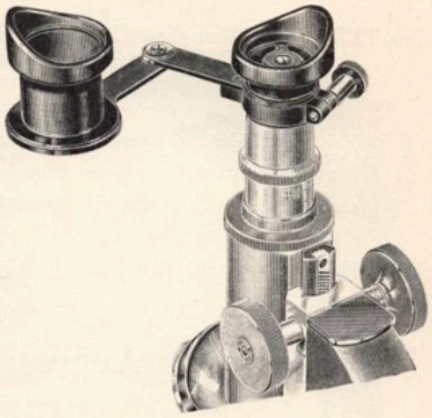


Fig. 167 About 1/2 actual size 13850

No. 12 83 31. PFEIFFER Heatable Stage

A simple device for moderately heating microscopic objects during observation.

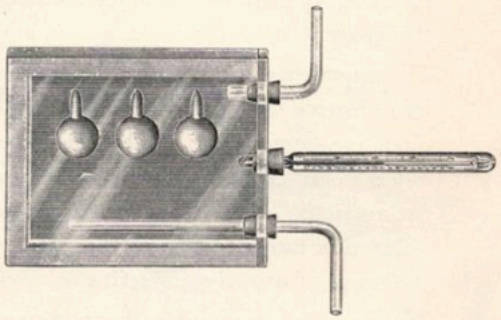


Fig. 168 About 1/2 actual size 13876

Consists of a glass box about half an inch high, through which warm water is circulated to heat the cover plate, which can be directly used as the object carrier. By employing a cover plate with spherical concavities like that of Fig. 168, the stage may be employed for observation in a hanging drop. The temperature is indicated by a thermometer extending into the circulating water. Condensers with long focal intercepts only can be used.

The water is heated in a boiling flask set up near the microscope. By the use of a micro gas burner and a thermo-regulator, the water may be held at a predetermined temperature.

Heatable Stage with Spherical Cavities ..... Code word: *Micidus*

No. 12 83 20. Thermo-regulator ..... Code word: *Micidiores*

No. 12 83 25. Micro Gas Burner ..... Code word: *Micidorum*

No. 12 08 66. Self-regulating Electric Heating Stage with Resistance and Signal Lamp, in case ..... Code word: *Kehep*

This is a special stage designed to be substituted for and held in the centring piece of the revolving vulcanite or large compound stage. It is principally intended for moderately warming

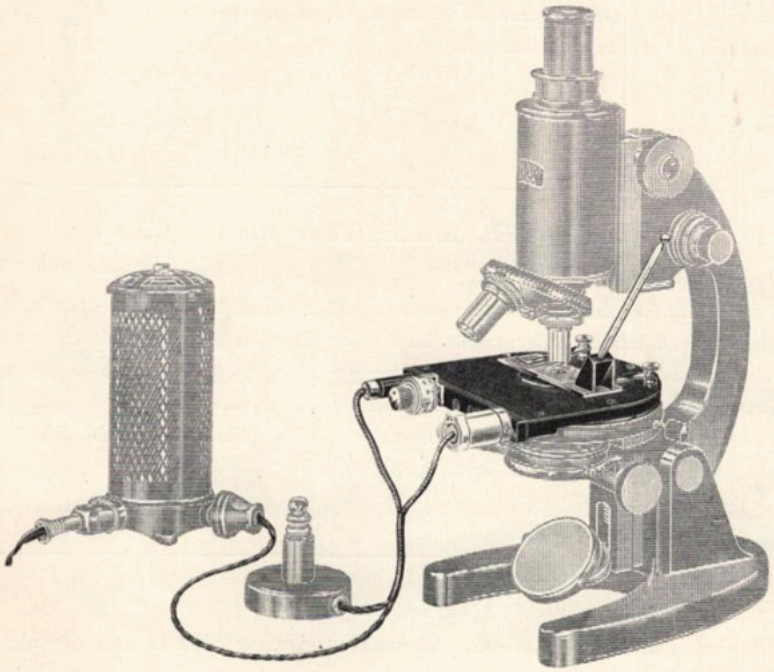


Fig. 169 About $^1/_3$ actual size 13855

the preparation. The stage automatically maintains a given temperature constant within about one degree F. Any desired temperature can be set by varying the position of a contact pin in accordance with a scale. The heating element is connected to a shunt circuit. The duration of the heating period is indicated by the burning of a small bulb. About 0.35 amps. are required.

No. 12 92 20. MALTWOOD **Finder,** in plain case

An object slide carrying a photographic reproduction of 900 small consecutively numbered squares. The spot under observation is brought as near as possible to the centre of the field, the finder substituted for the preparation, and the field corresponding to the observed spot sought. The design of the present finder deviates to some extent from that in the original description of the device, in the Zeitschrift für wissenschaftliche Mikroskopie, Vol. 5, 1888, p. 40.

Code word: *Micranthes*

No. 12 92 30. Object Marker W,

in round box Code word: *Micrandra*

For marking points in the preparation for rapid future identification, we supply this instrument, made by R. Winkel, of Göttingen. The marking is effected by scratching a circle around the spot to be identified by means of a diamond.

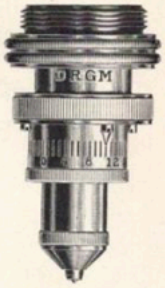


Fig. 170
About actual size

No. 12 92 40. BORN and PETER **Orienting Plate with two Glass L's**

Code word: *Micraspis*

This device is designed for orienting preparations intended for serial sections in solidifying paraffin, and for marking the paraffin block with direction lines. To this end, the plate is provided on one side with parallel and uniformly wide sharp-edged grooves. A graticule serves for lining up two glass L's, which are placed upon the plate to form a chamber for the paraffin. Particulars about the use of the device will be found in the Zeitschrift für wissenschaftliche Mikroskopie, Vol. **15,** 1898, pp. 31 to 49.

No. 12 92 41. Pair of Glass L's only ..... Code word: *Micrantha*

Moist Chambers

a) Object slide with fused-on (not cemented) ring cell. 11 mm. inside diam. Resists all commonly used fluids (Fig. 171a).

No. 12 97 71. Moist chamber, 0.4 mm. deep ..... Code word: *Militema*
No. 12 97 75. Moist chamber, 1 mm. deep ..... Code word: *Militemur*
No. 12 97 77. Moist chamber, 2 mm. deep ..... Code word: *Militenlo*

b) **LASSÉ Object Slide,** with fused-on rectangular cell (Fig. 171b).

No. 12 97 85. Code word: *Minutez*

for embedding comparatively large objects, up to 1.2×2.2 cm. in suitable fluid media. Flexible objects may be straightened out for photomicrography by means of glass plates. Especially adapted to the microscopic examination and photomicrography of textile fabrics (see Melliands Textilberichte, 1931, pp. 249 to 253), for holding floating cornea sections, and the like. Depth of chamber 2 mm.

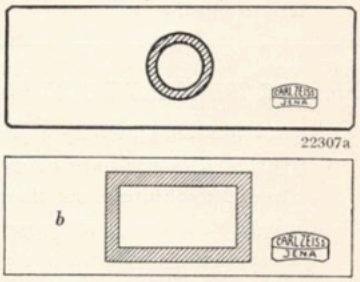


Fig. 171 About 2/3 actual size 13544

JANSE and PÉTERFI "Mipu" Micromanipulator

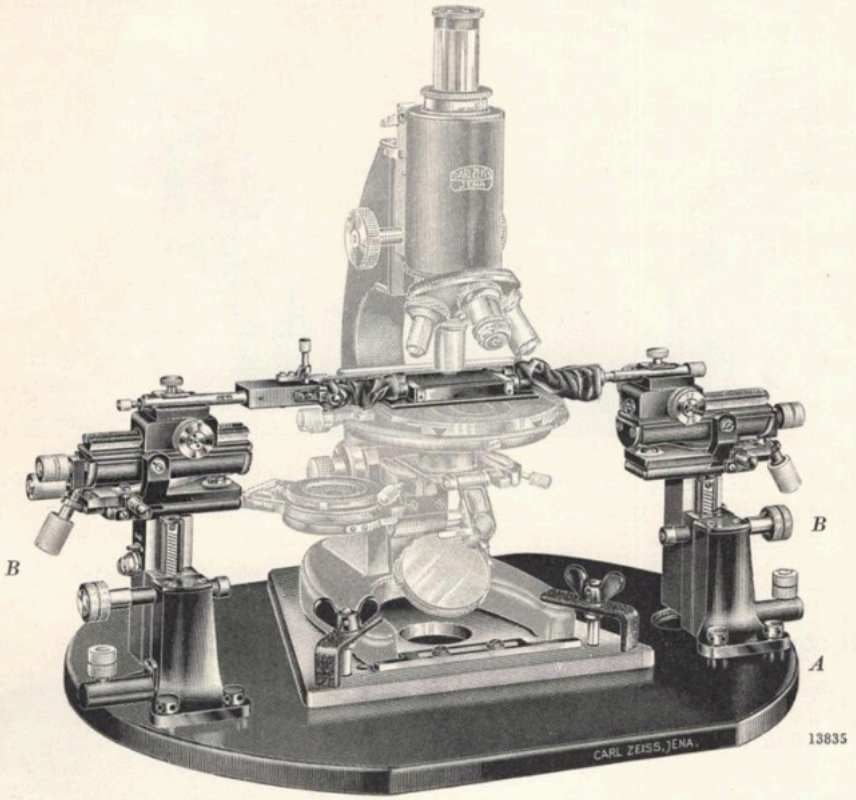


Fig. 172 About 1/4 actual size

With the Micromanipulator, bacteria or other microscopic objects, such as cells, can be singly treated, operated upon, injected, or exposed to physical or chemical influences. Inanimate microscopic objects, such as minute amounts of chemical substances, fibres, crystals, and the like, may similarly be rendered accessible to experimental investigation under the microscope. Included with the Micromanipulator are the base plate A, one or more manipulating stands B for carrying implements, and one single and one double needle holder.

No. 12 87 24. Micromanipulator with one Manipulating Stand, in case ..... Code word: *Kehiu*

No. 12 87 26. Second Manipulating Stand B for implements, with 7 motions Code word: *Kehmy*

No. 12 87 35. Accessories Set No. I, comprising moist chamber, micro-burner, thermo-cautery, and electrical heater for fine pipettes ..... Code word: *Mincassent*

No. 12 87 36. Accessories Set No. II, comprising 2 fine glass needles, 100 55 × 26 mm. cover glasses for moist chamber, and 90 glass tubes and glass rods for making auxiliary instruments ..... Code word: *Minions*

For **Dissecting Condensers** for use with above, see page 99.

For detailed description and directions for use, see "Mikro 374e."

For work at low and medium magnifications, the slow motions of the manipulating stands are not required, and *simplified* manipulating stands with coarse motions suffice.

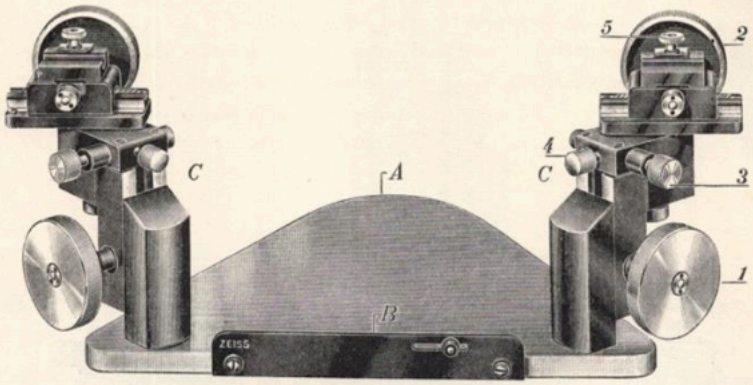


Fig. 173
About 1/3 actual size
22095

No. 12 87 45. Micromanipulator with **one Simplified** Manipulating Stand .. Code word: *Miradera*
No. 12 87 48. Simplified Manipulating Stand for carrying implements, with three motions ..... Code word: *Miraderol*

Bell covers for microscopes

No. 12 96 26. Light-metal Bell Cover with Three Cellon Windows (without base)

Code word: *Minutala*

These bell covers have the advantage, over glass covers, of decidedly lower weight and larger diameter, of about $10^1/_2$ inches as against $9^1/_2$ inches. Both circumstances reduce the risk of damage to projecting parts, such as the stage centring screws and the like, in placing the cover on the microscope. The clear height inside is $16^1/_2$ in. The bell cover is supplied either with or without glass base plate as ordered.

