ic timer. The scleral mark obtained by the short burst of strong current affects the external scleral layers only and is visible as a small gray ring or a gray spot. It does not make a durable mark in the fundus.

Biomicroscopy of the Posterior Segment

The vitreous cavity does not lend itself well to the usual methods of clinical examination for two reasons: first, it has a delicate structure which is relatively transparent, and second, it is located so posteriorly that a large portion of it is beyond the focusing range of a biomicroscope. Being transparent, the vitreous must be studied in optical section by using a focused slit beam and viewing the optical section on a dark background. At the present time, the biomicroscope used with a lens neutralizing the corneal refractive power is the only instrument that allows this type of examination.

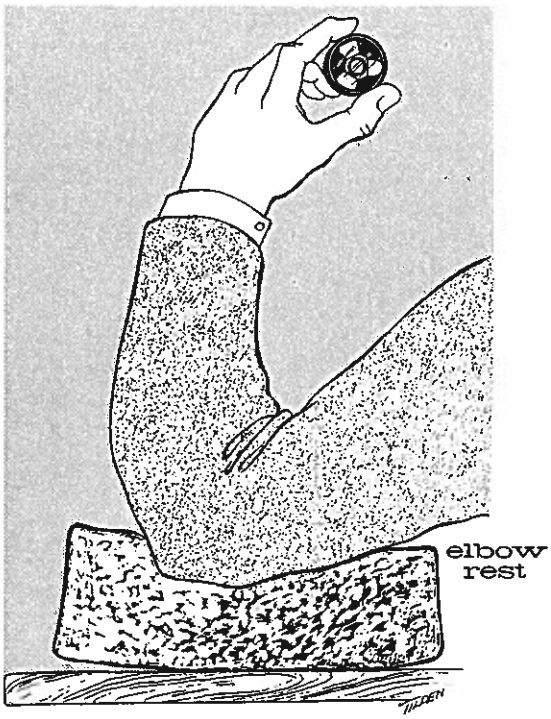

Figure 7–26 Elbow rest made of cork or foam rubber helps the biomicroscope observer's comfort. Pad height should be determined by length of observer's forearm. (Courtesy of Tolentino, F. I., Schepens, C. L., and Freeman, H. M., *Vitreoretinal Disorders: Diagnosis and Management.* Philadelphia, Saunders, 1976)

Biomicroscopy of the posterior segment (18–20) is largely based on observation of the Tyndall phenomenon which is elicited when a sharply outlined light beam is projected, in a totally darkened room, through a transparent medium containing suspended particulate matter. The suspended particles scatter part of the light passing through the medium and are thus rendered visible, provided they are examined against a dark background. The Tyndall phenomenon is accentuated when the suspended particles are increased in number, size, or optical density.

Biomicroscopic examination of the vitreous cavity is of great value not only in detecting pathologic changes in the vitreous and retina but also in evaluating vitreoretinal relationships. It aids particularly in establishing an association between retinal changes observed ophthalmoscopically and alterations in the vitreous body. Much of the information in the sections that follow was derived from the book on vitreoretinal disorders by Tolentino and coworkers (20).

Preparation for Examination

Slit lamp examination of the vitreous cavity must be performed with maximum mydriasis and in a darkened room. Darkening of the room is even more important than in ophthalmoscopy because barely visible vitreous structures are more easily detected after some degree of dark adaptation.

Since a good biomicroscopic examination is impossible with an uncooperative patient, the examiner should take time in explaining the procedure, allaying the patient's apprehensions and giving reassurance that the procedure will not hurt. The patient must be informed of the length of the examination and, since it is usually prolonged, made as comfortable as possible. The patient's seat, the microscope table, and its chin rest must be adjusted for optimum comfort. For easy focusing, the patient's forehead should be in contact with the headrest. The patient

may be encouraged to hold the instrument's grasping bar for stability. Children stand on the floor or on a footstool. Occasionally, an infant may be examined satisfactorily if a parent can hold the patient sufficiently still. Good anesthesia of the cornea, which helps to allay the patient's apprehensions during the examination, is obtained with 0.5% proparacaine hydrochloride.

Because of the prolonged duration of the examination, the examiner should also be comfortable. An elbow rest made of rubber or cork (Fig. 7–26) may be helpful for steadying the hand that holds the contact lens on the patient's eye. The examiner's seat should be adjusted to the proper height before the start of the procedure. The preferred type of seat for both patient and examiner is a rotating stool which can be easily adjusted up or down.

Instrumentation

Two basic elements are considered in instrumentation (20): the slit lamp microscope and the neutralizing lens.

Slit Lamp Microscope. Any modern biomicroscope may be used for clinical examination of the vitreous cavity and the ocular fundus, but the examiner should be familiar with the equipment used. Two slit lamps have features that make them outstanding for this type of examination — the Haag-Streit 900 (Fig. 7–27) and the Zeiss-Oberkochen (Fig. 7–28). These features are a rotating slit that can be oriented in any desired meridian, and an illumination beam that can be inclined around a horizontal axis from 0 to 20 degrees upward. Such features are necessary for binocular inspection of optical sections in horizontal and oblique meridians. An extensive view of the peripheral

