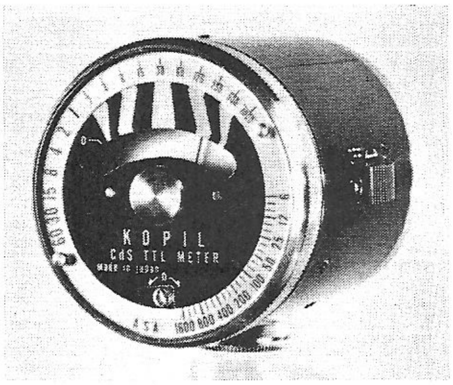
Camera
Jul 1966

Whither the Meter Cell?

Final part

Equivalent Image Planes

The principle of equivalent image plane measurement is the reflection of the image forming rays into a plane which corresponds optically to the film plane. The obvious example is the viewing screen of a reflex camera—provided the reading is made in the screen plane (and not a measurement of the brightness of the screen image). This idea is fairly widely used in amateur cine cameras (employing the same beam splitter or reflex shutter which diverts part of the light to the reflex viewfinder), but has not so far appeared in still reflex cameras. An interesting variation on the equivalent image plane, but this time with a separate exposure meter, is the Kopil TTL. This is a tube, simulating a camera body, with a cadmium sulphide cell at one end and a lens mount at the other. It is intended for camera set-ups where the lens or other supplementary gear



The Kopil through-the-lens meter replaces the camera body on the lens—provided the set-up is sufficiently static to permit removal of the camera without its optical system. A cadmium sulphide cell reads the light over a central portion of the image field.

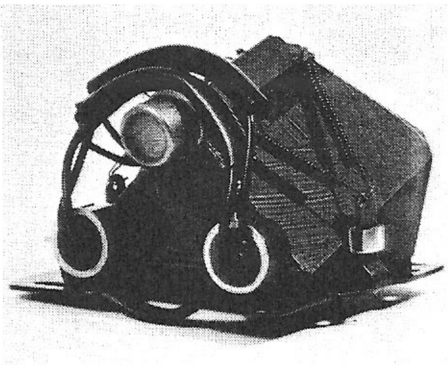
(such as focusing bellows) is firmly mounted, but the camera body removable. Examples are macrophotography, photomicrography, extreme telephoto work, etc. Once the camera is set up and focused, the body is removed and replaced by the Kopil unit. In the centre of the latter a cadmium sulphide cell of about 120 sq. mm. (roughly $^1/_7$ of the 24 × 36 mm. image area) measures the light coming through the lens from the subject set-up. The Kopil TTL is available with a variety of lens mounting rings to take interchangeable lenses of most leading camera types (focal plane shutter models).
The measurement is truly in the image plane, but selective image tone readings—possible only to a limited extent—require extensive rearrangement of the camera adjustment. For hand-held shooting such a substitution is not practical anyway, since the meter would then need an accurate viewfinder for aiming.

Reading the Reflex Screen

The compromise favoured by most cameras with through-the-lens metering systems involves measurement of the brightness of the screen image. (Needless to say, this applies only to reflex cameras.) This in all cases involves measuring the whole image area and is thus an average reflected light reading. Since the measurement can take place during viewing of the image, such systems are suitable for automatic exposure control.
Any attempt to read selected subject areas has been discarded here, largely on the assumption that such selective readings are impractical with the small image area of a miniature camera.
Since the finder screen is an equivalent image plane, measuring errors with different focal lengths and lens apertures are constant and are thus easy to compensate by calibration.
Screen measurement therefore requires allowance only for two potential sources of error: evenness of coverage and back light through the finder eyepiece.
The first of these is usually taken care of by having a pair of meter cells incorporated in the pentaprism housing of the camera and positioned to cover between them the full image area reasonably uniformly. Approaches to back light compensation are responsible for most of the variations in measuring set-ups with current screen measuring cameras.
The back light we are concerned with here is stray light reaching the finder screen through the eyepiece. Obviously such light would influence the measurement of the meter cell. In principle this is likely to be a serious question only if the eyepiece is left completely open. In practice, since the meter needle or other measuring indication is also viewed through the finder, trouble is only likely to arise with photographers wearing spectacles (and hence not keeping their eyes absolutely close to the finder eyepiece) while shooting in brilliant sunlight coming from behind the camera. An extreme case is such sunlight conditions with the camera pointing at a subject in the shade, so that the true image brightness is comparatively low but the stray back light fairly high. The various camera designs aim to deal with this back light correction in a variety of ways; most of them do not correct satisfactorily for the extreme (but very rare) case just described but are fully satisfactory on more normal occasions. (Comparative tests have in fact shown that this back light correction is largely superfluous.)
Actually only one camera attempts to compensate for stray light: the Alpa 9d. Introduced