For use with above:

No. 12 96 29. Glass Base Plate

Code word: *Kehoa*

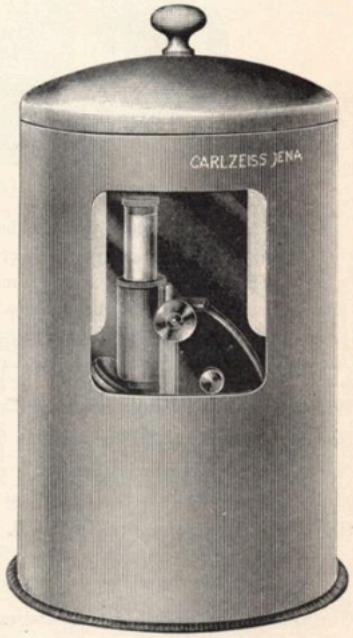


Fig. 174 About 1/3 actual size 13533

No.			Code word
	Object Slides		
	English Size, 3×1 in.		
12 97 09	Half white, rough edges ..... per 100		*Kehte*
12 97 10	Plate glass, rough edges ..... per 100		*Microbios*
12 97 12	White plate glass, polished edges ..... per 100		*Microcarpa*
12 97 13	White plate glass, polished edges, selected for thickness within 0.1 mm. ..... per 100		*Mictorio*
	Extra Large, $3^1/_2 \times 1^1/_2$ in.		
12 97 32	Plate glass, polished edges ..... per 100		*Microcere*
	With spherical cavity, and beveled and polished edges:		
12 97 50	$2^1/_4 \times 1^1/_4$ in. ..... each		*Mictoriora*
12 97 52	3×1 in., 1.2 to 1.5 mm. thick ..... per 10		*Kehuf*
	For object slides **with fused-on glass ring cell** for use as moist chambers, see page 132.		
	Cover Glasses		
12 98 12	**square,** 12 mm. sides ..... per 100		*Kehxi*
12 98 18	**square,** 18 mm. sides ..... per 100		*Microcosmi*
12 98 21	**square,** 21 mm. sides ..... per 100		*Mictuale*
12 98 24	**square,** 24 mm. sides ..... per 100		*Microcrith*
12 98 48	**round,** 18 mm. diameter ..... per 100		*Microdere*
12 98 51	**round,** 21 mm. diameter ..... per 100		*Microdon*
12 98 54	**round,** 24 mm. diameter ..... per 100		*Microdonte*
12 98 70	**rectangular,** 24×21 mm. ..... per 100		*Mictuali*
12 98 75	**rectangular,** 32×24 mm. ..... per 100		*Microfono*
12 98 78	**rectangular,** 55×26 mm. ..... per 100		*Miniopteri*
	Sets of Dissecting Instruments		
12 99 02	Razor, two scalpels, lancet knife, two scissors, section lifter, forceps, lancet needle, two needle holders with straight needles, needle case with four needles and camel hair pencil, 100 labels, brush, in case		*Mindera*
12 99 03	Scissors, forceps, scalpel, lancet needle, two needle holders with needles, camel hair pencil, two spare needles, in case		*Minderde*
12 99 08	GIEMSA **Staining Trough,** porcelain with glass cover		*Mincates*

Microscope Lamps and Accessories for Artificial Illumination

No. 13 93 21. Electric Microscope Filament Lamp No. I

A simple lamp, comprising a closed housing for accommodating a filament bulb, a frosted glass screen designed for being inserted into or taken out of the path of the light, and a globular flask serving as a cooling cell and lens. The light is projected obliquely downward on to the microscope mirror.

The bracket supporting the globular flask can be removed and exchanged for the condenser lens No. 13 93 83 described on page 137.

Without bulb — Code word: *Mingi*

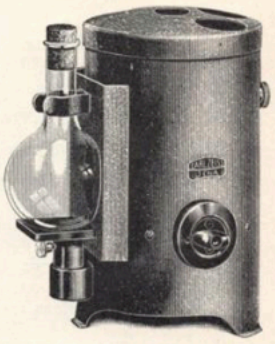


Fig. 175 About 1/6 actual size 13692

No. 12 93 22. Electric Microscope Filament Lamp with Iris Diaphragm

In front of the globular flask is an inclined iris diaphragm, the image of which is formed by the microscope condenser in the preparation, thereby preventing disturbance from excess light in the field of view.

Without bulb — Code word: *Keiny*

For bright field illumination, ordinary 25 c. p. commercial bulbs are used in conjunction with the frosted glass screen. **Dark field illumination** calls for **special dark field bulbs:**

100-Watt **Dark Field Bulbs**

No. 13 93 11, for 110 volts — Code word: *Mierla*
No. 13 93 14, for 220 volts — Code word: *Mierra*

In ordering please state voltage.

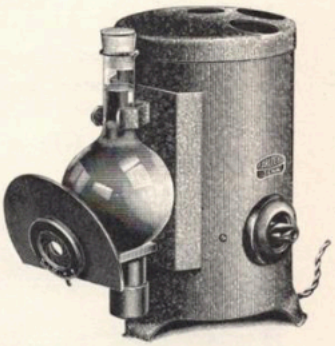


Fig. 176 About 1/6 actual size 13869

No. 13 93 23. Electric Microscope Filament Lamp No. II

For observation with a vertical illuminator in incident light.

Housing as in No. 13 93 21. The place of the bracket for the globular flask is taken by a lens with iris diaphragm. The light issues horizontally from the lamp.

Without bulb

Code word: *Minier*

For detailed information, see "Mikro 322e."

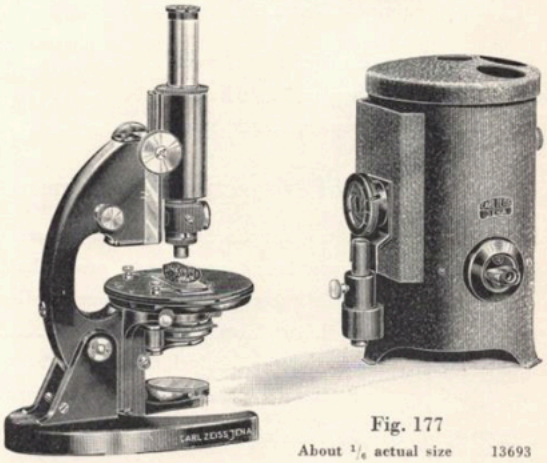


Fig. 177
About 1/6 actual size 13693

Lamps Nos. 13 93 21 and 13 93 23 can be converted from one into the other by exchanging the globular flask and the lens with iris diaphragm. The several components are directly interchangeable and may be individually ordered at any time.

No. 13 93 82. Bracket with Globular Flask ..... Code word: *Minutu*

No. 13 93 83. Condenser Lens with Iris Diaphragm ..... Code word: *Minutula*

Low voltage lamps combine inexpensive operation with small size of bulbs and housings. By connecting them to a transformer, they are cheap to use with alternating current. For these reasons, we recommend Microscope Lamps Nos. III and IV especially for difficult work where very intense illumination is required, as for instance for dark field observation at high magnification. For low-voltage bulbs, see page 138.

No. 13 93 53. Microscope Filament Lamp No. III

with iris diaphragm and ground-glass screen
without bulb Code word: *Miragu*

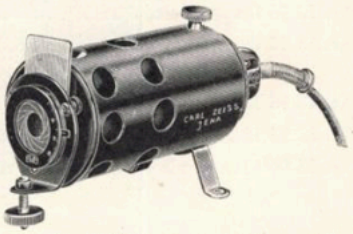


Fig. 178 About 1/3 actual size 22066

This lamp, Fig. 178, is for work in incident light, and is of low design. It rests on three feet, of which the front one is adjustable for height to enable the lamp to be inclined and adjusted with reference to the microscope mirror. The light issues through an aspherical lens system located at the same height as the microscope mirror. The lamp is equipped with a field stop in the shape of an iris diaphragm. Ground-glass and colored-glass screens may be inserted for modifying or colouring the illuminating beam.



Fig. 179 About 1/4 actual size 22068

No. 13 93 86. Connecting Bar

For ensuring correct position of the lamp relative to the microscope, we furnish for the stands now being manufactured by us the connecting bar of Fig. 179. This bar is adjustably connected to the lamp housing at one end, while the other end bears a cross rail with two studs fitting two matching holes in the bottom surface of the microscope foot and thereby giving a rigid connection.

Code word: *Miram*

No. 13 93 54. Microscope Filament Lamp No. IV

Code word: *Mirail*

The lamp of Fig. 180 is intended as a universal device for illumination in transmitted or in incident light. The housing is attached to a standard, on which it can be adjusted for height and inclined as required. The light can be thrown upon the microscope mirror at any desired angle. It may be pointed horizontally to pass through a vertical illuminator, or directed immediately on to an object on the microscope stage.

Low-voltage lamps must be connected to the lighting circuit through a resistance in the case of direct current, a transformer with alternating current.



Fig. 180 About 1/5 actual size 22067

No. 13 96 03. 6 Volt, 5 amp. **Low-voltage Bulb** ..... Code word: *Mirak*
No. 13 95 72. **Transformer with Leads to lamp and wall socket,** for 110 or 220 volts ..... Code word: *Mirand*
No. 13 95 11/1. **Fixed Resistance,** for 110 volt D. C. ..... Code word: *Prodigor*
No. 13 95 12/1. **Fixed Resistance,** for 220 volt D. C. ..... Code word: *Prodigose*
No. 13 96 51. **Leads** for lamp and resistance ..... Code word: *Mirano*

For details, see "Mikro 486e."

No. 13 93 35. Micro Arc Lamp

A microscope arc lamp of the hand feed type for 4 to 5 amp. direct or alternating current, with iris diaphragm and ground-glass screen.

This lamp is to be recommended for microscopic work demanding very intense illumination. It is particularly adapted for use in dark field observation to bring into view objects ordinarily hard to perceive, and for the illumination of colloid substances with the Cardioid Ultra-Microscope described in "Mikro 306e." By means of a knob, the hood of the lamp may be clamped in the horizontal position for use with a vertical illuminator. The necessary resistance and carbons will be found listed on page 139.

Code word: *Miniare*

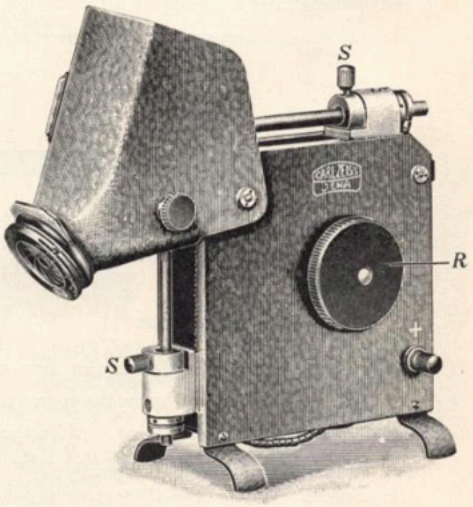


Fig. 181 About 1/4 actual size 11496

Micro Clockwork Arc Lamps

are microscope arc lamps with a clockwork for the automatic feed of the carbons. During the life of the carbons, manual adjustment by means of handwheel *R*, Fig. 181, will be necessary but once or twice to compensate for irregular burning of the carbons, such as may result from lack of homogeneity in the carbon material.

Different clockworks are required for direct and alternating current.

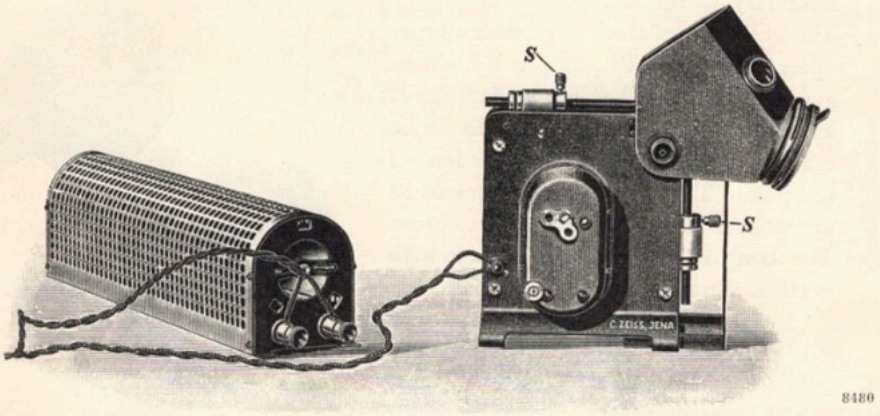


Fig. 182 About 1/3 actual size

In order to keep down current consumption in the case of alternating current, the use of a transformer is recommended. A higher voltage than the terminal voltage of the lamp (about 45 volts) for the secondary circuit must, however, be furnished by the transformer, because otherwise the lamp will flicker and the arc is apt to be easily broken. An adequate resistance for quieting the action of the lamp must therefore be left. Particulars upon request.

No. 13 93 32. **Micro Clockwork Arc Lamp,** for direct current ..... Code word: *Miniareis*

No. 13 93 33. **Micro Clockwork Arc Lamp,** for alternating current ..... Code word: *Miniarem*

No. 13 93 37. **Resistance for 110 volts,** with lead and plug ..... Code word: *Mimosen*

No. 13 93 38. **Resistance for 220 volts,** with lead and plug ..... Code word: *Mimosite*

No. 13 98 20. **100 pairs of carbons** for direct current { 170×8 mm. / 170×6 mm. } .. Code word: *Mimologico*

No. 13 98 21. **100 pairs of carbons** for alternating current { 170×7 mm. / 170×7 mm. } Code word: *Mimologos*

In ordering please state type and voltage of current.

For details, see "Mikro 393e."

Micro Spot Arc Lamp

The Micro Spot Arc Lamp occupies a position midway between the filament lamp and the arc lamp.

The lamp consists of an inclinable spherical housing containing a spot arc bulb and supported on a pedestal base. An enlarged image of the glowing spherical or hemispherical electrode of this lamp is formed by a lens system in the housing, and an intense beam of illuminating light thrown on the microscope mirror. The image of the iris diaphragm of the lamp formed in the plane of the preparation supplies a well defined boundary to the field of view.

The bulbs are of the Tungsten arc type, operating on 2 to $2^1/_2$ amps. in a closed gas-filled bulb. They differ for direct and alternating current, and with direct current require correct connection of the poles. They are more convenient in operation but less bright than arc lamps. The lamp is also suitable for use with vertical illuminators.

For details, see "Mikro 410e."

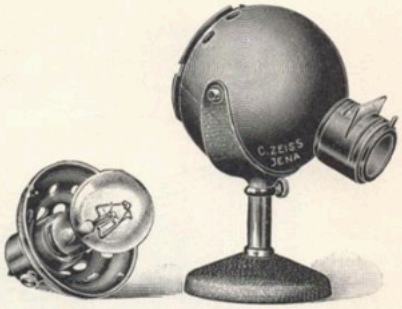


Fig. 183 About $^1/_4$ actual size 11166

No. 13 93 62. **Lamp Housing,** on pedestal base, with triple lens system ..... Code word: *Minnodu*
No. 13 93 64. **Spot Arc Bulb,** Type 2 G, for 2 amp. **direct current** ..... Code word: *Miniora*
No. 13 93 67. **Spot Arc Bulb,** Type 2 W, for 2 amp. **alternating current** ... Code word: *Minious*
No. 13 93 72. **Transformer,** for 110 or 220 volt **alternating current** ..... Code word: *Miradura*
No. 13 93 75. **Two-part resistance** for 110 volt **direct** or **alternating** current Code word: *Minirend*
No. 13 93 71. **Two-part resistance** for 220 volt **direct** or **alternating** current Code word: *Minhoca*

No. 13 41 10. Water Chamber (Heat filter)

for micro arc and other microscope lamps with intense illumination and accompanying generation of heat.