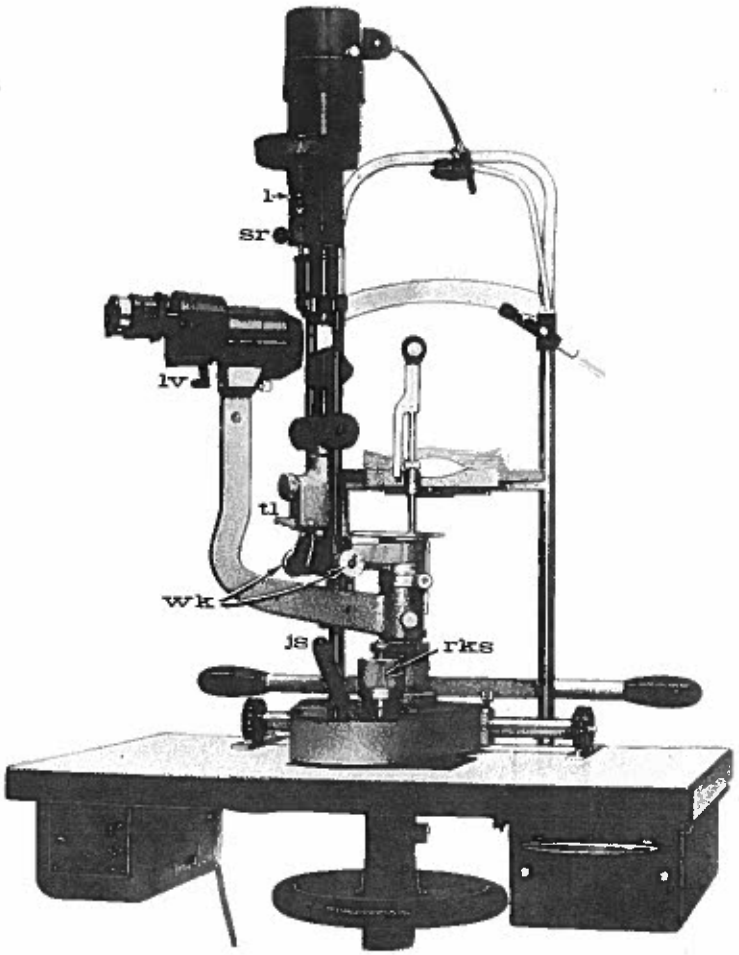

Figure 7–27 Haag-Streit slit lamp, model 900. Controls: slit rotation, sr; slit length, l; slit width, wk; illumination column inclination, tl; instrument height, rks; horizontal movement joy stick, js; magnification, lv.

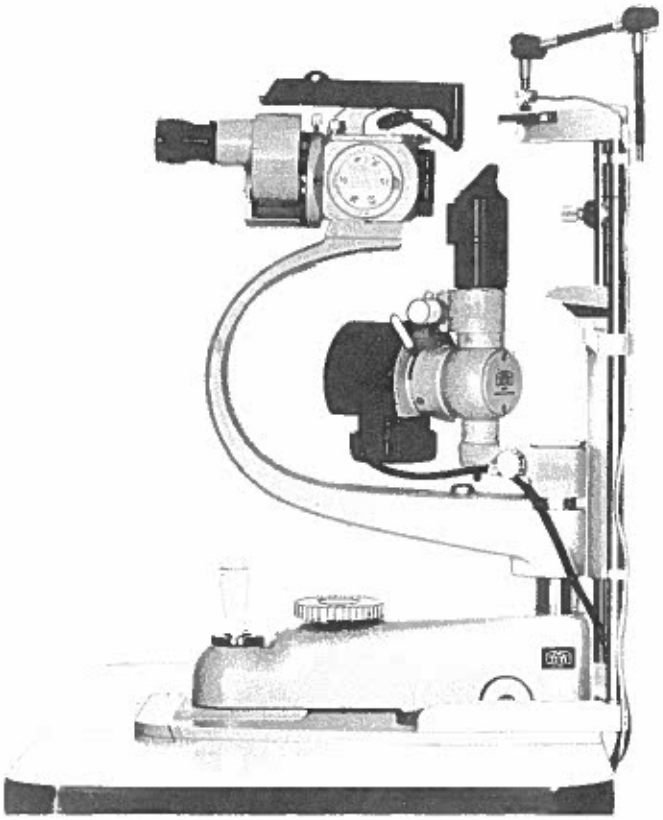

Figure 7–28 Zeiss-Oberkochen slit lamp, model SM/M 100/16 (TC 14,679)

vitreous and retina is best provided with a three-mirror contact lens.

The Haag-Streit 900 slit lamp and the technique for using it will be described in some detail. The slit beam can be rotated 360 degrees by means of knob sr in Figure 7–27, assuring orientation of the beam in any desired position. The slit length should at all times be equal to or less than the diameter of the pupil; this is controlled by lever 1 in Figure 7–27. The slit width is controlled by knobs wk. A narrow slit has a decreased luminous intensity. The slit beam can be moved easily on either side of the observation system, in order to place the optical section in the most appropriate position. Displacement of the slit beam may also be used to eliminate disturbing reflections from the surface of the contact lens. The illumination column can be inclined at the desired angle by using the thumb latch (tl). When the vertical illumination column is inclined forward, the slit beam, which was reflected horizontally from the mirror located on the column, becomes reflected upward, permitting better observation of a horizontal or oblique optical section. The height of the slit beam and microscope is easily adjusted by turning knob rks, which can also be used to move the whole biomicroscope horizontally, instead of utilizing the joy stick (js) for this purpose.

The illumination column is provided with a long and a short mirror. The long mirror obstructs the view through one of the microscope objectives when the illumination-observation angle is 6 degrees or less. Therefore the long mirror is impractical for stereoscopic viewing of the posterior vitreous cavity. The short mirror is more useful because at any angle it provides an unobstructed view through the objectives. A disadvantage of the short mirror is that when the illumination column is vertical, part of the light does not fall on the mirror. When the illumination column is tilted 6 to 8 degrees forward, however, all the light falls on the mirror. Since most of the examination is done with the illumination column tilted, this disadvantage is not very important. The mirror becomes dusty easily and should

be cleaned carefully with a camel's hair brush before each examination. If there are fingermarks on the mirror, they must be washed with soap and lukewarm water gently rubbed on the mirror with the pulp of one's finger, rinsed, then patted dry — without rubbing — with lens paper. Rubbing the mirror with cloth or lens paper may scratch its surface.

The intensity of the slit beam is controlled by a four-position knob on the variable transformer box. These positions supply 0, 5, 6, or 7.5 volts. At 7.5 volts the bulb is overloaded and very bright. This setting is best for most cases, especially when examination is performed through a narrow slit or when the media are hazy.

The microscope has two pairs of oculars, ×10 and ×16, and two pairs of objectives, ×1.0 and ×1.6. The ×10 oculars are most convenient for routine work. They give a magnification of ×10 or ×16, depending on the objectives used. The objectives are changed by flipping a lever (lv, in Fig. 7–27). The ×16 oculars used with ×1.6 objectives result in ×25 magnification. Each ocular should be focused independently on the cornea or on the focusing rod provided with the instrument. The interpupillary distance should be adjusted before examination is begun.