The Alpa 9d was the first screen reading camera on the market. Operational convenience is comparatively low, since the meter is not coupled and requires a complex sequence of operations to take a reading. The key on the camera front, below the winding lever, switches on the meter circuit and locks the shutter release, to permit stopping down of the lens. Readings are taken at the working aperture.

about a couple of years ago, this was the first of the through-the-lens screen measuring miniature reflexes. The compensation here consists of a third cadmium sulphide cell—in addition to the pair receiving the light from the finder screen—to measure the stray light coming through the eyepiece. The current from this cell passes through the galvanometer circuit in opposition to the current from the measuring cells, so providing an electric compensation.



The two lower cells of the Alpa 9d system measure the brightness of the screen via the pentaprism. The third cell at the top points backwards into the eyepiece to record stray light and correct the screen reading electrically.

Most other cameras either aim to reduce the effect to stray light on the cell, or ignore it altogether. The simplest way is to close the finder eyepiece—but that also closes off the view of the meter needle. (The Canon Pellix

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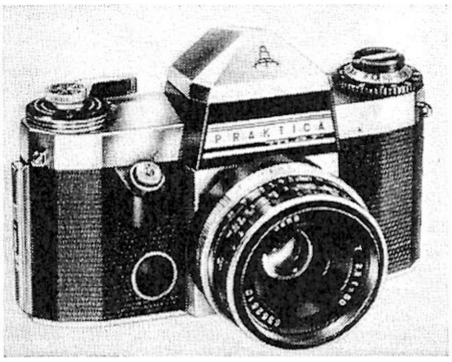
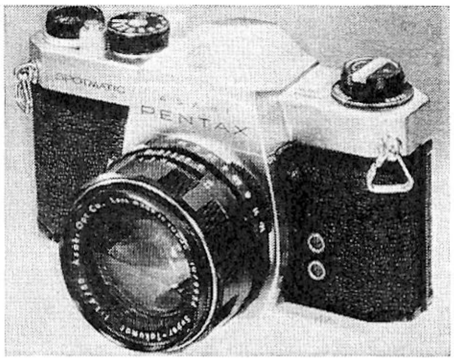
by L. A. Mannheim

The Nikkormat has its meter cells also in the pentaprism finder, with shielding against stray light. The meter system is coupled with the shutter speed and aperture settings; readings are taken at the full lens aperture and lining up the meter needle with a setting index selects the required stop. The coupling works with the interchangeable lenses.



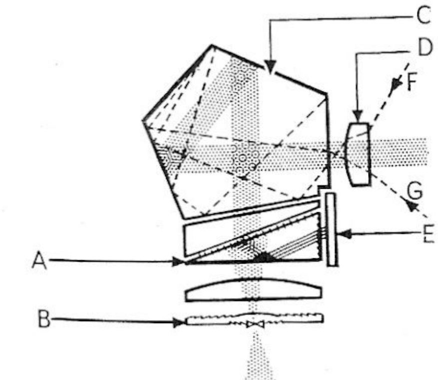
The Praktica-Mat. Measurement takes place at full aperture and is coupled with the pre-selector iris and shutter speed adjustments.



The Asahi Pentax Spotmatic was the first 35-mm reflex introduced (though not immediately marketed) with through-the-lens measurement. The readings are taken with the lens stopped down to the working aperture; the latter thus is used to adjust the meter needle position.

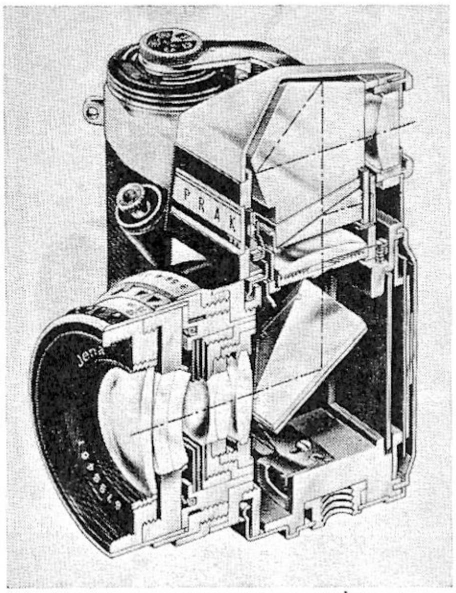
has an eyepiece shutter to avoid light reaching the film via the fixed mirror.) Others, for example Nikkormat, use specially baffled cells to prevent stray light from reaching them (but without specific allowances for stray light on the screen).