The chamber consists of a porcelain vessel with rubber-packed joints. All parts are acid proof and can be readily taken apart for cleaning.

Porcelain Cell with stopper Code word: *Mimologum*

A particularly effective cooling liquid is a solution of MOHR'S Salt.

No. 13 41 16. Vial of Cooling Liquid, for Water Chamber
Code word: *Miniabunt*

For details, see "Mikro 378e" and "Mikro 393e."

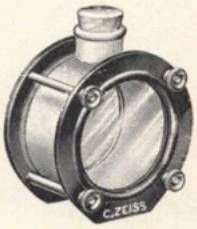


Fig. 184 904
About $^1/_4$ actual size

Small MÜLLER Capillary Microscope*)

60× magnification

The Capillary Microscope is principally intended for observation of the terminal capillaries of the fingers and of the surface of the skin generally. Additional uses are in the examination of flat objects, such as cloth, metal plates, and the like, upon which the microscope is directly placed after detaching the base. Without base, and by the addition of one of the micrometer eyepieces described on page 112, the instrument may also be used as a plain measuring microscope directly on the work.

See Directions for Use, "Mikro 363e."

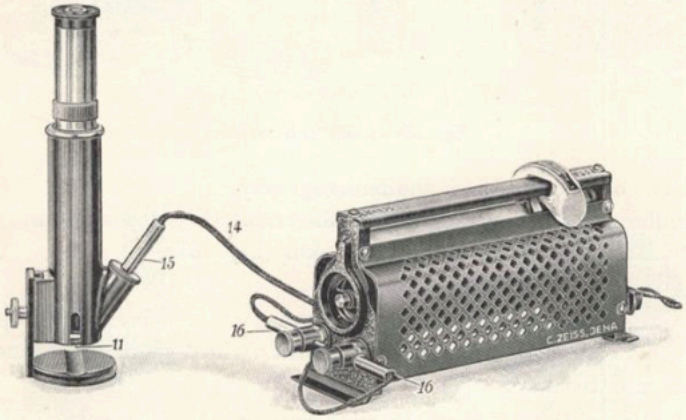
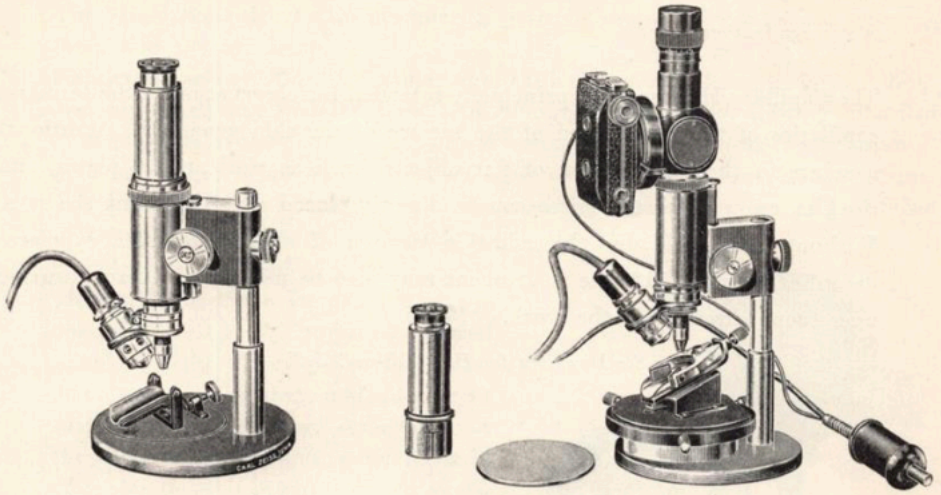


Fig. 185 About 1/5 actual size 11586

No.			Code word
12 45 20	**Capillary Microscope,** with two bulbs		*Mietera*
	For connection to lighting circuit:		
13 95 80	**Transformer,** for 110 volt alternating current	with lead and plug	*Minutum*
13 95 81	**Transformer,** for 220 volt alternating current		*Minuturu*
13 90 60	**Adjustable Resistance,** for 0.5 amp. 110 to 240 volt direct or alternating current ...		*Migratoa*

*) See Otfried Müller: Die Kapillaren der menschlichen Körperoberfläche in gesunden und kranken Tagen. Stuttgart, F. Enke, 1922. — Prof. Dr. Bettmann: Zur Kapillarmikroskopie. Klin. Wochenschrift, Vol. 5, 1926, p. 2068.

Capillary and Skin Microscope IV



a) 22094 b) 13958

Fig. 186 About 1/4 actual size

For visual **observation** and **photomicrography** of
the **capillaries** of the **border of the fingernail** (Figs. 186a and b)
the **capillaries** of the **surface of the skin** (Fig. 187c)
the **capillaries** of the **lips** (Fig. 187d)
and for the **examination of non-transparent** objects, including objects of large extent, such as the skin, fractures, fabrics, sheet metals, specimens of handwriting, and the like.

Size of picture $1^1/_4 \times 1^1/_2$ in., 16 exposures on $1^1/_2 \times 2^1/_2$ in. roll film.

The source of light is an 8-volt, 0.6 amp. filament lamp connecting to the lighting circuit through a transformer, or in the case of direct current through a resistance. In making exposures, the lamp is momentarily overloaded in order to obtain the requisite degree of brightness.

a) For **visual observation of the capillaries of the fingers:**

Microscope with rack-and-pinion motion and **illuminating apparatus** with lead, on **base** with **finger rest, objective 8, H 10×** **eyepiece, 6 bulbs** in **centred caps,** in shipping case, and **plain transformer** for 110 or 220 volt alternating current

Code word: *Mirage*

b) For **visual observation** and **photomicrography** of the **capillaries of the fingers:**

Microscope with **photographic camera** and **adjustable eyepiece,** on **base** with **centring finger rest, illuminating apparatus** with lead, **objective 8, 6 bulbs in centred caps,** in shipping case, and **adjustable transformer** with accessories for 110 or 220 volt alternating current

Code word: *Miraggio*

Required with a) and b) for examining the **capillaries** of the **surface of the body** and **the lips:**

Wide vulcanite forked base, carrier body with **vulcanite handle,** and **lip rest** with 10 interchangeable glass plates ..... Code word: *Keioz*

c) for **visual observation** and **photomicrography** of the **capillaries of the skin:**

Microscope with **camera** and **adjustable eyepiece,** on **forked base** designed to be placed on body, **illuminating apparatus** with lead, **objective 8, 6 bulbs** in **centred caps,** in shipping case, and **regulating transformer** with accessories for 110 or 220 volt alternating current

Code word: *Keipa*

Required with c) for examining the **capillaries of the lips:**

Lip rest with 10 interchangeable glass plates and **stand,** comprising column on circular base

Code word: *Keirb*

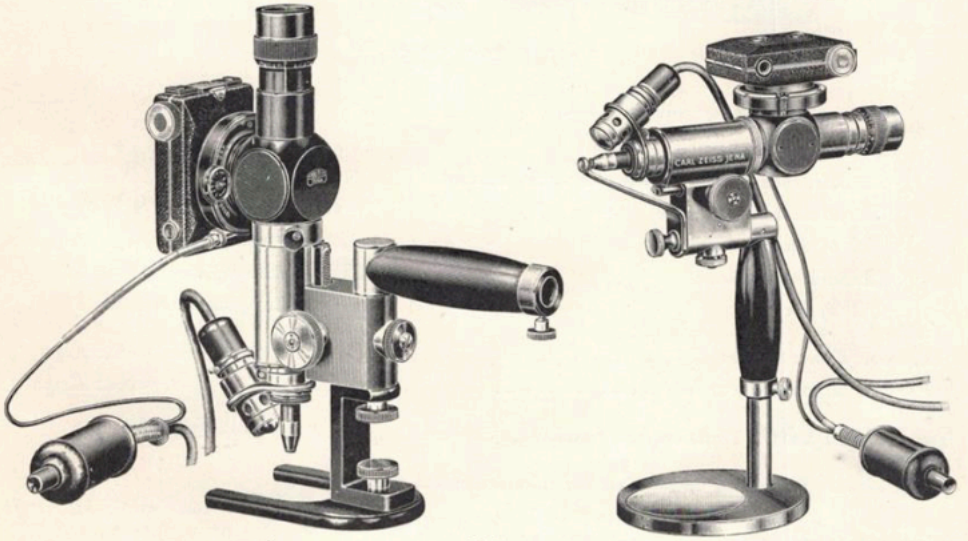
d) For **visual observation** and **photomicrography** of the **capillaries of the lips:**

Microscope with **camera** and **adjustable eyepiece,** on **base** with **handle,** with **illuminating apparatus** and lead, **objective 8, lip rest, 6 bulbs in centred caps,** in shipping case, and **adjustable transformer** with accessories for 110 or 220 volt alternating current.

Code word: *Kejaj*

Required with d) for examining the **capillaries** of the **surface of the body:**

Wide forked vulcanite base and **carrier body** ..... Code word: *Kejen*



c) 22084 d) 22300

Fig. 187 About 1/4 actual size

For detailed description, see "Mikro 479e."

SIEDENTOPF **Cardioid Ultra-Microscope**

Especially suited to the exact study of the ultra-microscopic particles of fine colloidal solutions and to the examination of dilute precipitates and micro-chemical and photo-reactions.

For detailed description, see "Mikro 306e."

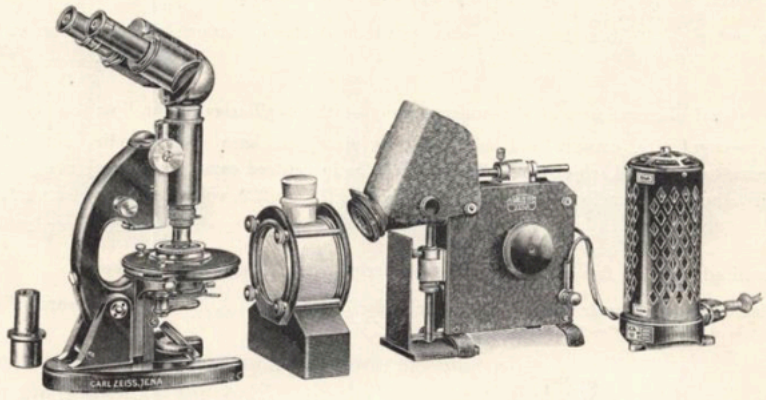


Fig. 188 About 1/4 actual size 13872

We recommend the following set:

Microscope clockwork arc lamp	Two quartz cells
100 pairs carbons for direct or alternating current	Glycerine immersion **60,** N.A. 1.0 (V) with iris diaphragm
Water chamber on base	Adjustable compensating eyepiece, **20**×
Vial of cooling fluid	HUYGENS eyepiece, **4**×
Cardioid condenser	Two auxiliary supports in case
Cell holder	

Set: for direct current ..... Code word: *Kejfo*
for alternating current ..... Code word: *Kejku*

For use with above: **Transformer** or **resistance** for arc lamp listed on page 139.

No. 12 88 53. Perforated cover glass for micro-chemical reactions
Code word: *Midasaffe*

If no microscope is on hand, we recommend
Stand ESA ..... Code word: *Mineriame*
or **Stand ESA bi** ..... Code word: *Kejis*

In ordering, state type and voltage of current.

Microscopes manufactured by R. Winkel G.m.b.H., Göttingen

Dissecting Microscope No. 1

Rectangular stage with interchangeable black, white and transparent glass plates
Magnifiers focused with rack-and-pinion motion
Jointed magnifier arm for examining entire stage surface
Two leather-covered metal hand rests, in case.

a) **With Winkel-Zeiss Optical Equipment:**
7×, 10×, and 22× STEINHEIL magnifiers
Code word: *Wind*

b) **With Zeiss Optical Equipment:**
Code word: *Windab*
8× and 10× aplanatic magnifiers

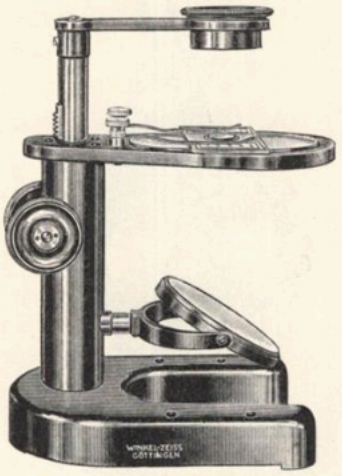


Fig. 189 About 1/4 actual size

Dissecting Microscope No. 2 (Fig. 189)

similar to No. 1, but with rigid magnifier arm and two metal hand rests for attachment to base.

One each Winkel-Zeiss 5× and 7-and-14× non-achromatic magnifier, in case
Code word: *Windablass*

For details, see "Winkel No. 222."

Simple Laboratory Microscope
Microscope ODC

Body inclinable through 90°
Fixed rectangular stage with stage stop
Non-extensible tube, coarse adjustment by rack and pinion
Three-lens objective system S,
factorial magnifications: 5×, 10×, and 15×
6× and 12× HUYGENS eyepieces
Total magnifications: 30×, 66×, 90×; 60×, 132×, and 180×
in polished case
Code word: *Winchingly*

Supplied to order for use with above:

Fine adjustment between tube and objective
Code word: *Wincopipe*

Additional for draw tube: Code word: *Windbeere*

For details, see "Winkel No. 243."

