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Gullstrand Slit Lamp

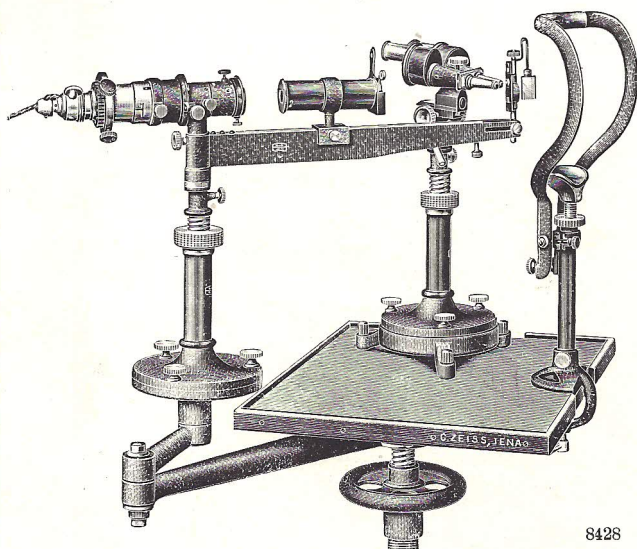
The methods of slit lamp microscopy developed by Gullstrand, Koeppe, and Vogt have attained significance in equal measures in scientific research as well in daily practice, where it is being recognised as an indispensable means of securing an unerring clinical diagnosis and also as a perfect aid in the ophthalmology of injuries due to accidents. As an instrument of differential diagnosis and delicate prognosis the method is of immense clinical value in that it

furnishes a means of recognising various cellular and allied microscopic changes of a morbid character long before any clinical symptom makes its appearance, indeed at an early stage where every other method fails to disclose a change or to utter a warning capable of suggesting prompt treatment at incipience, such as could not fail to offer a vastly increased chance of successfully bringing aid to the patient.

Normal and morbid conditions which hitherto were known as anatomical facts only are disclosed by this method in the living eye, as pointed out by Prof. Vogt. Indeed, it brings into view, not only what is anatomically known but also a number of appearances which hitherto were not amenable to anatomical demonstration. The method furnishes for the first time a means of seeing the living endothelium of the posterior wall of the cornea and of tracing the course of the

Fig. 1. Simple Combination for the use of oculists. The slit Nitra lamp (on the double radius bar attached to the instrument table) in combination with the corneal microscope on annular foot (resting on the glass plate which covers the table). The slit lamp bar carries a single Koeppe light-screening tube with a Vogt redfree filter and a Vogt slit lamp lens (about $\frac{1}{10}$ full size).

normal nerve fibres throughout their finest ramifications. Individual blood corpuscles can be seen rolling through the blood vessels of the cornea, and the oedema of the epithelium or endothelium of the cornea is rendered manifest by visible dew formation. The slit lamp enables us to distinguish between acquired and numerous forms of congenital opacities. It is the only means so far evolved which furnishes clearly defined clinical criteria for the differential diagnosis of complicated and senile cataract. The new method throws also a considerable amount of light on the physiology of the young and ageing lens. By means of the slit lamp the living vitreous may further be studied in its manifold forms. In one case it will be seen to form a highly transmissive seething structure of folds, in others the latter reduces to a slender arrangement of fibres, striae or membranes, and much more varied appearances are presented to the eye by the many pathological changes which the vitreous humour may undergo.



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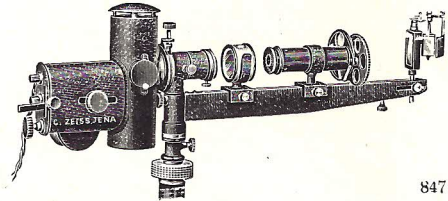
The slit lamp enables the surgeon to localise with the utmost precision any circumscribed section within the media of the eye. The focal pencil of light furnishes an optical section, and the localisation within the cornea, lens and vitreous obtained in this way acquires a degree of precision comparable to that obtaining in an anatomical preparation.

By *Prof. Koeppe's method* the slit lamp microscopy may be carried as far as the posterior half of the living vitreous and even as far as the fundus of the eye, and the finest histological details of structure existing under normal and pathological conditions may then be studied. In this connection, as elsewhere, it is the delicate precision of the method as a means of differential diagnosis which dictates its application in all cases where the ophthalmoscopic examination of the fundus has furnished doubtful results. The precision of the method as a means of recognising very early changes extends to the minutest centres of degeneration on the retina, to diminutive haemorrhages, infiltrations, etc. It affords, for example, a means of very early differentiation of optic neuritis and choked optic disc, of incipient ablation due to choroid tumour and other forms of retinal detachment.