Interesting is the solution of the Praktica-Mat from East Germany. Here a beam splitter di-

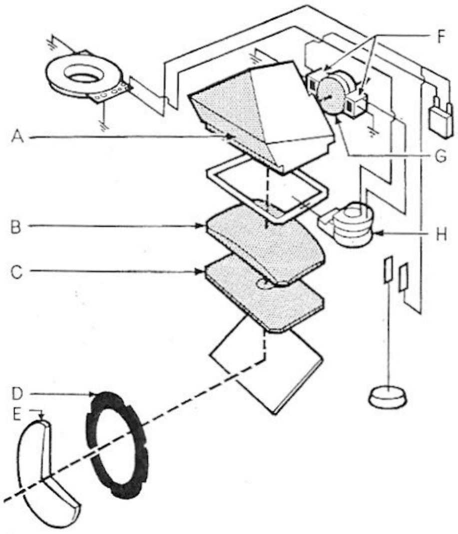


Optical system of the Praktica-Mat. A beam splitter A diverts part of the light from the screen B to a cadmium sulphide cell E. The rest of the light goes through the pentaprism C and the eyepiece D for viewing and focusing. Stray light from outside the optical axis of the eyepiece (F, G) is internally reflected in the pentaprism, but does not reach the screen.

verts part of the light from the screen to the cell, before reaching the pentaprism. The latter is thus further removed from the screen and designed in such a way that only light along the viewing axis can reach the screen. Since that is where the photographer's eye would be anyway, any stray light is effectively minimised. Incorporating meter systems behind the reflex screen invariably involves more or less complex circuity in the camera. Hence such cameras are new and correspondingly expensive designs. Where the pentaprism finder unit is



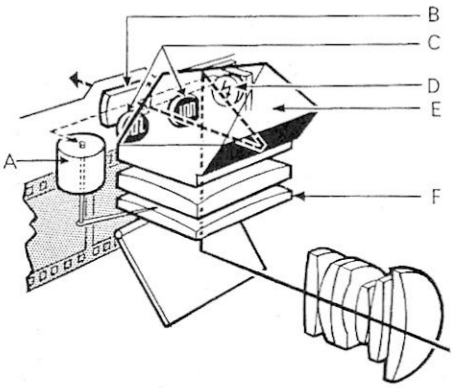
Section through the Praktica-Mat.



The measuring system of the Spotmatic is comparatively straightforward for reflex screen readings. The main elements are the pentaprism A, the screen B, the Fresnel field lens C, the lens diaphragm D, the lens E, the cadmium sulphide cell F, the eyepiece G, and the galvano meter movement H. The circuit also includes variable and fixed resistors for coupling with the shutter speeds, etc.

▶

The main elements of measurement with the Voigtlander Ultramatic CS are the galvanometer A, the eyepiece B, the cadmium sulphide cells C, the battery D, the pentaprism E, and the screen F. This camera is one of the few through-the-lens meter models with fully automatic exposure control: an internal mechanism selects the lens setting immediately before the shutter opens.



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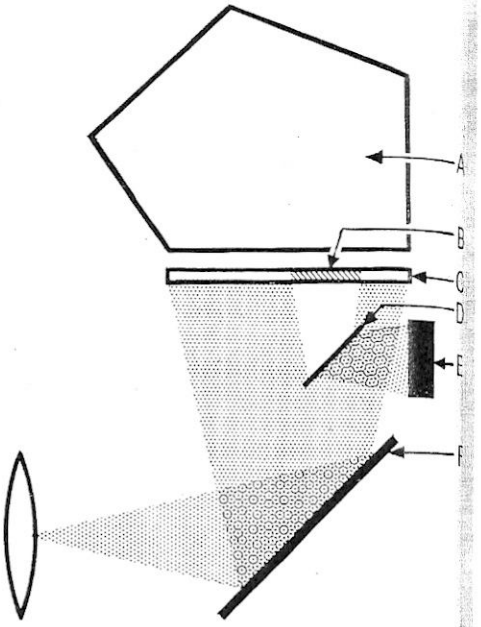
The Photomic T converts the Nikon F into a screen measuring camera. The Photomic T is however a separate pentaprism unit with the coupling with shutter speeds and apertures as well as the cadmium sulphide cells built in.