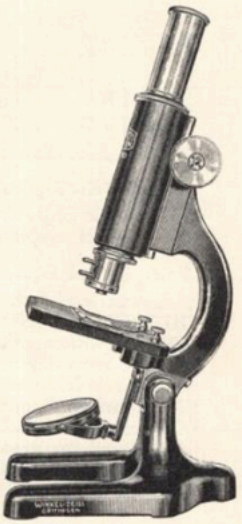


Fig. 190 About 1/4 actual size

Class Microscopes

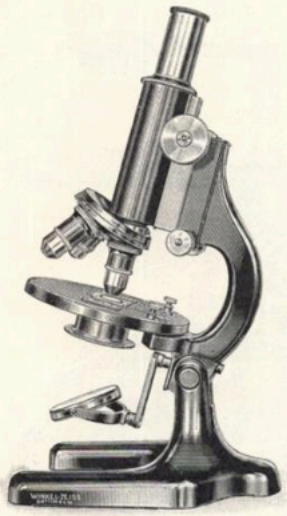


Fig. 191 About 1/4 actual size

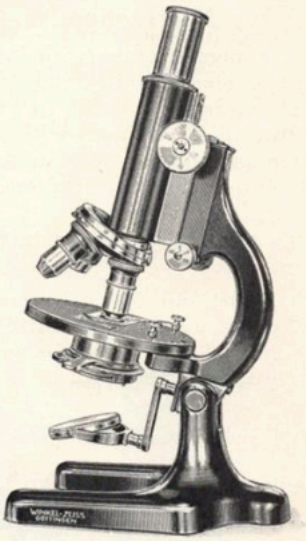


Fig. 192 About 1/4 actual size

Inclinable through 90°, non-extensible tube, fixed circular stage, micrometer screw with heads on both sides, in alder case

Stand I B R
Condenser sliding sleeve, cylinder diaphragm with three stops
Code word: *Woawn*

Stand I E R
Condenser sliding sleeve, adjustable condenser 1.2, with iris diaphragm
Code word: *Woayp*

Upon order, the above stands may be furnished with **fixed rectangular stage:**

Stand I B C ..... Code word: *Woazr*
Stand I E C ..... Code word: *Wobar*

Winkel-Zeiss Optical Equipment: Magnifications: 60× to 504×
Achromatic objectives **10,** N.A. 0.28 **42,** N.A. 0.85
HUYGENS eyepieces, **6**× and **12**× ..... Code word: *Wobdu*

Zeiss Optical Equipment: Magnifications: 40× to 400×
Achromatic objectives **8,** N.A. 0.20 **40,** N.A. 0.65
HUYGENS eyepieces, **5**× and **10**× ..... Code word: *Kejoy*
For use with above:
Double revolving nosepiece ..... Code word: *Winberris*
Triple revolving nosepiece ..... Code word: *Wince*
Iris cylinder diaphragm ..... Code word: *Winced*
Condenser N.A. 1.2, with iris diaphragm ..... Code word: *Wincepit*
Additional for draw tube ..... Code word: *Windbeere*
Simplified attachable mechanical stage with rack-and-pinion motion .. Code word: *Minuebare*
Simplified attachable Object traverser H with hand adjustment ..... Code word: *Wobev*

For detailed description, see "Winkel No. 243."

Microscopes for Diagnostic Purposes

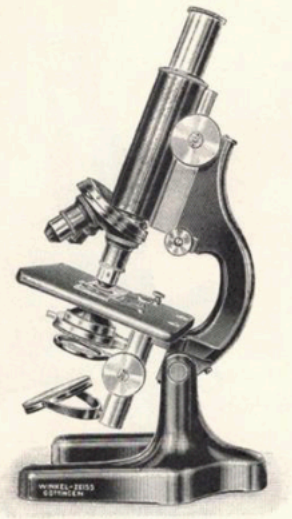


Fig. 193 About 1/4 actual size

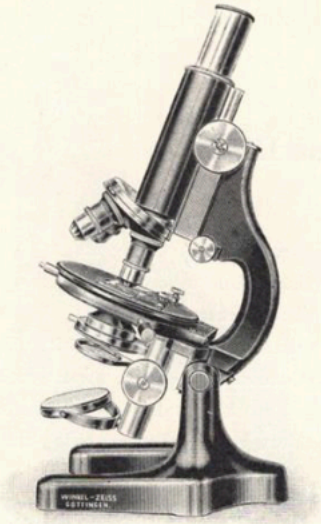


Fig. 194 About 1/4 actual size

Stand G T C
with fixed rectangular stage C
Code word: *Wobiz*

Stand G T A
with simplified mechanical stage A
Code word: *Wobja*

Stand G T B like Fig. 194, but with simplified revolving mechanical stage B
Code word: *Wobne*

Stand inclinable through 90°, non-extensible tube, illuminating apparatus with rack-and-pinion-motion for adjusting condenser, micrometer screw with heads on both sides, one head with circumference divided into 50 graduations, in alder case.

Winkel-Zeiss Optical Equipment Magnifications: 60× to 1080×
Condenser N.A. 1.2, with iris diaphragm Triple revolving nosepiece
Achromatic objectives **10,** N.A. 0.28 **42,** N.A. 0.85
Homogeneous oil immersion **90,** N.A. 1.3
HUYGENS eyepieces, **6**× and **12**× ..... Code word: *Wobof*

Zeiss Optical Equipment: Magnifications: 40× to 900×
Condenser N.A. 1.2, with iris diaphragm Triple revolving nosepiece
Achromatic objectives **8,** N.A. 0.20 **40,** N.A. 0.65
Homogeneous oil immersion **90,** N.A. 1.25 with iris diaphragm (also for dark field illumination)
HUYGENS eyepieces, **5**× and **10**× ..... Code word: *Kejra*

For use with above:
Attachable mechanical stage with scales, in case (p. 105) ..... Code word: *Migrateur*
or simplified mechanical stage ..... Code word: *Minuebare*
Winkel 12× compensating eyepiece (1080× magnification with oil immersion) ..... Code word: *Winching*
Additional for draw tube ..... Code word: *Windbeere*

For detailed description, see "Winkel 242."

CARL ZEISS JENA

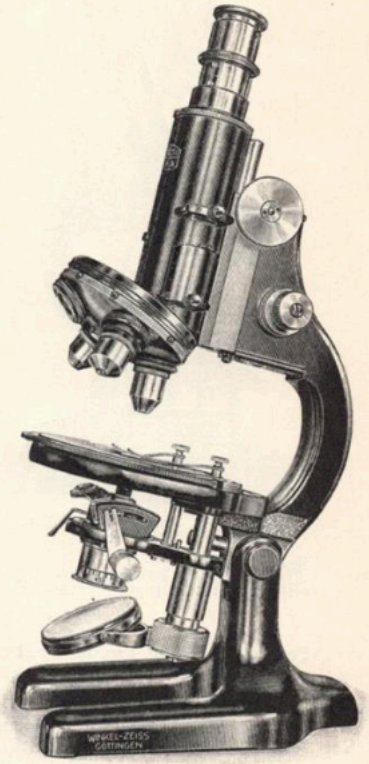
Mineralogical Class and Routine Microscope II M

Stand II M

Graduated revolving stage
Extensible tube, keyed to prevent rotation
Telan lenses
Illuminating apparatus with side screw
Condenser N.A. 1.2, upper lens arranged for being swung out by lever mechanism
Revolvable polarizer; swing-out analyser
Amici-Bertrand lens
Centring quadruple revolving nosepiece
in mahogany case

Accessories:

Quartz wedge, first to third order inclusive, in metal mount; gypsum plate, red first order, in metal mount; mica plate, $^1/_4$ w. l., in metal mount



Code word: *Wobsi*

Fig. 194 About $^1/_3$ actual size

Optical Equipments

a) for **Mineralogical Work** Magnifications: 15× to 504×
Achromatic objectives 2.5 M **(3)** 10 M **(13)**, N.A. 0.35
23 M **(30)**, N.A. 0.60 42 M **(54)**, N.A. 0.86
HUYGENS eyepieces **6**×, with cross lines; **9**× with micrometer
12×, with cross lines ..... Code word: *Wobuk*

b) **For Micro-chemical Work** Magnifications: 39× to 131×
Achromatic objectives 4.3 M **(5.5)**, N.A. 0.22; 7.3 **(10)**, N.A. 0.28
HUYGENS eyepieces **9**× with cross lines; **18**× ..... Code word: *Wobyo*

Additional for **Ahrens' Prism** with straight end surfaces, to serve as polarizer in place of the Nicol ..... Code word: *Wocap*

Mineralogical Routine Microscope IV M

Stand IV M

Inclinable through 90°
Large graduated revolving stage
Vernier and orienting scales
Revolving nosepiece with centring fittings
Draw tube secured against rotation, with rack-and-pinion motion and millimetre scale
Optical system rendered telecentric by permanently mounted correction lenses
Illuminating apparatus with side screw
Condenser N.A. 1.2
in mahogany case

Accessories:

Quartz-wedge, first to third orders, in metal mount. Gypsum plate, red first order, in metal mount. Mica plate, $^1/_4$ w. l., in metal mount

Code word: *Woceu*

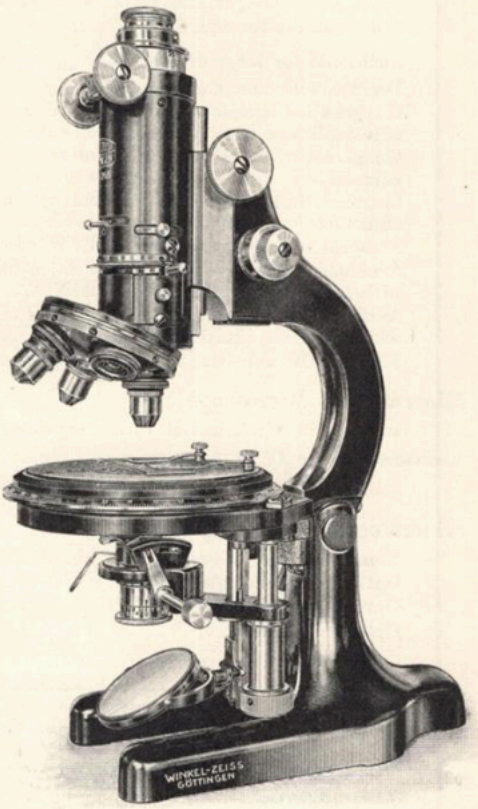


Fig. 196 About $^1/_3$ actual size

Optical Equipment Magnifications: 15× to 824×

Achromatic objective 2.5 M (**3**) 10 M (**13**), N.A. 0.35 23 M (**30**), N.A. 0.60 42 M, (**54**), N.A. 0.86
Oil immersion 69 M (**88**), N.A. 1.30
HUYGENS eyepieces **6**×, with cross lines; 9×, with micrometer; **12**×, with cross lines

Code word: *Wocka*

The iris diaphragm of the illuminating apparatus operates as an aperture stop with orthoscopic path of light, and as a field stop with conoscopic path of light. The upper lens can be swung aside. A dark field condenser may be used. Draw tube with rack-and-pinion motion. Iris and slit diaphragms above Bertrand lens. N.A. 1.2 illuminating apparatus replaceable by large N.A. 1.4 illuminating apparatus of Stand VI M. Polarizer in the shape of a revolvable Ahrens prism with straight end surfaces, marked at 15-degree intervals. Tube analyser, extensible and rotatable through 90°.

Additional for large illuminating apparatus of Stand VI M ..... Code word: *Windarm*

For use with above:

Huygens **6**× eyepiece, with enlarged field of view, cross lines, and adjustable eye lens ..... Code word: *Wocoe*
Complanatic 9× eyepiece with enlarged field of view, cross lines, and adjustable eye lens ..... Code word: *Wocti*
Complanatic 12× eyepiece with enlarged field of view, cross lines, and adjustable eye lens ..... Code word: *Wocuj*
Attachable mechanical stage M R, in case ..... Code word: *Windbal*
Arrangement for synchronizing rotation of Nicols, for stands equipped with large illuminating apparatus N.A. 1.4 ..... Code word: *Windbalg*
Arrangement for synchronizing rotation of Nicols, for standse quipped with small illuminating apparatus ..... Code word: *Wocyn*
FEDOROW universal revolving stage ..... Code word: *Windballen*

Mineralogical Microscope V M

same as in Fig. 196, but with compound stage with 15 mm. range of movement.

Accessories as for IV M ..... Code word: *Windberry*

For details, see "Winkel No. 253."

Mineralogical Microscope VI M

Stand VI M ..... Code word: *Windband*
Optical equipment a) ..... Code word: *Windbarrow*
or Optical equipment b) ..... Code word: *Windbauch*
or Optical equipment c) ..... Code word: *Windbaum*

see "Winkel No. 254."

