A WIDE-LATITUDE DEVELOPER FOR USE IN ASTRONOMICAL and SCIENTIFIC PHOTOGRAPHY*

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Astronomical applications and characteristics of a low-gamma Phenidone (POTA) developer are investigated. IIa-D plates exposed on an astrosensitometer, developed in POTA, show retention of density information over an extreme brightness range and no change in minimum detectable intensity when compared with plates developed in D-76 and D-19. The successful application of POTA developer to scintillation-tube photographs and possible future uses are also discussed.

For certain applications in astronomical and scientific photography there has been a need for a low-gamma developer capable of retaining information over an extreme intensity range and without sacrificing minimum detectable intensity or resolution in areas of extreme brightness. Such a developer has undergone tests in our photographic department plus field tests on the McMath Solar and 84-inch telescopes.

Though compounded for use in aerial photography, the formula, POTA (Levy 1966), that has proven applicable in astronomical usage is:

Water	750.0	milliliters
Phenidone*	1.5	grams
Sodium Sulfite (anhyd)	30.0	grams
Water, to make	1.0	liter

* Reg. trademark of Ilford Ltd.

Sensitometric plates, with Kodak IIa-D emulsion, for comparing D-19 and D-76 with Phenidone were made on a spot sensitometer and an astrosensitometer (Millikan and Marchant 1965). For the astrosensitometer tests (Plates I*a* and I*b*) a development time of ten minutes at 20 °C was selected arbitrarily. A Macbeth Quanta-

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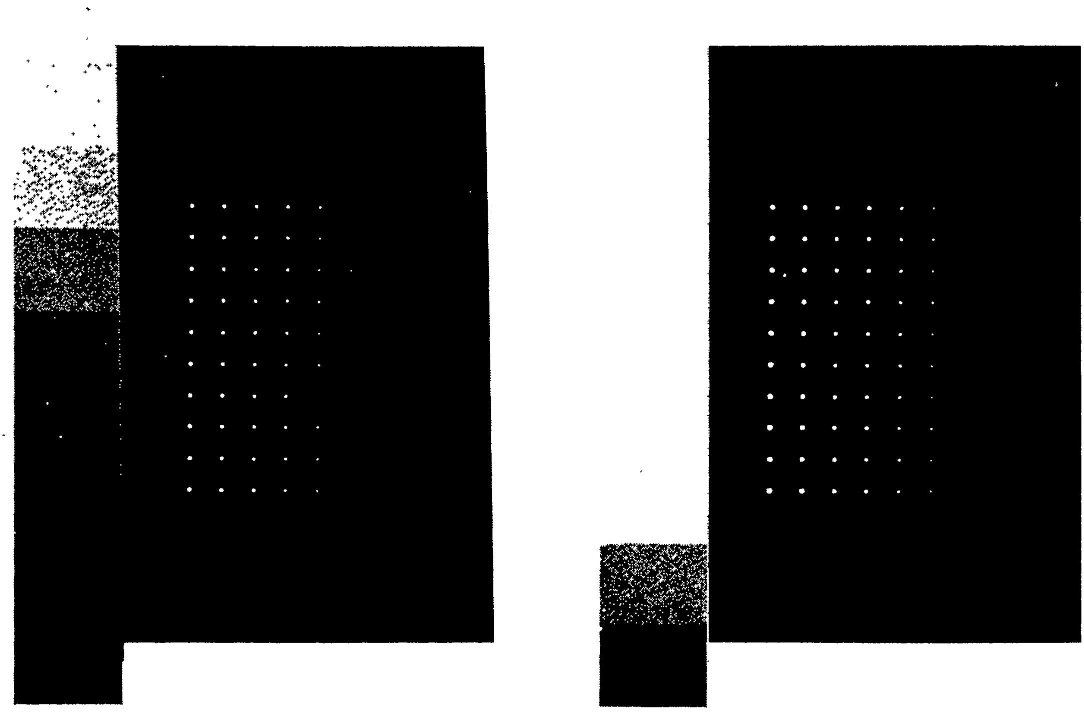

a *b*

PLATE I

The intensity of the exposing light source is decreased per row by an equivalent of 1/4 magnitude. Under laboratory conditions emulsion sensitivity to stellar sources is determined when 50 percent of the spots on the faintest row are visible. *a*) IIa-D developed in Phenidone. Note extended tonal scale with no loss in sensitivity. *b*) IIa-D developed in D-76.

log* densitometer was used to measure spot density on comparison samples and $D \log E$ curves were then plotted. These curves (Fig. 1) demonstrate the low gamma and wide range linearity produced by Phenidone developer. For consistent results all samples were developed in an automatic tray rocker.