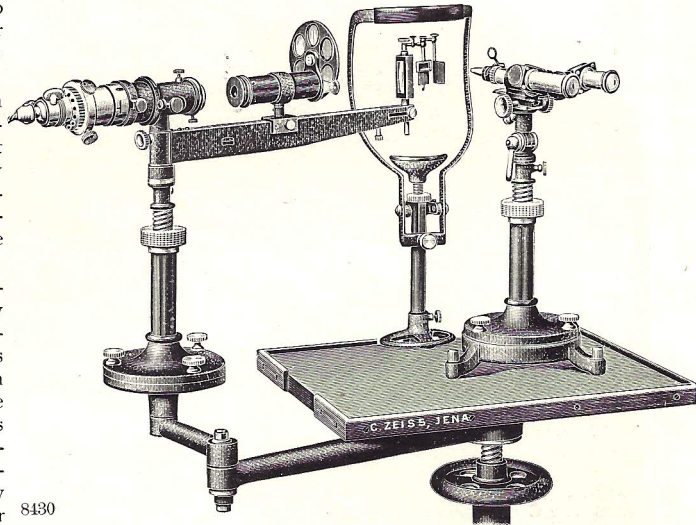
The results which are obtainable by microscopy with natural slit lamp light are widely exceeded by the *ultra-microscopic* and *micro-polariscopic* study of the living eye.

Apart from the detailed microscopic study of the histological structure of the living tissues of the eye contained in the reluctant section, the method offers a means of at the same time investigating their biophysical properties by the observation of their optical behaviour. It is only by comparing the appearances which present themselves in natural and in polarised slit lamp light that a complete picture is to be formed of the true nature of the peculiarities of the various tissues and structures. The power of the method of disclosing evidence of the presence of minutest structural elements and changes in the eye tissues by a great variety of colour appearances which are brought into view by the ultra-microscopic side of the method intensifies to the utmost degree its value as a means of differential diagnosis and renders it possible to recognise incipient affections in their very earliest stages.

For *micro-polariscopic* and *ultra-microscopic* observations it will be necessary to add a Koeppe binocular eye microscope as a special supplement to the slit lamp. Being equipped with a single objective, this instrument admits of the posterior half of the vitreous and the fundus of



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Fig. 2. Complete set of apparatus for eye hospitals: **Slit Nitra lamp** with Koeppe diaphragm tube, polariser, revolving coloured glass wheel and non-spherical aplanatic Vogt slit lamp lens with adjustable Koeppe silvered mirror, and Koppe eye microscope with single objective, analyser and binocular attachment for ultra-microscopic and micro-polariscopic observations. Above this: A Vogt **slit arc lamp** (interchangeable with the Nitra lamp) with cooling cell, Koeppe diaphragm tube with polariser, and double revolving wheel with smoked glasses and coloured glasses, with non-spherical aplanatic Vogt slit lamp lens and adjustable Koeppe silvered mirror (about $\frac{1}{10}$ act. size).

the eye being explored with greater ease and within a wider area than can be accomplished with the corneal microscope. The iridic chamber, in particular, it may be interesting to note, is amenable to investigation by the Koeppé instrument only. Naturally, the microscope with double objectives has, over that provided with one objective only, the advantage of furnishing a brighter image and of producing a more pronounced stereoscopic effect. It is also an important advantage that the object seen by it appears erect. For the examination of the anterior strata of the eye in ordinary slit lamp light the corneal microscope is therefore to be preferred.

The Gullstrand Slit Lamp serves mainly for the focal illumination of the eye. The main object of the apparatus is to produce an intensely bright illumination upon a very small area within sharply defined boundaries in the tissues of the eye. This form of illumination is obtained by projecting an image of the filament of a 50-c. p., 8-volt **Nitra lamp** or the carbon crater of a 3.3 amp. **arc lamp**, as the case may be, either in reduced size into the slit at the end of the illuminating tube or greatly magnified upon the slit lamp lens at the end of slit lamp arm. In either case the

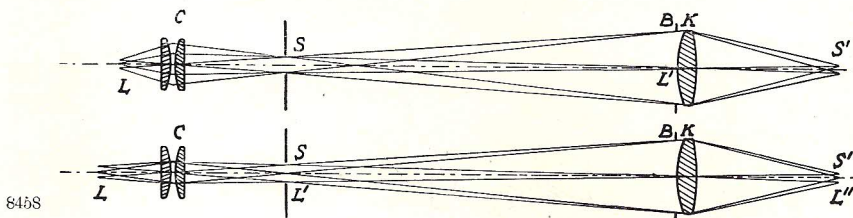


Fig. 3. Image of the luminous filament, or the carbon crater, formed on the slit lamp lens (L source of light, C condenser, S slit of the slit lamp, B, K slit lamp lens with diaphragm, L' image of the source of light upon the lens, S' image of the slit.)