Manipulation of the most frequently used controls of the biomicroscope should be performed with one hand, leaving the other free to hold the contact lens. The most convenient position for one-handed manipulation (Fig. 7–29) is achieved by placing the thumb on the latch (tl) that controls the inclination of the illumination column and the index or middle finger on the horizontal part of the illumination arm. This grip allows easy manipulation of the illumination-observation angle, slit beam inclination, and slit beam width (wk).

Neutralizing Lens. The most useful method of neutralizing the corneal curvature is by means of a flat contact lens. For slit lamp examination of the vitreous cavity a three-mirror lens is recommended. The central portion of the three-mirror lens (Fig. 7–30) provides a view of 30 degrees around the macula. The equatorial mirror (II) is used to view the area from 30 degrees to the equator; the peripheral mirror (III), the area from the equator to the pars plana ciliaris. The third mirror (IV) is used for gonioscopy and also serves occasionally for viewing the extreme fundus periphery. The areas seen with the various mirrors overlap. Before the lens is inserted, 1% methylcellulose is placed on its corneal portion while it is hand-held or resting on a soft cloth on the table. The lens should be cleaned after each use by rinsing it with warm running water. When greasy, most often from fingermarks, soap lather is placed on the pulp of one finger and rubbed gently on the greasy surface, then the surface is rinsed with warm water. The lens surfaces should be dried with

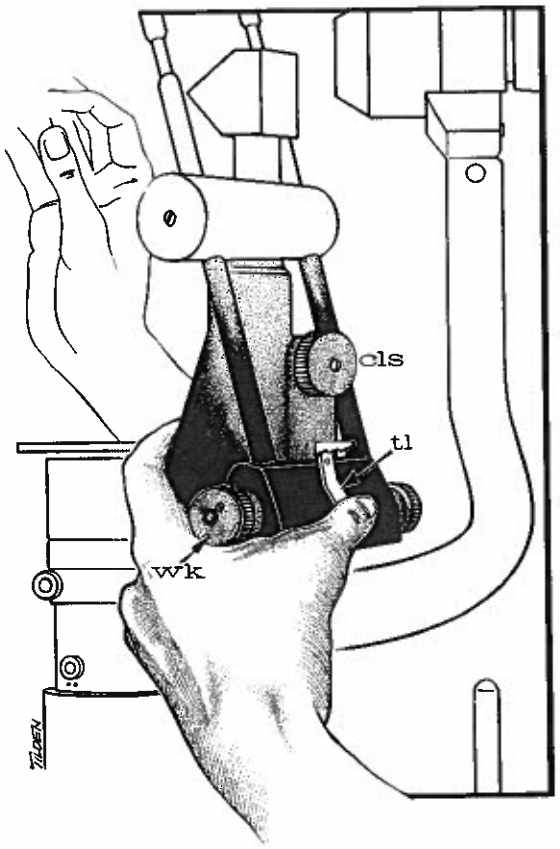

Figure 7–29 One-handed manipulation of slit lamp: slit width control knob (wk), column inclination thumb latch (tl), and center locking screw (cls) are within easy reach. (Courtesy of Tolentino, F. I., Schepens, C. L., and Freeman, H. M., *Vitreoretinal Disorders: Diagnosis and Management.* Philadelphia, Saunders, 1976)

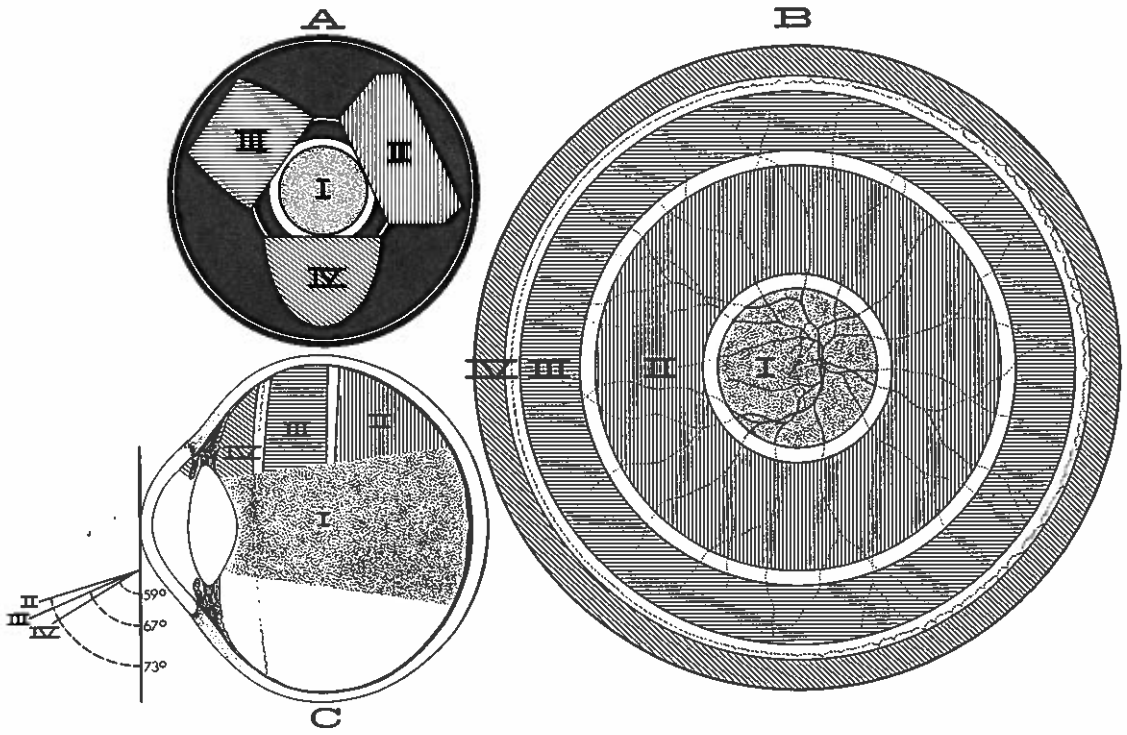

Figure 7–30 Three-mirror contact lens. (A) Viewed from front. I, area used for viewing without mirror; II, equatorial mirror; III, peripheral mirror; IV, gonioscopy mirror. (B) Fundus sketch on which areas viewed through I, II, III, and IV are projected; white areas indicate overlapping. (C) Cross section of eye indicating areas viewed through three mirrors. Angles indicate inclinations of mirrors on optic axis of contact lens. (Modified from Tolentino, F. I., Schepens, C. L., and Freeman, H. M., *Vitreoretinal Disorders: Diagnosis and Management.* Philadelphia, Saunders, 1976)

lens paper. They should never be wiped because they scratch easily. When not in use, the lens should be placed in its container.