The following folders describing the mineralogical Stands and accessories manufactured by the **R. Winkel G. m. b. H., of Göttingen,** will be gladly sent upon request:

Class Microscope K M	Winkel	List	No.	258
Ore Microscope E M	„	„	„	259
Universal Laboratory Microscope, Stand U	„	„	„	202
Simple Stands I M to III M	„	„	„	252
Medium Stands IV M and V M	„	„	„	253
Large Stand VI with Synchronous Motion	„	„	„	254
Accessories and Auxiliaries for Mineralogical Microscopes	„	„	„	255
Optical Equipment for Mineralogical Microscopes	„	„	„	256
General Information about Mineralogical-Petrographical Microscopes	„	„	„	257
Microtomes and Honing Machines	„	„	„	251
Automatic Honing Machine	„	„	„	205
Honing Devices	„	„	„	204

ALPHABETICAL INDEX

Page

ABBE diffraction apparatus 129
illuminating apparatus 19, 36
test plate 52
Accessories, miscellaneous 129
Achromatic Objectives, see **Objectives**
Ahrens prism 148
Analyser, analysers
for polarizing tube 39, 120, 121
prism 121
Angular magnitude 11
Apertometer 53
Aperture
determining 53
numerical 11, 53
stop 11
Apochromatic objectives, see **Objectives**
Apparent magnitude 11
Aquarium microscopes 73
Azimuth diaphragm 98

BELL COVERS 134
Binocular Stand Magnifier ..... 80 to 82
eyepieces for 82
magnifications, etc. 82
objectives for 82
Bitukni eyepiece attachment 127, 128
Bright-field obervation, accessories for, 90 to 96
Business terms 3

CALIBRATING STANDARDS
Camera, cameras
Lucida 109
attachments 126
Contax, adapter for 126
Phoku 126
spectroscopic 123
Capacity of objectives 51
Capillary microscopes 141, 142
Cedarwood oil 55
Centring devices 96, 107
Changing devices 12, 107, 108
Class microscopes 21
Comparison eyepieces 125
Compensating eyepieces 51, 62, 63
Condenser, condensers
achromatic 94
for aqueous objects 100
aplanatic 93
cardioid 97
correction lens for 94
slide fitting for 98
change-over 99
Z, on slide 99
dark-field ..... 55, 90, 97 to 100
dissecting 99
Epi 91, 102
for general work 97
for observation in hanging drop 99

Page

luminous spot ring 55, 97
photographic 97
polarizing 120
slide fitting for 96
quartz 96
for smear preparations 100
special 32
swing-out 95
three-lens 92
for tissue cultures 99
two-lens 92
Z-slide 32
Contax camera, adapter for 126
Contrast micrometers 112, 113
Correction mounts 16, 54
lens 96
Counting chamber, chambers 116
for bright-field and dark-field observation 117
double 118
quadruple 118
rulings 117
single 117
uses of 116
Counting devices 115
Counting eyepieces 115
Counting particles in dry preparations 115
in liquid preparations 116
Cover glass, cover glasses
effect of incorrect thickness 16, 51
neutralizing 16
gauge 16, 54
for haemacytometers 116
perforated 144
test plate for 16
thickness 16, 51, 53
Covers, bell 134
Cross line eyepieces 124
Curvature of image field 52
Cylinder diaphragm 91
iris 91
Z 91

DARK-FIELD
accessories ..... 90, 97 to 100
condensers 55
illumination 91
lamps 136
objectives 55
work 55
Dermatoscope 71, 72
Double eyepiece 124
Double tube XII 81
Diaphragm 10
azimuth 98
carrier 31
Diffraction apparatus 12
Abbe 129

Page

Diffraction plate 129
Dissecting condensers 99
Dissecting instruments 49, 135
Dissecting microscopes ..... 65 to 82
Dissecting stages 75
Mayer 89
Dissecting stands 88, 89
Distance, free object 10
Distance, interpupillary, with tube X 70
Distance of normal vision 11
Double tube X 65, 67, 72
Draw tube 13
Drawing apparatus ..... 109 to 111
Abbe 109
and Bernhardt drawing table 111
for dissecting stand 88
Drawing board, slanting 109
Drawing prism 109
simplified 110
Drawing tables 110
Draw tube 13, 38
with clamping device 38

EFFECTIVE MAGNIFICATION 12, 53
English Standard thread 12, 50
Epi-condensers 91, 102
Epi lamps 101
Epi-mirror 102
Epi bar 43
Eyeguard, binocular 130
Eye lens 10
Eyepiece, eyepieces 14, 50
adjustable 112, 124
attachments, inclined 127
comparison 125
compensating 51, 52, 63
counting 115
cross line 124
disk 124
diaphragm 10
double 124
with enlarged field of view 70
field of view number of 64
for flat image 64
goniometer 114
Homal 64
Huygens 62, 63
Kolibri Phoku 126
micrometers ..... 111 to 113
screw 113
and objectives 10
orthoscopic 62
paired, for Binocular Stand Magnifier XII 63
for tube X 69
Phoku 125, 126
photographic 125
pointer 124
special 62, 64
spectroscopic 123
stops 115
tube XII, for 82
Exit pupil and image 12

Page

FIELD LENS 10
Field diaphragm 11
Field of view number 64
Field, diameter of 114
Filter holder 95
Flat objects, flat image of 52, 62, 64
Fluorite objectives 51, 52, 58, 60
Finder, Maltwood 131
Free working distance 10, 56, 60
table, for tube X 70
Focus, depth of 12
Focusing magnifiers 84
Focusing motion 14

GENERAL INFORMATION 7
Glycerine immersions 57
Goniometer eyepiece 114
Greenough microscope 65
prism rotator 77
Gypsum plates 120, 121
holders for 121

HAEMACYTOMETERS ..... 116 to 118
Bürker 119
cover glasses for 116
measuring pipettes for 119
mixing pipettes for 119
mixing vessels for 119
Hanging drop, condensers for 99
Heller object holder 77
Homogeneous oil immersions ..... 57 to 61
Homal eyepieces 64
Huygens eyepieces 62, 63

ILLUMINATING APPARATUS
Abbe 19, 36
slideway for 32
Illuminating attachments ..... 90 to 102
Image 12
and exit pupil flat, of flat objects . 52, 62, 64
real 10
virtual 10
Immersion lenses, oil 54
water 55
Immersion medium, refractive index of ... 11
Inclined eyepiece attachments 127

KOLIBRI PHOKU 126

LAMP, EPI 101
Lamps, microscope, see **Microscope Lamps**
Luminous spot ring condenser 55, 97

MAGNIFICATION, MAGNIFICATIONS 51
altering, allowance for 64
determining 114
effective or useful 12, 53
low, binocular vision at 80
minimum 53
with screw micrometers 113
table of, for tube X 70
total 64

Page

Magnifier, magnifiers
anastigmatic 83
aplanatic 84
list of 86
textile 85, 86
Binocular Stand ..... 80 to 82
dissecting stand 83, 85
focusing 84, 86
folding 83, 84, 86
free aperture of 83
for general survey 84
illuminating 85, 86
jointed arm for 89
with lens ring and handle 85
magnification of 83
measuring 85, 86
pipette reading 86
power of 83
in ring mount 85
stands ..... 87 to 89
survey 85, 86
thread counter 85, 86
Maltwood finder 131
Marker, object 132
Measuring devices ..... 111 to 114
angle 114
Measuring pipettes 119
Mechanical tube length 13, 53
Metallographic microscopes 47, 48
Meyer slow motion 15
Mica plates 120, 121
Micromanipulator 133, 134
Micrometer eyepieces 111, 112
Micrometer, micrometers ..... 111 to 113
adjustable 112
calibrating 114
contrast 112, 113
squared 115
determining absolute values of 111, 113
scale 112
scale on plate glass 114
screw 113
magnification with 113
stage 114
Microscope, microscopes
adjustment, fine 15
aquarium 73
binocular ..... 26, 41, 65 to 82
binocular, dissecting 89
for biological work 34
capillary 141
and skin 142
choice of 7
class 146
completely equipped 18
diagnostic 147
dissecting ..... 65 to 82
double tube X 65
general information on 65
Greenough 65
implements for 49
laboratory 145

Page

lamps and accessories ..... 136 to 140
arc 138
clockwork arc 139
dark-field 136
filament ..... 136 to 138
low voltage 137
spot arc 140
large, with interchangeable tubes 33
and centring slide condenser 35
for large objects 73
metallographic 47, 48
mineralogical 148, 150
monocular 68
path of light through 8
plate culture 79
polarizing 34
research 24, 25, 29, 45, 46
routine 22, 23, 24, 28, 44
section through 13
stereoscopic ..... 65 to 82
training and class 21
traveling 49
tube 12
length 12
tube change 42
with wide tube 37
Winkel ..... 145 to 150
list of folders 150
Micro-spectroscopic apparatus 122
Mineralogical microscopes 148, 150
Mipu Micromanipulator 133
Mixing pipettes 119
Mixing vessels 119
Mobimi paired eyepieces 63, 64
Mohl set of gypsum and mica plates 121
holders for 121
Moist chambers 132
Monobromnaphtalene immersion objectives 61
Monokni inclined eyepiece attachment 126, 127, 128

NOSEPIECE, NOSEPIECES
revolving 108
triple, for tube X 67
Numerical aperture 11
and magnification 53

OBJECT DISTANCE, free 10
Object holder 77
Object marker 132
Object slides 9, 132
Objective, objectives 14
achromatic 51, 56, 60, 62
apochromatic 51, 59, 61
section through 13
capacity of 51
centring devices 96, 107
changers, sliding 108
large 108
changing 12, 107, 108
cleaning 50

Page
correction for cover glass thickness 16
with correction mounts 50
dark-field 55
dry series ..... 56, 58 to 60
and eyepiece 10
fluorite 51, 52, 58, 60
glycerine immersion 57
homogeneous oil immersion ..... 57 to 61
immersion 97
intermediate collar for 60, 61
legends on 16
M 62
monobromnaphtalene immersion 61
mounts 50
paired 69
in short mounts 60
slide fittings 108
special 52, 56, 61
threads on 12, 50
for tube XII 82
types of 51
water immersion 57, 59, 61
guard sleeve for 57
glass vessel for 57
Observation
of aqueous objects, condensers for 100
bright-field, accessories for ..... 90 to 96
dark-field 55
accessories for ..... 90, 97 to 100
general 97
condensers for 100
in hanging drop, condensers for 99
in incident light 101, 102
of opaque objects 91
in polarized light 19
stereoscopic 32
of tissue cultures, condensers for 99
Oil, cedarwood 55
Oil immersion lenses 54
Oil testing device 54
Opaque objects, observation of 91
Orthoscopic eyepieces 62

PAIRED EYEPIECES, Mobimi 63, 64
Penetration, power of 12
Phoku attachment camera 38, 43
eyepiece 125, 126
Kolibri 126
Photographic eyepieces 125
Photography, instantaneous 97
Photomicrographic stage 30, 107
tube 38, 39
Pipettes 119
Pipette reading magnifiers 86
Plate culture microscope 79
Pointer eyepiece 124
Polarizers 120
analysers for 120
Polarized light, observation in 19
stages for 104
Polarizing tube 32, 38, 49
attachments 120

Page
condenser 120
microscopes 34
sets, complete 122
Prism rotator 77
body 81
illuminating attachments for 81

QUARTZ CONDENSER 96

RAMSDEN CIRCLE 12
Real image 10
Refractive index 11
Resolving power 12
Revolvers, objective 108

SCALE Micrometers 112
Screw micrometers 113
Slides, object 9, 132
Slideway for illuminating apparatus 32
Slow motion, geared 15
in tilting axis 27, 39
Smear preparations, condensers for 100
Spectroscopic apparatus 122
eyepiece 123
Stage, stages
attachable mechanical 105
centring pieces for 106
general information on 103
heatable 130, 131
electric 131
large mechanical 30, 106, 107
micrometers 114
with graduated rim 106
and object 9
photomicrographic 30, 107
for polarized light 104
rectangular mechanical 30, 105
replacing 103
revolving 104
with graduated rim 104
revolving and centring vulcanite 106
simplified 105
simplified mechanical 104
types of 103
vulcanite 30, 106
Staining trough 135
Stand, stands
accessories for ..... 76 to 78
base plate for 78
basic forms of 18
for binocular microscopes 66
Dermatoscope 71, 72
design of 17
dissecting 88, 89
E ..... 18 to 26
F 30, 32
G 30, 36
H ..... 38 to 42
with inclined binocular tube 20
L ..... 43 to 46
large 30, 38, 47, 48
magnifier ..... 87 to 89

Page

medium 18, 27
S 47, 48
U 27
X ..... 65 to 82
adapter for 74
stage plates for 78
standard for 78
Stereoscopic observation 32
camera 75
enlarging attachment for 75
side microscope tube for 75
microscopes ..... 65 to 82
stop 95
Stops, eyepiece 115
Süffert base plate 78
Swing-out condensers 95

TELLUP 123
Test plate for cover glasses 16, 52
Thermo-regulator 130
Tissue cultures, condensers for 99
Tracing prism on slide 110
Traveling microscope 49
Tube, tubes
double X 65, 67, 72
draw 13
length 13, 53
of microscope 12
monocular, for stand X 68
paired objectives and eyepieces for 69
slides 108
X, adapter for 74

USEFUL MAGNIFICATION 12

VERTICAL ILLUMINATORS 91, 101
Virtual image 10

WATER CHAMBER
for microscope lamps 140
cooling liquid for 140
Water immersion lenses 55
Water immersion objectives 57, 59, 61
Winkel microscopes ..... 145 to 150
list of folders 150
Working distance, free 10, 56, 60
Working distances, table of, for double tube X 70

Z ILLUMINATING APPARATUS 36
Zeissler plate culture microscope 79

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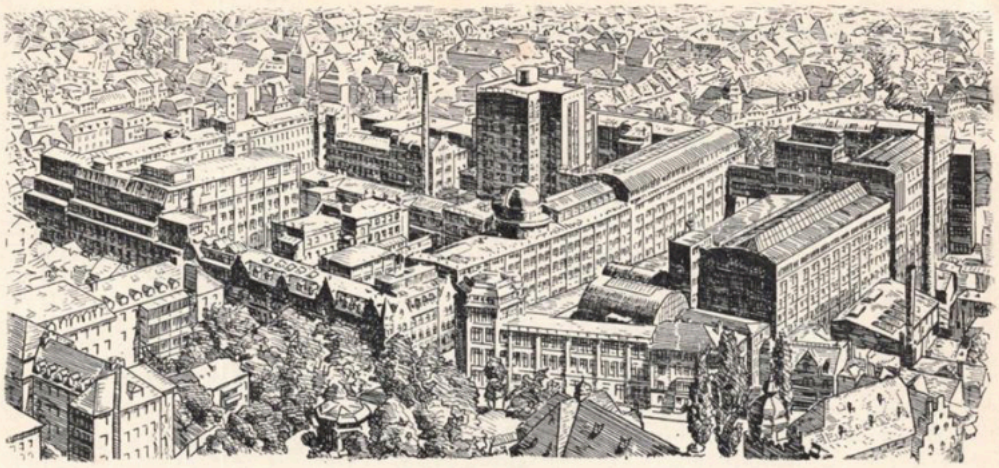
INDEX OF ORDER NUMBERS