Fig. 4. Image of the luminous filament, or the carbon crater, formed on the slit of the slit lamp (L source of light, C condenser, S slit of the slit lamp, L' image of the source of light on the slit, B, K slit lamp lens with diaphragm, S' image of the slit, L'' second image of the source of light.)

slit lamp lens projects an image of the brightly luminous slit into the tissues of the eye. The latter mode of projection is that commonly adopted in the microscopic method of examination by the slit lamp. It furnishes a particularly narrow pencil of light, the most concentrated section of which (the slit image) exhibits the greatest degree of uniformity in its intensity. Differences of intensity due to the composition of the source of light do not therefore become manifest until the distance from the focal slit lamp image exceeds a certain amount.

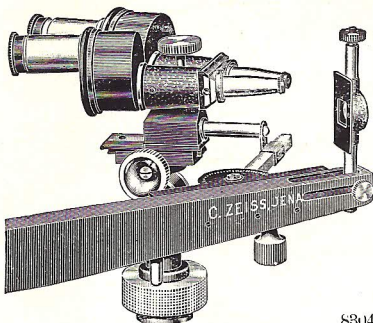


Fig. 5. The Vogt angle gauge for ascertaining the angle contained between the viewing and illuminating systems.

The following slit lamp lenses are supplied for use with the slit lamp: *For general purposes* (and adapted for most purposes) a Vogt **achromatic slit lamp lens** $f = 7$ cm. (with a diaphragm of 15×10 mm.) or a Koeppé lens (with three diaphragms of 16×10 , 13×9 and 9×6 mm.); *for special purposes* (for example for the microscopic examination of the iridic chamber: a Koeppé achromatic **slit lamp lens** $f = 10$ cm. (with three diaphragms of 16×10 , 13×9 and 9×6 mm.) and a Vogt lens (with a diaphragm of 15×10 mm.), and also, for other special purposes, a Vogt **aplanatic non-spherical slit lamp lens** $f = 7$ cm. (with a diaphragm of 45×15 mm.). When employing arc light this latter large lens should invariably be used, since the smaller slit lamp lenses are inadequate to receive the whole of the image of the carbon crater.

Observation should be made with the aid of a binocular magnifier (e. g. a binocular telescopic magnifier), or with the aid of a **corneal microscope** or a **Koeppé eye microscope**, as the case may be. According to the methods of Koeppé and Vogt alternate observations should be made in a directly

and in an indirectly illuminated field, in an oscillating field, in the reflected image, or within the reflected region, and finally in a dark field (For detailed information see Directions Med 135). The microscopic magnification may be carried from $8\times$ to about $109\times$.

A simple means of determining the angle comprised between the viewing and the illuminating systems is obtainable by attaching the **Vogt angle gauge** to the corneal microscope and applying it by its base line to the slit lamp arm (see Fig. 5).

The **Koeppé Supplements** to the slit lamp (comprising a **silvered mirror** and **eye adhesion lenses**) provide the requisite means for the stereo-microscopic examination by focal illumination of the iridic chamber, of the deeper strata of the vitreous humor, and the fundus. These examinations are best carried out with the aid of the Koeppé eye microscope. The iridic chamber, in particular, is amenable to the Koeppé instrument only. The eye microscope renders it also possible to subject the living eye to observation under the ultra-microscope and the polarising microscope.

The focal illumination of the eye, including that of the fundus, may also be made with **redfree** light with the aid of the **Vogt redfree filter***. The latter slips into the end of the simple **screening tube** (which serves for cutting off adventitious light); or it is mounted together with four other coloured glasses (two being blue and the other two yellow) in the **revolving coloured glass disc** of the Koeppé screening tube.