The use of a precorneal lens instead of a contact lens has a definite place in vitreous and fundus examination. In spite of its drawbacks, in specific situations a precorneal lens has advantages over a contact lens for slit lamp examination of the vitreous cavity and retina. It is particularly useful for the examination of children, apprehensive adults, and patients with suspected external infection, recent intraocular surgery, or narrow palpebral fissure. However, its limitations should also be recognized — some details that are visible with a contact lens cannot be demonstrated. For example, the peripheral portion of the vitreous cavity cannot be seen at all, and a good picture of the general configuration of the vitreous body is more difficult to obtain with a precorneal lens than with a flat contact lens without reflecting mirrors. As far as is practical, the axis of the precorneal lens should coincide with that of the eye examined. Even a very slight error in centering causes considerable distortion of the fundus image and further limits the value of the technique.

The planoconcave lens is the one most often used (Fig. 7–31). Its concave side must face the cornea at a distance of 17 mm in emmetropes. This distance should be less in high myopes and greater in hyperopes. The slit lamp manipulations and examination procedure are conducted in the same manner as with the central part of the three-mirror contact lens. To extend the peripheral view, the lens is decentered toward the opposite meridian. The view may be extended more peripherally by directing the patient's gaze toward the meridian to be examined. Bothersome reflections and aberrations may be somewhat decreased by tilting the lens, adjusting the illumination-observation angle, or refocusing the slit beam.

A precorneal planoconvex lens can also be used with the biomicroscope. It functions as if it were the condensing lens of an

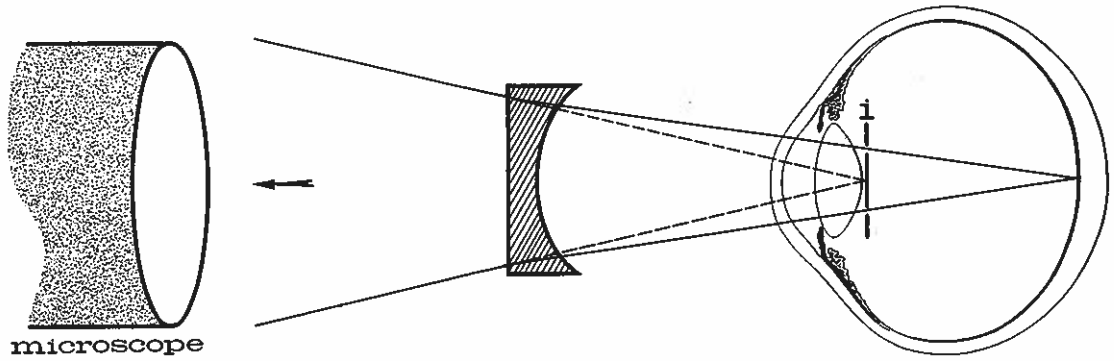

Figure 7–31 Planoconcave lens placed in front of eye images fundus in location close to i, which is within focusing distance of slit lamp microscope. (Modified from Tolentino, F. I., Schepens, C. L., and Freeman, H. M., *Vitreoretinal Disorders: Diagnosis and Management.* Philadelphia, Saunders, 1976)

indirect ophthalmoscope (Fig. 7–32). Its advantages over indirect ophthalmoscopy are greater magnification and slit illumination. It is especially useful for examining the retina of high myopes. With this technique, the examiner must focus the microscope and slit lamp on the inverted aerial image of the vitreous cavity and fundus. For this purpose it is necessary to use a slit lamp microscope that permits such focusing. It is available with the Zeiss biomicroscope, which has a chin rest that can be moved away from the corneal microscope; its use is impractical with the Haag-Streit 900 slit lamp.

Examination Technique

Examination of the vitreous (20) is preceded by an ophthalmoscopic examination. The fundus drawing should be available for reference. The patient is instructed to keep forehead and chin snugly against the supports provided on the slit lamp and to hold the hand bar. He should keep the eyes open all the time and follow the fixation light with the eye that is not being examined. Biomicroscopic examination of the anterior segment and anterior vitreous is conducted first without the contact lens. The structures in the anterior vitreous appear more magnified without the contact lens and this makes it easier to detect fine details such as minimal bleeding and low-grade inflammation or degeneration.

After instillation of anesthetic drops, the biomicroscope is moved to one side and the examiner holds the contact lens containing methylcellulose in the right hand if he is right-handed, with the

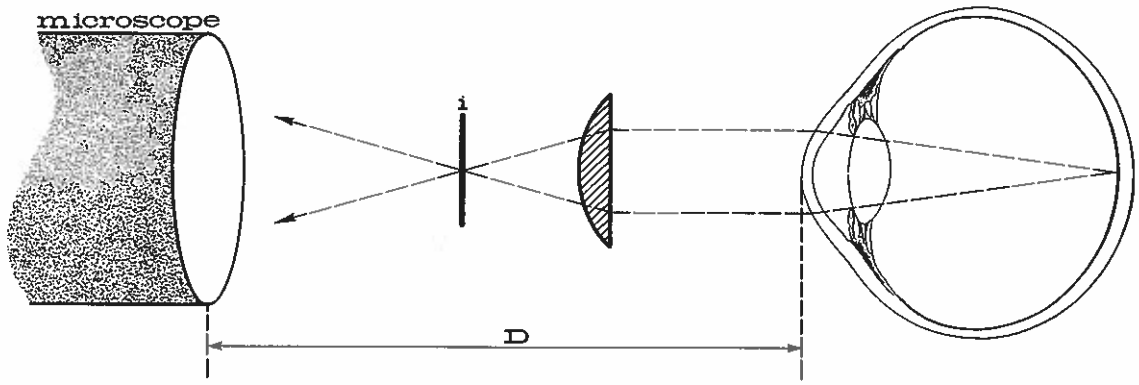

Figure 7–32 Planoconvex lens placed in front of eye makes inverted fundus image (i) between lens and microscope. Observation of this image requires greater than usual distance (D) between patient's eye and microscope. (TC 14,683) (Modified from Tolentino, F. I., Schepens, C. L., and Freeman, H. M., *Vitreoretinal Disorders: Diagnosis and Management.* Philadelphia, Saunders, 1976)

