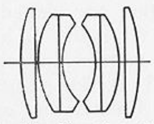
are also designed to include a rather small angular field, and have a maximum aperture of *f*/8 to *f*/10. The principal types are shown in Plate VI, Directory Section.

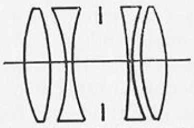
Lenses For Enlarging

Enlarging lenses must be corrected for shorter image distances than camera lenses and for good definition over a flat field. They must also be well-corrected for chromatic aberration for visual focusing and for spherical aberration, because ordinarily the image is focused at the largest aperture and the lens stopped down for the exposure. The short object distances make it possible to use lenses of shorter focal length, for the same size negative, than is desirable on the camera, provided the lens is well-corrected.

Most lenses for enlarging are triplet or Tessar designs. While the maximum aperture is *f*/4.5, or in some cases larger, these lenses are designed for use at one or two stops smaller. To provide improved correction particularly in color work and in enlarging from 35mm negatives, a number of manufacturers have brought out enlarging lenses of more complex design. The *Componon* of Schneider is a Gauss-type lens (Fig 36) which is made in two series; one at *f*/4 for 35mm negatives and the other *f*/5.6 for larger negatives. The *Pro-Raptar* of Wollensak *f*/4 to *f*/5.6 depending on focal length is also a six-element lens (similar to Fig. 11) designed especially for precision enlarging. The *Tri-Color f*/4.5 of the Goerz American Optical Company (Fig. 37) is also designed for color work and is described as "near-apochromatic." The same firm also makes an apo-



36. The Schneider Componon enlarging lens.



37. The Goerz Tri-Color Enlarging and copying lens.

chromatic *Artar f*/9.5 in focal lengths as short as 4 inches (105mm) for enlarging from 35mm color transparencies and color negatives.

Care Of Lenses

Cases are available for most interchangeable lenses for miniature cameras, but not usually for larger lenses in lens shutters. When not on the camera, these should be protected with lens caps over both the front and rear elements. In use, avoid touching the surface of the glass with the fingers, and as far as possible protect it from chemical and industrial fumes and salt spray. Avoid also sudden shock and quick changes in temperature. Prolonged exposure to high temperatures is undesirable, particularly with lenses having cemented elements, but no ill effects need be feared at temperatures below 100°F., or higher, if the lens is a recent one in which the new thermoplastic cements are used.

It should seldom be necessary to clean the surfaces of a lens which has been properly protected from dust and finger marks, and when it is, gentle wiping with clean lens tissue should be sufficient. If it is not sufficient, apply a diluted solution of a detergent, such as "Dreft," with a medical cotton swab. Solvents, such as alcohol or acetone, are best avoided; if used, they should be applied sparingly with a cotton swab just barely moistened with the solution. Avoid pressure, whether using lens tissue alone or a solution. Hard rubbing, even with lens tissue, may do more harm than good.

Lens Testing

To determine the performance of a lens with the utmost precision, it is necessary to use an optical lens bench. On a lens bench the various aberrations can be detected and measured by examining with a microscope the image formed by the lens of an illuminated test object or "target."

The photographer with a camera focusing on the ground glass can test his lens by examining the image of a test ob-