A Koeppé diaphragm tube with **double revolving wheel** (smoked glass and coloured glass discs) is supplied for use with the slit arc lamp. The former wheel (behind the other) has a plain hole and three smoked glasses, the other in front a plain hole and three coloured glass filters (red, yellow and blue). The light-transmitting capacity of the smoked glass and coloured glass filters is graded in such a way that each colour filter transmits three times the intensity of the Nitra light when the smoked glass wheel presents a plain hole, whilst the introduction of the smoked glasses reduces the intensity of the monochromatic illumination for each colour to an intensity 2 and $1\frac{1}{2}$ times respectively of that of the Nitra light. Any of these intensities may be imposed without injury to the living media of the eye. The Vogt redfree filter slips into the plain hole of the coloured glass wheel.

The slit lamp lens is set up on the platter of the **double swing bracket**, which affords a convenient and rapid means of adjusting the lamp in any horizontal direction with respect to the sight of the eye under examination. When observing by focal illumination, the corneal microscope is best set up on the **annular foot**, whilst a **glass plate** on the instrument table enables one to easily move the microscope about and fix it in any desired position (see Figs. 5 to 7). On the other hand, it may be set up on a **compound slide**, in which case the glass plate becomes superfluous (see Fig. 8).

*) When **Nitra lamp** light is used the redfree filter absorbs the **short-wave** red ranging from 680 to $573\text{ }\mu\mu$ but it transmits a portion of the **long-wave** light between 690 and $720\text{ }\mu\mu$. In the case of **arc light** the whole of the red is absorbed by the filter.

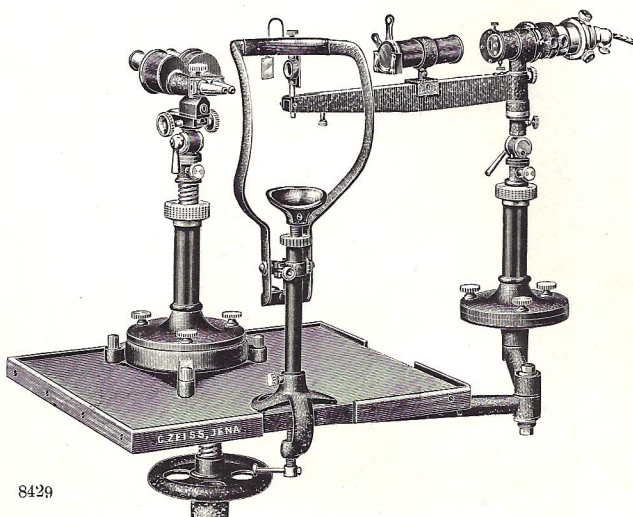


Fig. 6. The slit lamp with Koeppé diaphragm tube, Vogt redfree filter and Koeppé slit lamp lens with simple silvered mirror, and the corneal microscope on annular foot. The arrangement for raising and lowering the slit lamp is furnished with an inclining hinge (similar to that of microscope stands).

Thanks to its greater intensity, the **Vogt Slit Arc Lamp** is better adapted than the Nitra lamp for scientific investigations and for differential diagnosis as well as for observations with red-free light and ultra-microscopic and micro-polariscopic observations. The arc lamp enhances very considerably the distinctness of all details of the cornea. More especially, it shows the nerves down to the finest ramifications, and it does so under low as well as fairly high magnifications. The nerves exhibit a lustre which is derived from diminutive point-like elements. The endothelium and its details, the structural frame work of the vitreous, etc. are very distinctly visible. As the

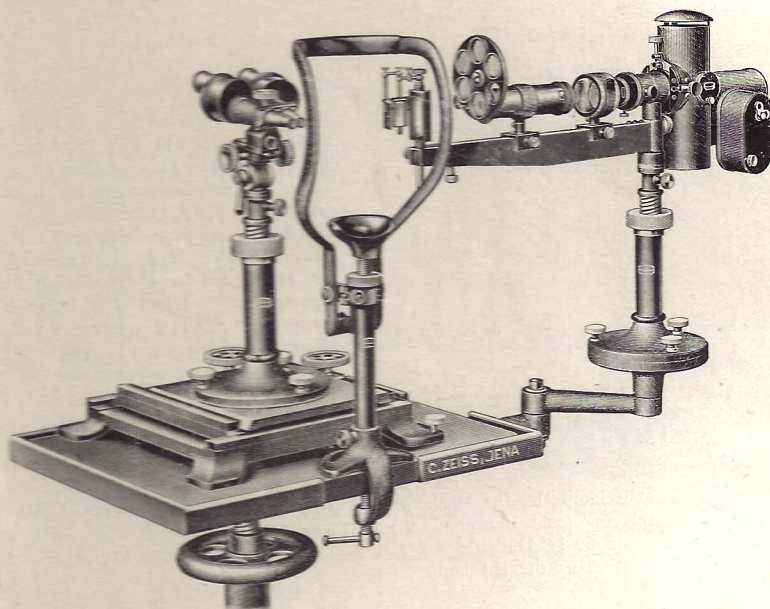


Fig. 7.