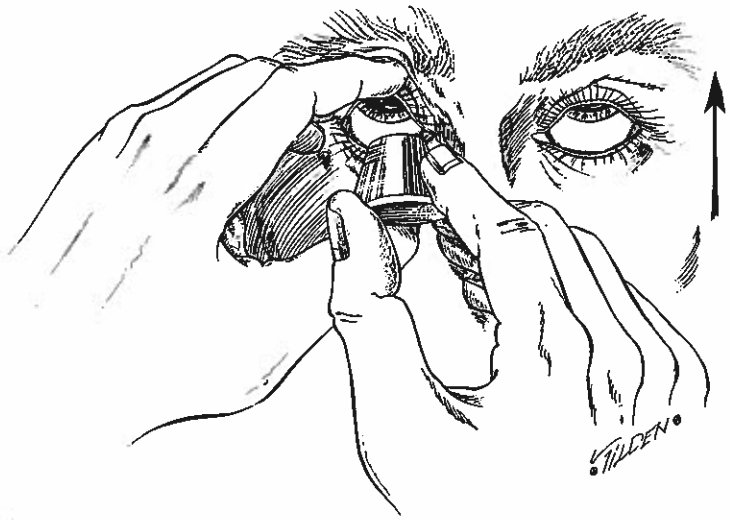

Figure 7–33 Technique of inserting three-mirror contact lens. (Courtesy of Tolentino, F. I., Schepens, C. L., and Freeman, H. M., *Vitreoretinal Disorders: Diagnosis and Management.* Philadelphia, Saunders, 1976)

corneal portion facing up. The lids are held apart with the left hand, the index or middle finger on the upper lid and the thumb on the lower lid. While the patient's eyes are directed slightly upward, the edge of the contact lens is placed in the lower conjunctival cul-de-sac (Fig. 7–33); then the corneal portion of the lens is placed against the globe. To prevent methylcellulose from running down the patient's face, a piece of tissue paper should be placed on the cheek, under the examiner's hand.

When the lens is in position, it should be held in one hand, between the thumb and index finger, the latter resting lightly on the front surface of the lens. The middle finger supports the lens underneath and the little finger rests on the patient's cheek (Fig. 7–34). The thumb and index finger are used to rotate the lens around its anteroposterior axis and to maintain it in place with constant gentle pressure in order to prevent the formation of air bubbles. If an air bubble forms under the lens, it may be expelled through a combination of gentle pressure, rotation, and tilting of the lens. If this is ineffective, the lens must be removed and reinserted.

Excessive pressure of the contact lens on the globe causes corneal edema. Releasing pressure on the lens and allowing it to remain in contact with the cornea by capillarity alone will often improve clarity. The methylcellulose solution provides optical continuity between cornea and con-

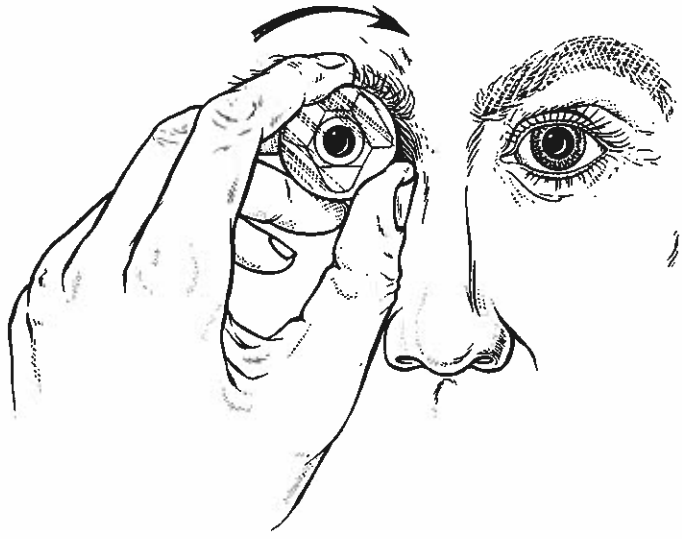

Figure 7–34 Position of examiner's fingers to hold and manipulate lens with one hand. (Courtesy of Tolentino, F. I., Schepens, C. L., and Freeman, H. M., *Vitreoretinal Disorders: Diagnosis and Management.* Philadelphia, Saunders, 1976)

tact lens; it is available in concentrations of 1%, 2%, and 2.5%. The higher concentrations are useful with apprehensive patients who blink constantly and with inexperienced examiners. However, the higher concentrations tend to produce epithelial edema, which precludes prolonged examination. It is also more difficult to remove a lens inserted with a strong solution. In this situation, gentle indentation of the globe with the back of a fingernail placed near the edge of the lens readily permits removal of the contact lens from the cornea. A viscous 2.5% methylcellulose ointment has been recommended to maintain the contact lens in place (21). It is a help for beginners who have problems in maintaining the lens in place without air bubbles, or for very difficult cases. However, the ointment appears less clear than the methylcellulose solution and is not recommended for routine use.

Most examiners use the left hand to hold the contact lens in the patient's right eye, and vice versa. When the illumination arm is changed from one side of the microscope to the other, it may be useful to switch hands. Switching of hands or allowing another observer to take hold of the lens is done by placing a fingernail against the front of the contact lens for support. This method avoids smudging the front surface. However, switching of hands can be avoided if the examiner moves an elbow toward the patient while maintaining hand position and hold on the lens. With the same technique the examiner can move out of the way and allow others to observe interesting findings through the microscope.