Order No.	Page
11 01 06 to 11 02 10	59
11 03 10 to 11 03 93	61
11 10 01 to 11 10 40	56
11 10 48 to 11 10 99	58
11 11 07	57
11 11 08 to 11 11 40	56
11 11 47 to 11 11 60	57
11 12 03 to 11 12 99	60
11 21 02 to 11 21 12	69
11 21 16 to 11 21 18	82
11 21 90	96
11 30 05 to 11 30 22	55
11 31 03 to 11 31 30	63
11 31 38 to 11 31 41	63
11 33 07 to 11 33 20	112
11 35 04 to 11 35 28	62
11 35 37 to 11 35 40	63
11 35 44 to 11 35 47	69
11 35 48	82
11 35 50 to 11 35 52	69
11 35 53	82
11 35 55 to 11 35 58	69
11 36 07 to 11 36 28	102
11 36 15	62
11 41 00 to 11 41 08	94
11 41 20 to 11 41 24	92
11 41 27 to 11 41 38	95
11 41 30 to 11 41 34	92
11 41 40 to 11 41 47	93
11 42 24 to 11 42 32	94
11 42 41	96
11 42 50 to 11 42 52	96
11 43 20 to 11 43 30	92
11 43 40	93
11 43 93	94
11 45 15 to 11 45 24	99
11 45 32	98
11 45 37 to 11 45 40	100
11 45 43 to 11 45 45	98
11 46 05	102
11 46 06	101
11 46 10	102
11 46 25	101
11 51 00 to 11 51 31	113
11 51 65 to 11 51 80	115
11 51 90	124
11 53 01	112
11 53 04	124
11 53 10 to 11 53 11	112
11 53 14	124
11 53 21 to 11 53 31	112
11 55 60 to 11 55 72	113
11 58 04	124
11 59 05	115
11 60 20 to 11 60 42	83

Order No.	Page
12 01 10	90
12 01 32	95
12 01 65	54
12 04 10 to 12 04 50	101
12 04 55	60
12 06 34 to 12 06 44	104
12 06 64 to 12 06 75	106
12 06 80	107
12 06 84 to 12 06 89	106
12 06 90	107
12 07 04	105
12 07 11 to 12 07 12	plate 7
12 08 04	49
12 08 05 to 12 08 08	105
12 08 66	131
12 12 01	67
12 12 04 to 12 12 24	108
12 12 71 to 12 12 74	plate 5
12 14 13 to 12 14 18	108
12 14 25	32
12 23 47 to 12 23 58	plate 6
12 28 05 to 12 29 11	plate 3
12 29 26 to 12 29 58	plate 4
12 30 05 to 12 30 08	plate 3
12 31 18	plate 3
12 31 90	130
12 32 05 to 12 33 09	plate 1
12 38 10	95
12 38 34 to 12 38 78	plate 5
12 39 02 to 12 39 18	plate 2
12 40 41 to 12 40 43	49
12 40 44 to 12 40 90	49
12 45 20	141
12 51 03 to 12 51 05	67
12 51 07 to 12 51 11	76
12 51 16	82
12 51 21 to 12 51 31	68
12 51 51 to 12 51 66	75
12 51 70	81
12 51 73/5	68
12 51 77 to 12 51 95	plate 7
12 52 00 to 12 52 08	72
12 52 21	73
12 52 22	74
12 52 24	75
12 52 25	73
12 52 27	74
12 52 28	78
12 52 40 to 12 52 41	75
12 52 50 to 12 52 54	72
12 52 55	77
12 52 56	72
12 52 58	77
12 52 65	78
12 52 86	79
12 54 04 to 12 54 15	88
12 55 85	114
12 58 01 to 12 58 11	87
12 58 13	88
12 60 00 to 12 60 21	109
12 60 22 to 12 60 26	110
12 60 50	111
12 60 65	110
12 63 00 to 12 64 54	114
12 65 01	54
12 66 60 to 12 66 83	117
12 66 85 to 12 66 89	118
12 67 70 to 12 67 75	117
12 69 20 to 12 69 34	118
12 69 90	119
12 70 00 to 12 70 04	117
12 70 20 to 12 70 24	118

Order No.	Page
12 73 00 to 12 73 50	119
12 73 29	86
12 76 07	53
12 76 10	52
12 76 20 to 12 76 21	129
12 78 01 to 12 78 08	120
12 80 21 to 12 80 23	121
12 80 51 to 12 80 54	122
12 80 58 to 12 80 70	121
12 81 02	122
12 81 30 to 12 81 35	123
12 83 20 to 12 83 31	130
12 85 05	124
12 85 07	125
12 85 21 to 12 85 23	128
12 85 24	129
12 85 29	128
12 85 30	125
12 85 72 to 12 85 90	126
12 86 12 to 12 86 18	plate 3
12 86 25 to 12 86 27	plate 5
12 87 02	77
12 87 20	57
12 87 24 to 12 87 36	133
12 87 45 to 12 87 48	134
12 88 53	144
12 92 11	107
12 92 14	plate 5
12 92 20	131
12 92 30 to 12 92 41	132
12 96 26 to 12 96 29	134
12 97 09 to 12 97 52	135
12 97 71 to 12 97 85	132
12 98 12 to 12 99 08	135
13 41 10 to 13 41 16	140
13 90 60	141
13 90 76	82
13 90 81 to 13 90 84	76
13 93 11 to 13 93 23	136
13 93 32 to 13 93 33	139
13 93 35	138
13 93 37 to 13 93 38	139
13 93 53	137
13 93 54	138
13 93 62 to 13 93 75	140
13 93 82 to 13 93 86	137
13 95 11 to 13 95 72	138
13 95 62 to 13 95 63	76
13 95 69	82
13 95 80 to 13 95 81	141
13 96 01	82
13 96 03 to 13 96 51	138
13 98 20 to 13 98 21	139



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Page of catalogue	Item or designation	Code word	£ s. d.
21	Stand EB	Minervalem	13 13 0
	Optics 102	Kaufa	8 7 0
	EB 102	Kaoss	22 0 0
	12 08 06	Minuebare	4 6 6
	12 12 05	Miluam	1 10 0
	11 35 10	Migliarina	12 0
22	Stand ESA	Mineriame	16 14 0
	Optics 116	Kauid	19 7 0
	ESA 116	Minervina	36 1 0
	11 35 10	Migliarina	12 0
23	Stand ESC	Mineriari	16 0 0
	Optics 117	Kauje	21 10 6
	ESC 117	Kauni	37 10 6
	12 08 06	Minuebare	4 6 6
24	Stand ESG	Kavau	30 0 0
	Optics 152	Kavey	66 8 0
	ESG 152	Kaooo	96 8 0
25	Stand ECE	Minoraber	37 8 0
	Optics 330	Kavga	30 13 0
	ECE 330	Kakko	68 1 0
26	Stand ESC bi	Kaklp	35 5 0
	Optics 218	Kavic	26 16 0
	12 08 06	Minuebare	4 6 6
	ESC bi 218	Kavke	66 7 6
28	Stand UTC	Karnl	28 8 0
	Optics 317	Kavoi	20 10 6
	UTC 317	Kavun	48 18 6
	12 08 06	Minuebare	4 6 6
29	Stand UCG bi	Karek	61 3 0
	Optics 631	Kavvo	40 7 0
	UCG bi 631	Katup	101 10 0
31	additional	Kavys	2 17 0
32	12 14 25	Miniemur	2 1 0
33	Stand FCD	Kawha	44 0 0
	Optics 654	Kawib	73 8 6
	FCD 654	Minimato	117 8 6
34	Stand FCE	Kawle	63 3 0
	Optics 591	Kawoh	48 5 0
	FCE 591	Kawpi	111 8 0
	binocular tube and 3 eyepieces	Kawsk	13 3 0
35	Stand FZE	Kawum	53 16 0
	Optics 592	Kawwo	166 17 6
	FZE 592	Minimava	220 13 6
36	additional	Kawyr	3 8 0
37	Stand GCE	Minguado	37 16 0
	Optics 355	Kaxas	83 5 0
	GCE 355	Minimis	121 1 0

Page of catalogue	Item or designation	Code word	£ s. d.
40	Stand HCD	Kabiw	46 1 0
	Optics 331	Kaxcu	36 14 6
	HCD 331	Kaxew	82 15 6
41	Stand HCG bi	Kaxgy	72 15 0
	Optics 659	Kaxia	98 11 6
	HCG bi 659	Kaxme	171 6 6
42	Stand HZE	Kaxog	83 4 0
	Optics 593	Kaxri	112 14 6
	HZE 593	Kaxul	195 18 6
44	Stand LTD	Kaxxo	36 14 0
	Optics 319 L	Kaxyp	26 3 0
	LTD 319 L	Kaobb	62 17 0
45	Stand LCG	Kayar	61 14 0
	Optics 636 L	Kaybs	45 18 0
	LCG 636 L	Kayct	107 12 0
46	Stand LZE	Kaydu	67 6 0
	Optics 857 L	Kayev	77 1 0
	LZE 857 L	Kayiz	144 7 0
48	Stand SCE	Mintiras	65 5 0
	Optics 590	Kaymd	98 11 0
	SCE 590	Minimose	163 16 0
49	Travelling Stand Optics	Minotto	27 12 0
		Kayof	19 1 6
	Travelling Microscope with optics	Kayne	46 13 6
	12 08 04	Minx	4 4 0
	12 40 90	Micabam	1 0 6

Stands E with non-extensible tubes

Plate 1 / Page 1	12 32 05 EB	Minervalem	13 13 0
	12 32 06 EBA	Minervalor	14 18 0
	12 32 07 EBB	Minervalyt	16 0 0
	12 32 08 EBC	Minerval	14 4 0
	12 32 09 EBG	Minervalus	24 16 0
Page 2	12 33 05 ES	Mineria	15 9 0
	12 33 06 ESA	Mineriame	16 14 0
	12 33 07 ESB	Minerianno	17 17 0
	12 33 08 ESC	Mineriari	16 0 0
	12 33 09 ESG	Mineriasu	26 12 0
	additional for extensible tube	Minervalia	11 6
	12 32 04 extensible tube	Minerviulo	1 0 6

Stands E with extensible tubes

Page 3	12 32 16 ECA	Minora	25 14 0
	12 32 21 ECB	Minoterie	26 16 0
	12 32 20 ECC	Minorato	25 0 0
	12 32 19 ECG	Minorabis	35 11 0
	12 32 17 ECD	Minoraba	26 16 0
	12 32 18 ECE	Minoraber	37 8 0
	12 32 03	Minotier	7 6

Page of catalogue	Item or designation	Code word	£	s.	d.
Plate 2	**Stands U with extensible tubes**				
Page 1	12 39 11 UT	Karki	27	17	0
	12 39 12 UTA	Karmk	30	5	0
	12 39 13 UTB	Kaysi	31	7	0
	12 39 14 UTC	Karnl	28	8	0
	12 39 18 UTG	Karsp	39	0	0
Page 2	12 39 02 UCA	Karwu	34	4	0
	12 39 03 UCB	Kayuk	35	7	0
	12 39 04 UCC	Karyw	32	8	0
	12 39 08 UCG	Kasda	42	19	0
	12 39 05 UCD	Kasax	35	9	0
	12 39 06 UCE	Kasby	46	1	0
Plate 3	**Stands F *without* tubes**				
Page 1	12 29 05 FCD	Miniatis	33	6	0
	12 29 06 FCE	Miniatius	40	2	0
	12 29 07 FCF	Miniatom	40	19	0
	12 29 08 FCG	Kazap	37	16	0
	12 29 10 binoc. tube	Miniatore	9	10	0
	12 29 11 monoc.tube	Miniatorum	2	6	0
	12 31 18 Polarizing tube	Minuisca	15	6	0
Page 2	12 28 05 FZD	Miniatote	34	1	0
	12 28 06 FZE	Miniatrice	41	19	0
	12 28 08 FZG	Kazeu	39	13	0
	12 29 10 binoc. tube	Miniatore	9	10	0
	12 29 11 monoc.tube	Miniatorum	2	6	0
	12 86 12 Inclined binoc. tube	Kazka	21	12	0
	12 31 18 Polarizing tube	Minuisca	15	16	0
	Stands G				
Page 3	12 30 05 GCD	Mingua	31	0	0
	12 30 06 GCE	Minguado	37	16	0
	12 30 07 GCF	Mingrana	38	13	0
	12 30 08 GCG	Minot	35	10	0
Plate 4	**Stands H *without* tubes**				
Page 1	12 29 15 HCD	Kecev	42	19	0
	12 29 16 HCE	Kechy	53	11	0
	12 29 17 HCF	Keciz	54	13	0
	12 29 18 HCG	Kecja	50	9	0
Page 2	12 29 95 HZD	Kazoe	45	9	0
	12 29 96 HZE	Kazti	56	1	0
	12 29 98 HZG	Kazuj	52	19	0
	12 29 28 monoc.tube	Kazyn	3	1	6
	12 86 18 Inclined monoc.tube	Kazzo	7	5	6
	12 86 12 Inclined binoc. tube	Kecdu	21	12	0
	12 29 26 Polarizing tube	Kacly	20	9	0
Plate 5	**Stands L *without* upper tube and nosepiece slide**				
Page 1	12 38 64 LTC	Kewif	30	18	0
	12 38 65 LTD	Kalxa	35	15	0
	12 38 66 LTE	Kalyp	44	11	0
	12 38 67 LTF	Kamac	45	14	0
	12 38 68 LTG	Kamce	41	10	0
Page 2	12 38 55 LCD	Kameg	37	19	0
	12 38 56 LCE	Kamgi	48	11	0
	12 38 57 LCF	Kamik	49	13	0
	12 38 58 LCG	Kammo	45	9	0
	12 38 75 LZD	Kamor	40	9	0
	12 38 76 LZE	Kamsu	51	1	0
	12 38 78 LZG	Kanab	47	19	0
Page 3	12 86 25 Inclined monoc.tube	Kalos	2	14	6
	12 86 27 Inclined binoc. tube	Kalnr	16	5	0
	12 38 34 monoc.tube	Kabbo		18	0
	12 12 71 Quadruple eyepiece revolver	Kabgu	7	19	0
	12 12 73 Triple revolv. nosepiece on slide	Kalru	3	8	0
	12 12 74 Quadr.revolv. nosepiece on slide	Kalux	3	12	6
	12 92 14 Centr. slide	Kalvy	3	3	6
Plate 6	**Stands S with extensible tubes**				
Page 1	12 23 56 SCD	Minting	54	13	0
	12 23 57 SCE	Mintiras	65	5	0
	12 23 58 SCF	Mintirer	66	7	0
	12 85 21 Bitukni I	Mirabunta	19	4	0
Page 2	**Optical outfits**				
	101	Kecne	6	15	6
	103	Kecof	10	18	6
	104	Kecsi	12	3	6
	115	Kecuk	22	13	6
Page 3	318	Kasol	22	3	0
	618	Kasso	25	16	0
	133	Kecyo	39	1	0
	333	Kedap	38	10	0
	353	Kasur	66	8	0
	653	Kasyv	72	19	6
Page 4	356	Kataw	114	2	6
52	12 76 10	Michauxie	1	7	6
53	12 76 07	Mimadoa	12	5	0
54	12 65 01	Middeling	3	1	6
	12 01 65	Minaretol		3	6
55	11 30 05	Miabais		2	9
	11 30 15	Milicia		1	0
	11 30 22	Kagir		8	0
56	**Achromatic objectives** Dry series				
	1—1,5 | 11 10 01	Migabamos	2	4	6
	1,5—2 | 11 10 02	Migado	1	16	0
	1,2—2,4 | 11 10 04	Migajaria	5	7	6
	2 | 11 10 08	Mingote	1	8	6
	3 | 11 10 03	Migaja	1	7	0
	5 | 11 10 05	Migajada	1	7	0
	6/0,17 | 11 10 06	Migajaron	2	9	0
	8/0,20 | 11 11 08	Mileon	1	16	6
	10/0,30 | 11 11 10	Migalha	3	12	6
	20/0,40 | 11 11 20	Migalhada	3	17	0
	40/0,65 | 11 10 40	Migalhamos	3	17	0
	M 8/0,20 | 11 11 09	Minuiremo	8	7	6
	Epi 20/0,40 | 11 11 23	Mipoux	5	12	0
	Epi 40/0,65 | 11 11 40	Mippi	5	0	6
57	Water immersions				
	6/0,11 | 11 11 07	Migardes	4	0	6
	40/0,75 | 11 11 47	Migaremos	8	12	0
	90/1,18 | 11 10 91	Migarmosa	12	1	0
	Glycerine immersion				
	60/1,0 | 11 11 60	Minianda	15	13	0
	Homogeneous oil immersions				
	50/0,85 | 11 10 50	Milesa	7	5	6
	90/1,25 | 11 10 92	Migaveis	6	14	0
	90/1,25 | 11 10 93 with Iris diaphragm	Mindinha	7	16	6