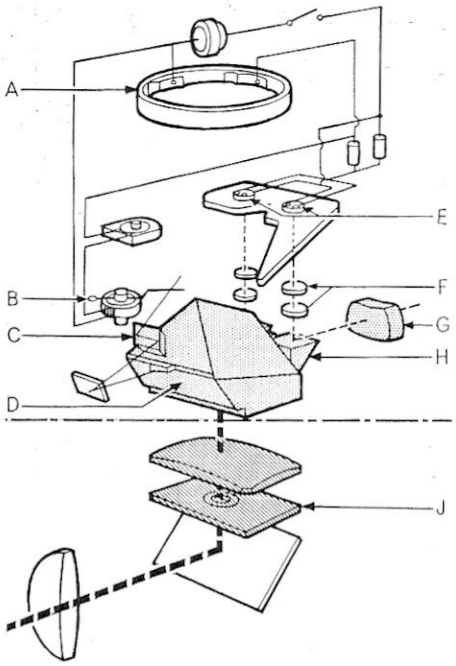
interchangeable, it is however also possible to put a measuring system on top of the screen as a separate unit. Several camera makers are working on systems of this kind. One which has already appeared is the Photomic T for the Nikon F. This is a pentaprism viewing unit, to replace the normal pentaprism, with a built-in screen measuring arrangement. This incidentally couples mechanically with the camera shutter as well as with the aperture setting of the interchangeable Nikon F lenses.

Are New Approaches Possible?

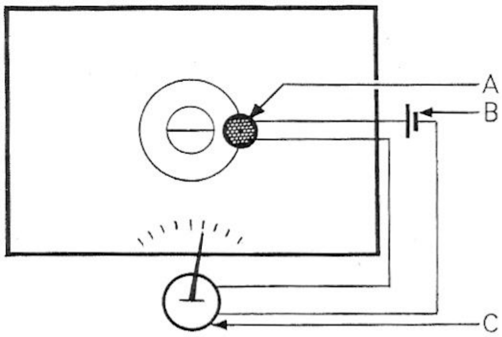
The equivalent image plane of the reflex screen remains attractive as the location of the meter cell for through-the-lens measurement. New developments along these lines will probably be linked with new designs for meter cells. Thus the cadmium sulphide cell is already small in area; it can also become negligible in thickness if the necessary conductor and semi-conductor layers are evaporated directly on to the surface where the light is read.
So it should be feasible to have either a cell spot or a grid applied to the underside of the viewing screen. A small enough spot—placed near the centre of the field—can then bring back the advantages of selective subject area readings to the through-the-lens meter of a miniature camera. The method of reading can be simple enough: just point the camera so that the spot (visible on the finder screen) covers the subject tone to be measured.

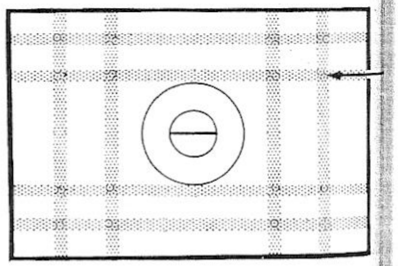


A beam splitter D between the fully silvered reflex mirror F and the focusing screen C diverts some of the light to the cell E. The corresponding slightly darkened spot B on the screen automatically indicates the measuring field.



Main features of the Photomic T. The elements above the dotted line belong to the separate finder system, below the dotted line to the camera. The lens aperture coupling ring A incorporates resistors for film speeds and shutter speed settings. The needle of the meter B is reflected into the pentaprism D via a prism and mirror system C. The twin cadmium sulphide cells E measure the brightness of the focusing screen J via condenser lenses F and condenser prism H through the pentaprism D. The image as well as the meter needle are visible through the eyepiece G. The electrical circuit further includes various resistors, switches and the mercury battery.





Cells beneath the screen. An evaporated semiconductor film on the underside of the screen can form a meter cell 'spot' A (left) within the screen area. Leads (also evaporated metalfilm lines) connect the cell with the battery B and meter movement C. To cover the whole screen an evaporated grid system D (right) could be used, and still permit viewing and focusing.

For automatic exposure control where the meter must read the average reflected light, a fine grid of cadmium sulphide cell elements applied to the underside of the screen does the job. The grid lines can be fine enough not to interfere seriously with viewing. Such a grid cell would thus only have a fraction of the area of the screen, but would in effect sample the whole of it.
Equally sensible would be a beam splitter system which diverts the light for exposure measurement between the reflex mirror and the screen. In principle this could be similar to the Praktica-Mat idea, but with the beam splitter below the screen. If cine cameras can do it, so should miniature reflexes. Moreover, this arrangement would again be suitable for selected spot readings as well as whole image measurement. Cine cameras have already achieved the latter, it is up to the miniature and larger still models to realise reasonably useful spot readings. Even here the principle has already been developed in special camera systems—for example in the Orthomat for photomicrography (see CAMERA, June 1962, page 33).