The examination proceeds by first looking with low magnification at the central part of the vitreous cavity, from the back of the crystalline lens to the retina. A vertical slit beam is used at the start; then the illumination column is tilted, and horizontal and oblique slit beams are used. The anterior vitreous cavity is best viewed with a large illumination-observation angle, which provides a very dark field against which to examine the optical section. As the focus of the biomicroscope is moved posteriorly, the illumination-observation angle must be narrowed to allow both axes to enter the pupil. Thus, inspection of the posterior vitreous cavity and adjacent retina becomes more difficult because the red glow of the choroid tends to obscure details in the optical section. This red glow may be decreased by shortening the length and width of the slit beam, or reducing the light intensity. The view through the central portion of the three-mirror lens may be extended peripherally by directing the patient's gaze to one side and sliding the contact lens toward the opposite side. Retroillumination is useful for detecting particulate matter in the vitreous cavity and on the inner retinal surface. It is best obtained with an optimally inclined slit beam which is focused slightly behind the structure under scrutiny. It is helpful in detecting preretinal membranes, layers of the vitreous cortex, new vessels on the inner retinal surface, and early vitreous detachment. It may be used in studying the surface of vitreous membranes, particularly the posterior hyaloid face. With retroillumination, particles and fibers in the vitreous often appear magnified.

The oscillation technique is utilized in studying vitreous details with retroillumination and direct focal illumination. This is accomplished by alternately raising and lowering the entire biomicroscope when the slit beam is horizontal or oblique, or by moving it from side to side when the slit beam is vertical. This method may be modified by moving the illumination arm to and fro, rotating the slit lamp mirror and slit orientation control around their vertical axis, or changing the incidence of the slit beam on the central or mirror surfaces of the contact lens. The latter is accomplished by rotating the contact lens back and forth around its anteroposterior axis or moving it to and fro horizontally or vertically.

The foregoing methods may be performed in conjunction with the ascension phenomenon, which is elicited by instructing the patient to look rapidly up and down, or left and right, then back to the primary position of gaze. This movement disturbs the configuration of the vitreous body, which continues to move after the eyeball has become stationary. The technique is used to demonstrate

minimal detachment of the posterior vitreous face and to detect discrete vitreoretinal adhesions in the inferior quadrants and the posterior pole.

At this point the examiner should remember that he is seeing only successive cross sections which must be reconstructed into a three-dimensional structure in order to get an overall picture of the vitreous body. To complete the picture, his attention should now be directed to the examination of the periphery. This is done through the mirrors in the contact lens (see Fig 7–30).

The equatorial mirror is used first, and then the peripheral mirror. The gonioscopic mirror is used occasionally to study the pars plana ciliaris through a sector iridectomy or a fully dilated pupil, with the help of scleral depression. With all the mirrors, the illumination column must be inclined forward except when examining the 12 o'clock area. The optimal inclination and orientation of the slit beam and mirror of the contact lens vary from one meridian to the other and must be determined by trial and error.

In order to follow an extensive structure in the vitreous cavity, it is necessary to use the mirrors in succession. The field of each mirror overlaps with that of the next so that the structure can be followed from beginning to end (see Fig. 7–30). The range of view through each mirror may be increased peripherally or centrally. To increase it peripherally, the patient's gaze is directed toward the area to be examined and the mirror is moved in the opposite direction. To increase it centrally, the same technique is reversed. Examples: A more peripheral view of the 12 o'clock meridian is obtained by directing the patient's gaze upward and tilting the contact lens downward; a more central view of the same meridian is obtained with the patient's gaze directed downward and the contact lens tilted upward.

A binocular view becomes more difficult to obtain in the extreme periphery because the pupil is transformed into an ellipse. This problem is more severe in the horizontal than in the vertical meridians since the examiner's eyes are necessarily located on a horizontal line. Consequently, when looking along a horizontal meridian, the observer's two visual axes must enter the patient's elliptical pupil along its short axis (Fig. 7–35). A technique that minimizes this difficulty is to reduce the illumination-observation angle to the minimum, position both arms of the biomicroscope opposite the meridian under observation, incline the illumination column optimally, rotate the slit beam parallel to the observed meridian, and reduce somewhat the interpupillary distance of the microscope.

Interpretation of the image seen in a mirror is often confusing to the beginner. The image is a view of the opposite end of the meridian in which the mirror is located. This image is inverted along the meridian examined. For example, a structure located in the periphery at 12 o'clock is viewed through a mirror placed at 6 o'clock. This image is upside down but

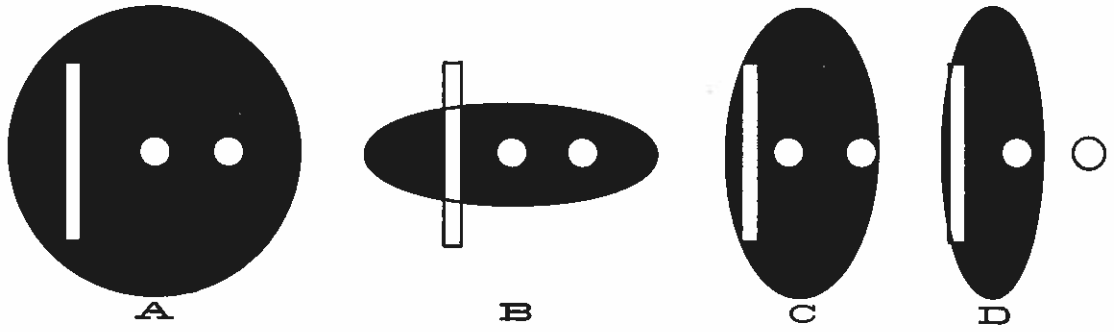

Figure 7–35 Limitation of binocularity when viewing fundus periphery through biomicroscope. Black areas represent patient's pupil. Vertical bar represents slit illumination coming from observer's left. White circles represent images of observer's pupils. (A) When looking centrally, binocularity through dilated pupil is no problem. (B) When looking at periphery above or below, binocularity remains good. (C) When looking slightly nasally or temporally, binocularity is still possible, but in far periphery (D), vision necessarily becomes monocular.