Page of catalogue	Item or designation	Code word	£ s. d.
57	Glass vessel for water immersion 6 N.A. 0.11		
	12 87 20	Miagolammo	8 0
	11 11 07/1	Kaglu	1 16 6
	11 11 47/1	Kagox	1 16 6
58	**Fluorite objectives** Dry series		
	40/0,85 | 11 10 48	Migalhando	7 1 0
	60/0,90 | 11 10 60	Migalharas	8 10 0
	40/0,85 | 11 10 45	Migamos	8 16 6
	60/0,90 with corr. | 11 10 65	Migarais	11 4 0
	90/0,90 with corr. | 11 10 95	Migaran	11 4 0
	Homogeneous oil immersion		
	100/1,30 | 11 10 99	Migdal	13 2 0
59	**Apochromatic objectives** Dry series		
	6/0,15 | 11 01 06	Miniaria	9 10 0
	10/0,30 | 11 02 10	Migma	7 5 6
	20/0,65 | 11 01 20	Migmata	10 17 0
	40/0,95 | 11 01 40	Migmatis	14 11 0
	60/0,95 | 11 01 60	Migmatum	15 13 0
	Water immersion		
	70/1,25 | 11 01 70	Mignard	19 7 0
	Homogeneous oil immersions		
	35/0,85 | 11 01 35	Minuritior	15 2 0
	60/1,0 with Iris diaphragm | 11 01 62	Mingled	14 2 0
	60/1,3 | 11 01 63	Mignardant	19 7 0
	60/1,4 | 11 01 64	Mignarder	30 4 0
	90/1,3 | 11 01 93	Mignata	19 7 0
	90/1,4 | 11 01 94	Mignella	30 4 0
	120/1,3 | 11 01 99	Mignellir	26 12 0
60	**Objectives in short mounts**		
	Achromatic objectives Dry series		
	4 | 11 12 03	Milesiase	1 9 0
	6 | 11 12 06	Milesienne	1 9 0
	7,3/0,17 | 11 12 07	Miniona	3 0 6
	9/0,20 | 11 12 08	Milesima	2 4 6
	12/0,30 | 11 12 10	Milesimos	4 5 0
	21/0,40 | 11 12 21	Milesimum	4 5 0
	40/0,65 | 11 12 40	Milesiora	5 0 6
	Homogeneous oil immersions		
	53/0,90 | 11 12 53	Milesium	7 5 6
	95/1,25 | 11 12 95	Miletum	9 10 0
	Fluorite objectives Dry series		
	40/0,85 | 11 12 48	Milesioris	8 1 0
	60/0,90 | 11 12 60	Milestone	9 10 0
	Homogeneous oil immersion		
	100/1,30 | 11 12 99	Miletuser	13 2 0
	Intermediate collar | 12 04 55	Minuritis	3 6

Page of catalogue	Item or designation	Code word	£ s. d.
61	**Apochromatic objectives** Dry series		
	10/0,30 | 11 03 10	Milanionem	7 5 6
	22/0,65 | 11 03 22	Milanionis	10 17 0
	40/0,95 | 11 03 40	Milax	14 11 0
	62/0,95 | 11 03 60	Milcorus	15 13 0
	Water immersion		
	74/1,25 | 11 03 70	Mildete	19 7 0
	Homogeneous oil immersions		
	64/1,30 | 11 03 63	Milden	19 7 0
	64/1,40 | 11 03 64	Mildened	30 4 0
	94/1,30 | 11 03 93	Mildewed	19 7 0
	Intermediate collar | 12 04 55	Minuritis	3 6
	Monobromnaphtalene Immersion Objective		
	74/1,60 | 11 03 74	Minnow	96 12 0
62	**Eyepieces** HUYGENS eyepieces		
	4× | 11 35 04	Migeam	12 0
	5× | 11 35 05	Miglia	12 0
	7× | 11 35 07	Migliare	12 0
	10× | 11 35 10	Migliarina	12 0
	15× | 11 35 15	Migliarol	12 0
	Orthoscopic eyepieces		
	12,5× | 11 35 12	Migliora	1 11 6
	17× | 11 35 17	Migliorato	1 11 6
	28× | 11 35 28	Migliorom	2 0 0
	Eyepiece 6×		
	11 36 15	Minuiren	3 9 6
63	Compensating eyepieces		
	3× | 11 31 03	Mignol	1 13 6
	5× | 11 31 05	Mignolano	1 13 6
	7× | 11 31 07	Mignolare	1 13 6
	10× | 11 31 10	Mignolassi	2 9 0
	15× | 11 31 15	Mignolato	2 9 0
	20× | 11 31 20	Mignolia	2 9 0
	30× | 11 31 30	Minionette	3 0 6
	Comp.-eyepiece for monobromnaphtalene immersion objective		
	15× | 11 31 16	Minoratius	6 3 0
	"Mobimi" Paired eyepieces HUYGENS eyepieces		
	5× | 11 35 37	Miniada	1 4 0
	7× | 11 35 38	Minestrava	1 4 0
	10× | 11 35 39	Miniadir	1 4 0
	15× | 11 35 40	Minestravel	1 4 0
	Compensating eyepieces		
	7× | 11 31 38	Minestravi	3 7 0
	10× | 11 31 39	Miniadol	4 18 0
	15× | 11 31 40	Minestrear	4 18 0
	20× | 11 31 41	Miniadus	4 18 0
67	12 51 03	Minestrone	13 6 0
	12 51 05	Minoranso	1 16 6
	12 12 01	Kedeu	2 14 6

Page of catalogue	Item or designation	Code word	£ s. d.
68	12 51 21	Millionum	3 1 6
	12 51 31	Milliped	5 18 0
	12 51 73/5	Miolu	1 7 6
69	**Paired objectives Stand X**		
	(2) 11 21 02	Milhar	3 2 6
	(3) 11 21 03	Milharada	3 7 0
	(4) 11 21 04	Milharadom	3 7 0
	(6) 11 21 06	Milharal	3 7 0
	(7)—(Pl) 11 21 07	Minarum	4 18 6
	(8) 11 21 08	Milharoz	3 7 0
	(12) 11 21 12	Milheira	3 7 0
	Paired eyepieces HUYGENS		
	4× 11 35 44	Mimosal	1 4 0
	5× 11 35 45	Mimosea	1 4 0
	7× 11 35 47	Mimoseado	1 4 0
	10× 11 35 50	Miaremus	1 4 0
	15× 11 35 55	Miares	1 4 0
	Paired eyepieces with enlarged field of view		
	Bi 6× 11 35 46	Minuriebat	6 18 6
	O.12,5× 11 35 52	Middelader	3 2 6
	O.17× 11 35 57	Middel	3 2 6
	O.28× 11 35 58	Miargyros	4 0 6
72	12 52 00	Ministre	11 14 0
	12 52 01	Minatarum	25 0 0
	12 52 02	Mincepie	27 6 0
	12 52 04	Kedka	23 15 0
	12 52 08	Kedoe	27 15 0
	12 52 50	Millonario	1 5 0
	12 52 51	Millones	18 1 0
	12 52 53	Milloraine	1 0 6
	12 52 54	Millosa	1 0 6
	12 52 56	Millouin	2 1 0
73	12 52 25	Mingere	32 15 0
	12 52 21	Keduj	16 16 0
	12 52 21/1	Kedyn	2 12 6
74	12 52 22	Millier	1 12 0
	12 52 27	Mioludos	1 14 0
75	12 52 41	Millimodor	23 11 0
	12 52 40	Ministress	8 8 0
	12 51 51	Millipora	17 17 0
	12 51 65	Miniarde	29 2 0
	12 51 66	Miniaran	8 13 0
	12 52 24	Micaceous	5 9 0
76	12 51 07	Milling	5 18 0
	12 51 11	Ministret	5 18 0
	13 90 81	Minandae	5 6
	13 95 62	Kedzo	1 18 6
	13 95 63	Kefan	1 18 6
	13 90 83	Mincerait	2 4 0
	13 90 84	Mincerions	2 14 6
77	12 87 02	Micos	9 4 0

Page of catalogue	Item or designation	Code word	£ s. d.
77	12 52 58	Milviuser	6 2 6
	12 52 55	Milva	20 14 0
78	12 52 28	Mioman	1 14 0
	12 52 65	Kefbo	2 10 0
	12 52 65/1	Kefes	9 0
	12 52 65/2	Kefgu	7 0
79	12 52 86	Milvaginum	46 14 0
	11 35 46	Minuriebat	6 18 6
81	12 51 70	Minutina	10 16 0
82	12 51 16	Kaesc	7 3 0
	13 96 01	Miopia	3 6
	13 95 69	Kaewg	2 2 0
	13 90 76	Kafoy	2 4 0
	Paired objectives for Binocular Stand Magnifiers XII		
	½ 11 21 16	Minutalius	3 16 0
	1¼ 11 21 17	Minutame	3 16 0
	2½ 11 21 18	Minutamos	4 9 6
	Paired eyepieces		
	8 × 11 35 48	Minutandi	3 2 6
	12½× 11 35 53	Minutant	3 7 0
	O.17 × 11 35 57	Middel	3 2 6
	11 35 56	Minziek	9 0
	Stands XII with prism body		
Plate 7	12 51 90	Kefiw	16 5 0
Page 1	12 07 12	Minutione	1 16 6
	12 51 91	Kefky	23 8 0
	12 51 93	Kefma	19 4 0
	12 07 11	Minutios	2 7 6
	12 51 94	Kefoc	19 15 0
Page 2	12 51 95	Kefre	27 3 0
	12 51 77	Kefuh	19 13 0
	12 51 78	Kefyl	28 11 0
	12 51 79	Kegam	16 16 0
83	**Anastigmatic Magnifiers**		
	11 60 20	Micturient	2 12 6
	11 60 21	Micturio	2 12 6
	11 60 22	Micturios	2 12 6
	11 60 30	Micturire	3 1 6
	11 60 31	Micturirem	3 1 6
	11 60 32	Micturires	3 1 6
	11 60 40	Micturisse	5 2 6
	11 60 41	Micturite	5 18 0
	11 60 42	Micturitis	5 18 0
86	**Aplanatic Magnifiers** see leaflet Med 243		
	12 73 29	Militeris	19 6
87	L I 12 58 01	Micuisse	6 2 6
	L II 12 58 11	Micuissent	2 10 0
88	L III 12 58 13	Minutare	3 10 6
	12 54 04	Minutaras	1 9 6
	12 54 10	Kegco	17 8 0
	12 60 30	Polergal	19 18 0
	12 54 15	Mimulama	48 10 6