The Vogt slit arc lamp with cooling cell, Koepple diaphragm tube, revolving coloured glass wheel, and Vogt non-spherical aplanatic slit lamp lens with adjustable Koepple silvered mirror, the corneal microscope on compound slides.

Nitra lamp is replaced by the arc lamp the vitreous exhibits a wealth of new details. Where previously were seen featureless gaps the arc light will frequently bring into view a close mesh-work of fine fibres. The coarse laminae which were scarcely visible acquire by the arc light illumination a high degree of opacity. Residual embryonic vessels cannot be seen without the arc light. Residues of the hyaloid artery and all its details are brought into view with surprising distinctness and precision. All these results are obtainable under the highest magnifications, since the intensity of the arc light is effective even then. Moreover, in many cases the 'optically empty' retrolental space ceases to appear dark or remains so only for a short distance. In the light of the arc lamp no vitreous ever appears devoid of structure, not even in the axial portions. The new models of the slit lamp may be arranged so that the Nitra lamps are interchangeable with the arc lamp. According to requirement, one or the other lamp may then be employed on one and the same instrument.

In conclusion, attention should be called to the possibility which the apparatus affords of subjecting the living eye to **spectroscopic examination**. The slit arc lamp, used in conjunction with the Abbe spectroscope eyepiece, provides apart from the histological structure of the tissues a means of arriving at inferences respecting the biochemical conditions of the media of the

eye, of the iridic angle and the fundus, in that it shows that the living conjunctiva, the iris, lens and the fundus give rise to well defined absorption spectra, which undergo certain changes during affections of the tissues of the eye.

By a simple re-arrangement of the parts of the slit arc lamp and the addition of a few supplements the **Vogt redfree lamp** is rendered available for ophthalmic examination with red-free light, and similarly it may be converted into a **Birch-Hirschfeld radiation lamp** for the ultra-violet treatment of inflammatory affections in the anterior segment of the eye. This will be found treated in a separate publication, viz. Med 156.

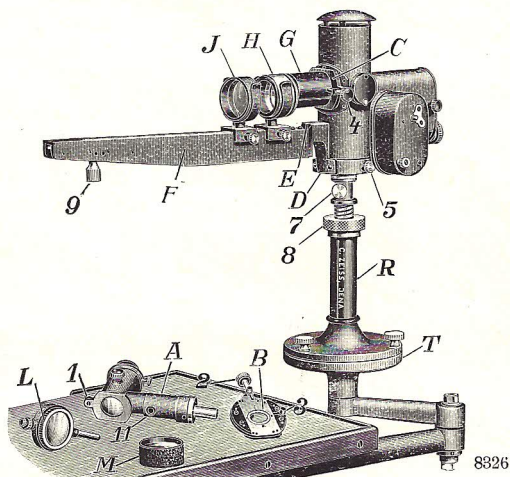


Fig. 8. Small Redfree Lamp on lamp cup *D* and vertical extension *R* with lamp casing *C* and illumination tube *G* with glass or quartz condenser respectively, cooling cell *H* of glass or quartz respectively, redfree filter *J* on lamp bar *F*. Below this, the equipment for the **Small Radiation Lamp**: Uviol filter *M* and quartz converging lens *L*; for the **Slit Arc Lamp**: The fitting *A* with condensing lens, slit and slide fitting *B*. Fixing screws 2 and 4, clamping screws 5 and 7, setting screws 9 for the quartz converging lens *L*, motion collar 8 for the vertical extension *R*.

In the place of a slit lamp the **large simplified Gullstrand ophthalmoscope** may be used as a slit lamp for producing focal illumination. This instrument, in conjunction with a corneal microscope or eye microscope is available for the same examinations and investigations by the method of focal illumination as the slit lamp.

Literature: *Med 4*, Corneal Microscope; *Med 131*, Koeppé Eye Microscope; *Med 110*, Large Simplified Gullstrand Ophthalmoscope; *Med 133*, Directions to the Slit Lamp; *Med 134*, Directions to the Eye Microscope; *Med 136*, Directions to the Large Simplified Gullstrand Ophthalmoscope (Directions are only provided with instruments supplied by us).

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