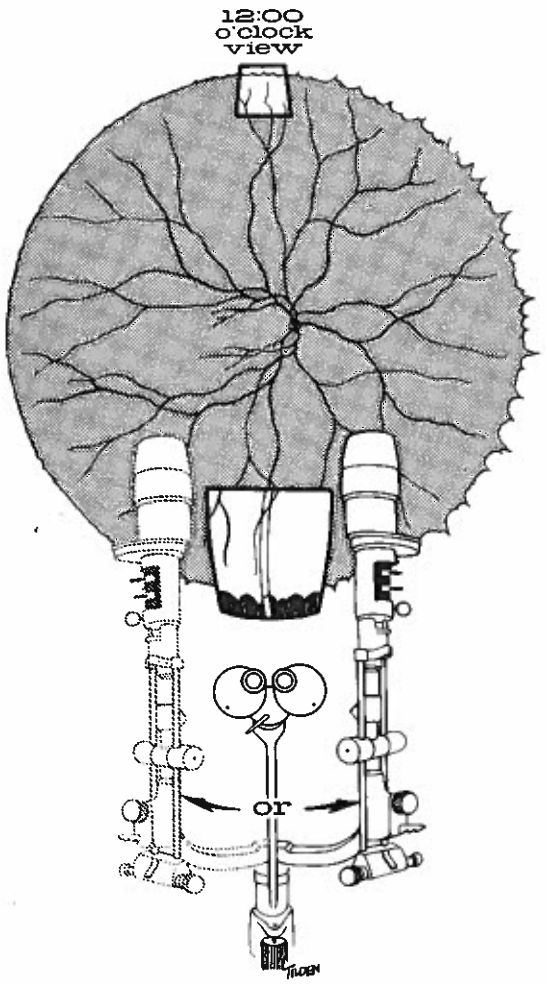

Figure 7–36 Fundus view through mirrors of contact lens. To examine upper area, slit-lamp column must be vertical and may be either to right or left of microscope. It is in the mirror placed at 6 o'clock that observer sees upside-down picture of upper periphery. However, sides are not reversed: right side remains to right and left side to left. (Modified from Tolentino, F. I., Schepens, C. L., and Freeman, H. M., *Vitreoretinal Disorders: Diagnosis and Management.* Philadelphia, Saunders, 1976)

structures on either side of the meridian examined remain on the same side (Fig. 7–36).

In order to maintain an optimal view of the vitreous and retina, the examiner must continuously adjust the illumination-observation angle, degree of inclination of the illumination column, slit beam rotation, illumination mirror rotation, focus and height of the biomicroscope, and contact lens position. Although these manipulations are difficult to master at first, they become second nature after a few months of practice.

The 12 o'clock meridian is viewed by placing the contact lens mirror in the 6 o'clock position. The illumination column is vertical and placed on either side of the microscope. The 6 o'clock meridian is viewed by placing the mirror at the 12 o'clock position, with the illumination column tilted forward. The horizontal meridian is viewed by placing the contact lens mirror at the opposite end of the meridian — i.e., the 9 o'clock area is viewed with the contact lens mirror at 3 o'clock, and vice versa; the illumination-observation angle must be reduced to zero, the slit beam oriented horizontally, and the illumination column tilted completely forward. The oblique meridians are examined by placing the mirror of the contact lens at the opposite end of the meridian examined. The slit beam must coincide with that meridian. The illumination column should be on the same side of the biomicroscope as the mirror in the contact lens when the mirror is located above the horizontal, and on the opposite side when the mirror is located below the horizontal (Fig. 7–37). When the vicinity of the horizontal meridian is examined, slit lamp and microscope should be coaxial.

It is suggested that at least half an hour be spent in the examination of each eye. For an experienced examiner, a ten-minute examination may provide the essential information, but complicated cases may require more than half an hour.

It is essential to make an accurate and clear record of all findings in biomicroscopy of the vitreous cavity. This is done on a Tolentino chart (18) (Fig. 7–38, p. 132). It has a small fundus drawing and appropriately oriented cross sections of the globe, which give a three-dimensional concept of the structures in the vitreous cavity. The color scheme used is identical to that employed in making a fundus drawing. Although it is not necessary to record each finding during examination, some sketching at that time is extremely helpful. Other findings are committed to memory and recorded when the examination is completed. The locations of the cross sections sketched are indicated