Page of catalogue	Item or designation	Code word	£ s. d.
	Illuminating attachments		
90	12 01 10	Keger	4 2 0
91	11 41 00	Miaria	10 0
	11 41 05	Miariais	1 10 0
	11 41 08	Miniatura	1 18 6
92	11 41 20	Miaron	1 10 6
	11 41 24	Miniatures	1 17 0
	11 43 20	Miasmatico	2 10 6
	11 41 30	Miascite	2 1 6
	11 41 34	Miniatuse	2 12 6
	11 43 30	Ministro	3 1 6
93	11 41 40	Micropus	6 2 6
	11 41 44	Miniavere	6 9 6
	11 43 40	Ministrone	7 5 6
	11 41 43	Pagfi	5 13 6
	11 41 47	Profanator	4 17 6
	11 41 42	Profanavam	6 0 6
94	11 42 24	Minutais	10 14 0
	11 43 94	Kepad	6 3
	11 42 30	Militeremo	7 19 0
	11 42 32	Minon	16 0
95	11 41 27	Migrating	5 11 6
	11 41 37	Migratio	6 5 0
	11 41 28	Migratione	6 2 6
	11 41 38	Migratiora	6 16 6
	12 01 32	Minabird	3 12 6
	12 38 10	Miraculis	7 0
96	11 42 41	Miaskite	2 10 0
	11 21 90	Minabitis	17 6
	11 42 50	Miasm	14 15 0
	11 42 52	Miniscor	1 5 0
98	11 45 45	Mineirako	5 11 6
	11 45 43	Minibus	16 0
	11 45 32	Minable	10 9 0
99	11 45 15	Miette	9 15 6
	11 45 17	Miniavi	10 7 0
	11 45 20	Mingo	9 4 0
	11 45 22	Mingoal	9 4 0
	11 45 23	Minurriet	9 4 0
	11 45 24	Minurrio	9 4 0
100	11 45 37	Minianto	7 3 0
	11 45 38	Miniavimus	7 12 6
	11 45 40	Minebamus	7 3 0
	Observation in Incident light		
101	12 04 10	Middelding	3 1 6
	12 04 50	Middelen	3 12 6
	11 46 06	Miope	6 12 0
	11 46 25	Mirken	14 4 0
102	11 46 10	Miopismo	10 9 0
	11 46 05	Miotomia	10 11 0
	3 concave mirrors 11 46 05	Katea	6 9 6
	Object stages		
104	12 06 34	Miauler	3 10 6
	12 06 43	Miaulera	4 13 0
	12 06 44	Ministror	6 9 6
105	12 07 04	Miracobi	12 5 0
	12 08 05	Migrateur	10 9 0
	12 08 06	Minuebare	4 6 6
	12 08 08	Miradore	4 6 6
	12 08 07	Miradoras	10 9 0

Page of catalogue	Item or designation	Code word	£ s. d.
106	12 06 70	Micaremus	3 1 6
	12 06 75	Minctio	4 17 6
	12 06 84	Minuira	13 13 0
	12 06 85	Kegiv	13 13 0
	12 06 89	Minurritur	15 9 0
	12 06 64	Minimael	1 14 0
	12 06 66	Kegly	1 14 0
107	12 06 90	Ministrum	16 10 0
	12 06 80	Miaulerent	12 5 0
	Devices for centring and changing objectives		
	12 92 11	Ministrans	1 9 6
108	12 12 04	Miasmology	2 2 6
	12 12 06	Miluamor	1 17 0
	12 12 05	Miluam	1 10 6
	12 12 10	Miasms	19 6
	12 12 11	Miassemos	1 9 6
	12 14 13	Miastenia	15 0
	12 14 18	Minderel	2 5 6
	12 12 20	Procazava	1 9 6
	12 12 21	Procazes	2 1 0
	12 12 24	Procludito	12 6
	Drawing apparatus		
109	12 60 00	Micantes	3 15 0
	12 60 60	Micationis	7 6
	12 60 21	Milter	10 5 0
110	12 60 24	Minctura	1 14 0
	12 60 26	Mintriendo	2 1 0
	12 60 22	Miltersa	5 11 6
	12 60 65	Minted	12 6
111	12 60 50	Micatione	9 13 0
	Measuring devices		
112	11 36 07	Mincturus	1 4 6
	11 36 10	Kegna	1 4 6
	11 36 12	Kegob	2 9 0
	11 36 17	Mindaros	2 9 0
	11 36 28	Kegse	2 16 0
	11 33 07	Minded	2 9 0
	11 33 20	Midasohr	3 2 6
	11 53 11	Miliorum	1 7 0
	11 53 21	Minutus	1 7 0
	11 53 31	Militabam	3 1 6
	11 53 01	Miliolim	3 1 6
	11 53 10	Minnig	3 15 0
113	11 51 00	Micatote	12 6
	11 51 01	Micatuum	17 6
	11 51 02	Micatus	17 6
	11 51 03	Minitabam	1 0 0
	11 51 30	Micchetto	1 4 6
	11 51 31	Kegug	1 4 6
	11 55 60	Miccinina	9 8 6
	11 55 66	Miccinino	10 11 0
	11 55 72	Minutalia	11 5 0
114	12 63 00	Micciades	1 7 6
	12 63 03	Miccianza	1 7 6
	12 63 10	Miccichino	1 7 6
	12 64 54	Miltonie	17 6
	11 55 85	Kegyk	5 7 0

Page of catalogue	Item or designation	Code word	£ s. d.
	Counting devices		
115	11 51 65	Michaelia	16 0
	11 51 67	Minderdeel	1 0 0
	11 51 80	Michaelis	19 0
	11 59 05	Kehal	4 11 0
	Haemacytometers		
117	12 66 64	Minerala	2 9 6
	12 66 83	Minuare	3 5 6
	12 70 04	Miraculos	2 9 6
	12 67 73	Mingones	2 6 0
	additional	Mingosmet	2 0
	12 66 60	Minelesi	1 8 6
	12 66 65	Mintrient	2 3 0
	12 66 82	Mintrietis	2 5 0
	12 70 00	Mirabole	1 8 6
	12 67 70	Mingitis	1 11 0
	12 67 75	Mintrio	2 5 0
	12 66 70	Minum	2 5 0
	12 66 75	Minumus	2 5 0
118	12 66 85	Minellar	2 3 0
	12 69 20	Mineon	2 7 0
	12 69 30	Minerado	2 13 6
	12 70 20	Mirabund	3 14 0
	12 66 89	Minerales	3 3 6
	12 69 24	Mineralia	3 7 6
	12 69 34	Mineralien	3 14 0
	12 70 24	Miraculum	4 14 6
	additional	Mingosmet	2 0
119	12 73 00	Midianiter	5 0
	12 73 03	Minutons	11 6
	12 73 10	Midias	5 0
	12 73 13	Minutor	11 6
	12 73 21	Miellatum	6 0
	Certificate		6 6
	12 73 50	Mindern	6
	12 69 90	Mineralium	6 15 0
	Polarizing attachments		
120	12 78 01	Michele	4 6 6
	12 78 05	Mint	6 16 6
	12 78 08	Mintage	10 6 0
121	12 80 21	Mimadoru	3 6 0
	12 80 20	Mimaret	2 17 0
	12 80 23	Mimaient	6 14 0
	12 80 62	Milzener	14 0
	12 80 63	Minadora	14 0
	12 80 64	Minadores	14 0
	12 80 65	Minae	14 0
	12 80 66	Milzour	9 0
	12 80 67	Minage	9 0
	12 80 68	Minageur	9 0
	12 80 69	Minahbird	9 0
	12 80 70	Mima	4 13 0
	12 80 58	Milza	2 0
122	12 80 54	Minuer	15 18 0
	12 80 55	Minuenti	11 16 6
	12 80 51	Minantem	9 6 6

Page of catalogue	Item or designation	Code word	£ s. d.
	Micro-Spectroscopic apparatus		
122	12 81 02	Minahouet	15 17 0
123	12 81 30	Micidiare	27 12 0
	12 81 35	Mimoseasse	21 7 0
		Medvexatum	1 7 6
	Special eyepieces		
124	11 53 14	Militabano	1 14 6
	11 53 04	Milionis	2 19 0
	11 51 90	Micolino	10 0
	11 58 04	Mickknopf	1 2 6
	12 85 05	Mieteranno	15 7 0
125	12 85 07	Mietendo	15 5 0
	12 85 30	Miliarius	11 19 0
		Minuisci	15 17 0
126	12 85 76	Miolas	21 0 0
	12 85 72	Kagem	19 15 0
	12 85 79	Kaggo	5 16 0
	12 85 80	Kails	4 15 6
	12 85 90	Kaikr	2 14 6
	12 85 73	Kaifl	15 0 0
	Inclined eyepiece tubes		
128	12 85 21	Mirabunta	19 4 0
	12 85 22	Miracci	19 4 0
	12 85 28	Kanij	4 17 6
	12 85 29	Kanef	3 8 0
129	12 85 24	Miolada	5 13 6
	Miscellaneous accessories		
129	12 76 20	Miehe	2 17 0
	12 76 21	Michel	1 7 6
130	11 31 90	Kehdo	2 1 0
	12 83 31	Micidus	3 8 0
	12 83 20	Micidiores	1 5 0
	12 83 25	Micidorum	10 0
131	12 08 66	Kehep	28 8 0
	12 92 20	Micranthes	2 10 0
132	12 92 30	Micrandra	4 11 6
	12 92 40	Micraspis	4 6 6
	12 92 41	Micrantha	1 5 0
	12 97 71	Militema	16 0
	12 97 75	Militemur	16 0
	12 97 77	Militenlo	16 0
	12 97 85	Minutez	1 5 0
133	12 87 24	Kehiu	34 14 0
	12 87 26	Kehmy	20 15 0
	12 87 35	Mincassent	8 6 0
	12 87 36	Minions	1 9 0
134	12 87 45	Miradera	16 19 0
	12 87 48	Miraderol	11 6 0
	12 96 26	Minutala	2 13 0
	12 96 29	Kehoa	7 0
135	12 97 09	Kehte	1 6
	12 97 10	Microbios	3 0
	12 97 12	Microcarpa	6 6
	12 97 13	Mictorio	8 6
	12 97 32	Microcere	8 6
	12 97 50	Mictoriora	8
	12 97 52	Kehuf	1 9
	12 98 12	Kehxi	1 0

Page of catalogue	Item or designation	Code word	£ s. d.
135	12 98 18	Microcosmi	2 0
	12 98 21	Mictuale	4 0
	12 98 24	Microcrith	5 6
	12 98 48	Microdere	2 6
	12 98 51	Microdon	4 0
	12 98 54	Microdonte	6 0
	12 98 70	Mictuali	4 0
	12 98 75	Microfono	7 0
	12 98 78	Miniopteri	12 0
	12 99 02	Mindera	2 5 0
	12 99 03	Minderde	1 2 6
	12 99 08	Mincates	1 3
	Lamps and accessories for artificial illumination		
136	13 9321	Mingi	2 5 6
	13 93 22	Keiny	4 11 0
	1393 11	Mierla	14 9
	13 93 23	Minier	14 9
137	13 93 82	Minutu	4 2 0
	13 93 83	Minutula	9 0
	13 93 53	Miragu	2 5 6
	13 93 86	Miram	see separate price list
138	13 93 54	Mirail	
	13 96 03	Mirak	
	13 95 72	Mirand	
	13 95 11/1	Prodigor	
	13 95 12/1	Prodigose	
	13 96 51	Mirano	
	13 93 35	Miniare	7 12 6
139	13 93 32	Miniareis	11 7 0
	13 93 33	Miniarem	11 7 0
	13 93 37	Mimosen	2 0 6
	13 93 38	Mimosite	2 14 6
	13 98 20	Mimologico	2 16 6
	13 98 21	Mimologos	2 16 6
140	13 93 62	Minnodu	7 3 0
	13 93 64	Miniora	1 13 0
	13 93 67	Minious	1 13 0
	13 93 72	Miradura	4 8 0
	13 93 75	Minirend	1 8 0
	13 93 71	Minboca	2 7 6
	13 41 10	Mimologum	1 16 6
	13 41 16	Miniabunt	6 0
	Capillary microscopes		
141	12 45 20	Mietera	11 0 0
	13 95 80	Minutum	1 3 0
	13 95 81	Minuturu	1 3 0
	13 90 60	Migratoa	1 18 6
142		Mirage	25 3 0
		Miraggio	47 14 0
143		Keioz	6 2 6
		Keipa	42 11 0
		Keirb	3 3 6
		Kejaj	43 0 0
		Kejen	2 14 6

Page of catalogue	Item or designation	Code word	£ s. d.
	Cardioid Ultra-Microscope		
144		Kejfo	59 14 0
		Kejku	59 14 0
	12 88 53	Midasaffe	3 10 6
	E S A	Mineriame	16 14 0
	E S A bi	Kejis	35 18 0
	Microscopes Winkel-Zeiss		
145	Dissecting microsc. 1	Wind	12 3 0
	" " 1	Windab	11 7 0
	" " 2	Windablass	5 12 6
	O D C	Winchingly	9 10 0
	Fine adjustment	Wincopipe	1 0 0
	additional	Windbeere	12 0
146	I B R	Woawn	8 13 0
	I E R	Woayp	11 15 6
	I B C	Woazr	8 13 0
	I E C	Wobar	11 15 6
		Wobdu	6 7 0
		Kejoy	6 17 6
		Winberris	1 10 0
		Wince	1 17 0
		Winced	1 5 0
		Wincepit	2 10 6
		Windbeere	12 0
		Minuebare	4 6 6
		Wobev	2 14 6
147	G T C	Wobiz	12 16 0
	G T A	Wobja	13 13 0
	G T B	Wobne	14 2 0
		Wobof	17 8 6
		Kejra	19 1 6
		Migrateur	10 9 0
		Minuebare	4 6 6
		Winching	1 10 0
		Windbeere	12 0
148	II M	Wobsi	61 9 0
		Wobuk	16 5 0
		Wobyo	6 6 6
		Wocap	2 11 0
149	IV M	Woceu	87 7 0
	additional	Wocka	25 17 6
150		Windarm	42 19 0
		Wocoe	1 10 0
		Wocti	2 4 6
		Wocuj	2 10 6
		Windbal	10 0 0
		Windbalg	20 9 0
		Wocyn	25 11 0
		Windballen	42 19 0
	V M	Windberry	107 4 0
	VI M	Windband	169 0 0
		Windbarrow	53 10 0
		Windbauch	69 1 0
		Windbaum	71 6 0