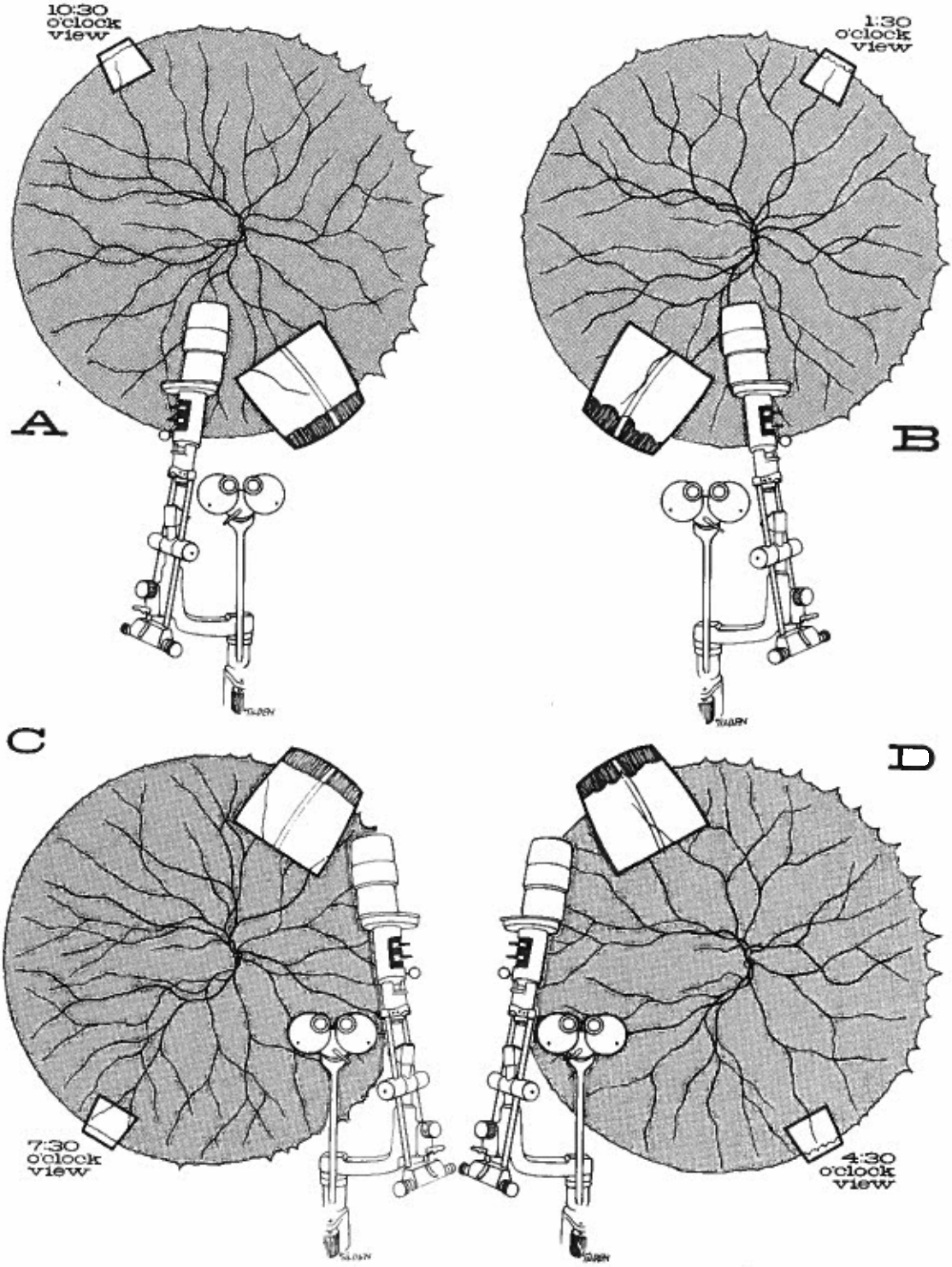

Figure 7–37 Best technique for observing periphery in oblique or horizontal meridians. Slit beam coincides with meridian examined. Slit-lamp column is inclined on its axis. It is located on opposite side of mirror used when mirror is located below horizontal (A) and (B), and on same side if mirror is located above horizontal (C) and (D). (Modified from Tolentino, F. I., Schepens, C. L., and Freeman, H. M., *Vitreoretinal Disorders: Diagnosis and Management.* Philadelphia, Saunders, 1976)

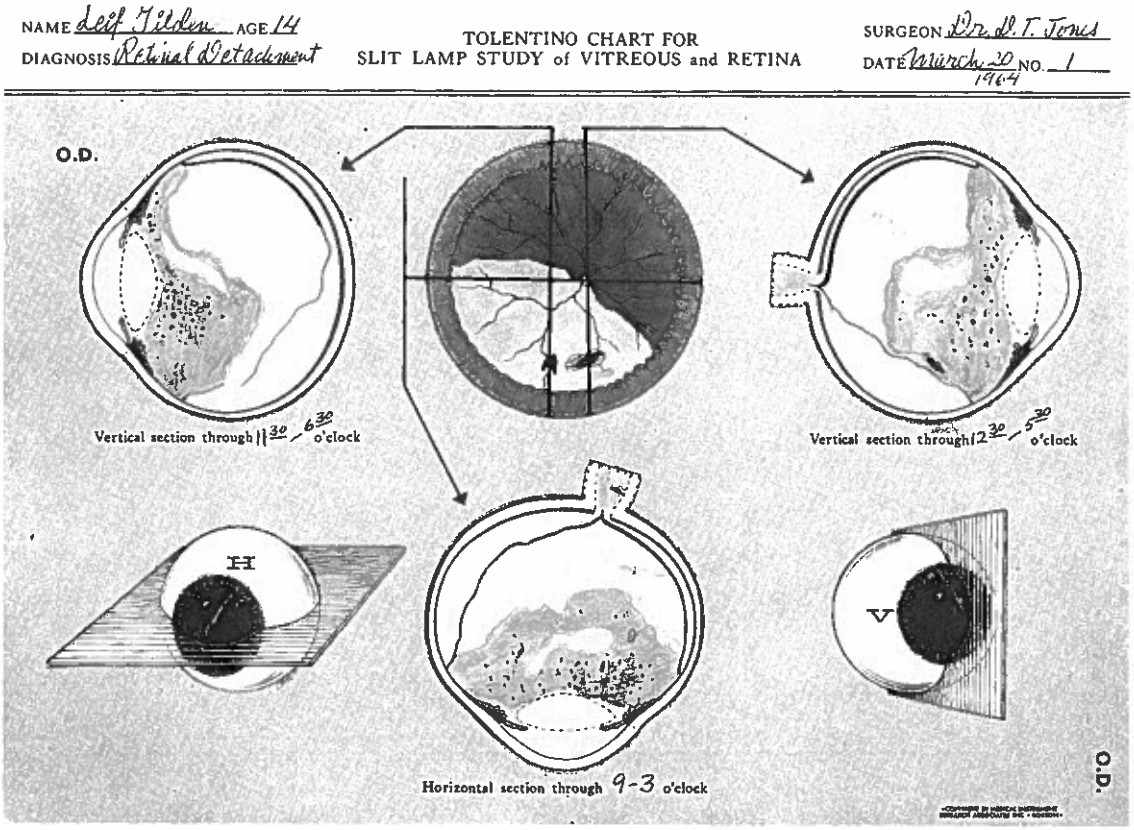

Figure 7–38 Tolentino chart for recording findings of slit lamp microscopy of fundus and vitreous cavity. Fundus is sketched in top middle for orientation purposes. Top left and right, vertical or oblique sections of globe are sketched. Bottom center, sketch of horizontal section. Lines crossing fundus sketch indicate cross sections represented at ends of arrows. H, plane through which horizontal section sketch was made. V, plane through which vertical section (12:30–5:30) was made. (Courtesy of Tolentino, F. I., Schepens, C. L., and Freeman, H. M., *Vitreoretinal Disorders: Diagnosis and Management.* Philadelphia, Saunders, 1976)

by straight lines across the small fundus drawing. These cross sections should show areas of attached and detached retina, attached and detached vitreous, blood clots, membranes in the vitreous cavity, and scleral implants or tumors. Comments on findings that cannot be drawn adequately should be written in.

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