In the past D-19 has been used to process 2×2-inch IIa-O plates exposed on an image intensifier system (Livingston, Lynds, and Doe 1965) attached to the Cassegrain spectrograph of the 84-

* Trademark, Macbeth Instrument Corp., Newburgh, New York.

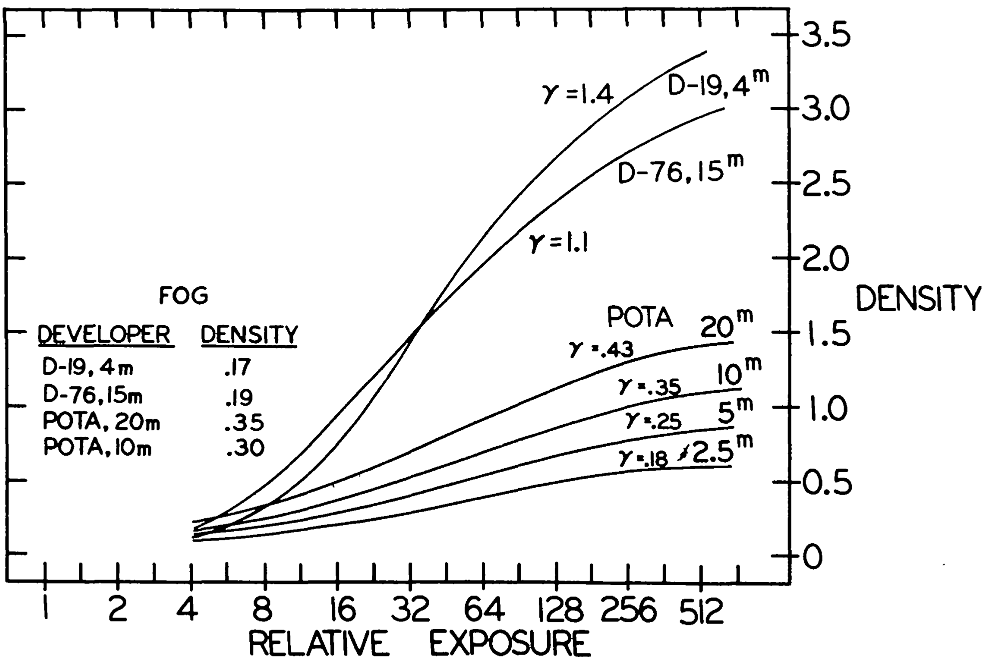

FIG. 1 — Summary of characteristic curves for IIa-D plates developed in D-19 for 4 minutes and in POTA developer for times from 2 1/2 to 20 minutes.

inch telescope. The high-gain ($\sim 10^6$) tube that was used forms an image of distinct scintillations (photons) by saturation. The gain of the tube involves processes that are statistical in nature causing a wide variation in scintillation brightness on the tube's signal output phosphor disk (from which the photographic record is made). Therefore on the photographic plate the scintillation density variance creates an impression of excessive granularity and contrast. Various methods to overcome this problem have previously been attempted, however without success. Using the above system during a recent observing schedule, C. R. Lynds used POTA developer for plate processing. The results are shown in Plates II and III. A development time of 20 minutes gave satisfactory results.

Further test results include the following. Caution must be exercised in plate handling, as verified by previous laboratory tests, since gelatin softening during development is greater than in D-19 or D-76. POTA developer retains an amber color for approximately four hours after mixing; however it was found that solution color has no apparent effect upon its developing qualities. Microscopic tests of samples show a slight granularity increase in POTA compared with D-76. Loss of gamma, though not of tonal scale, in

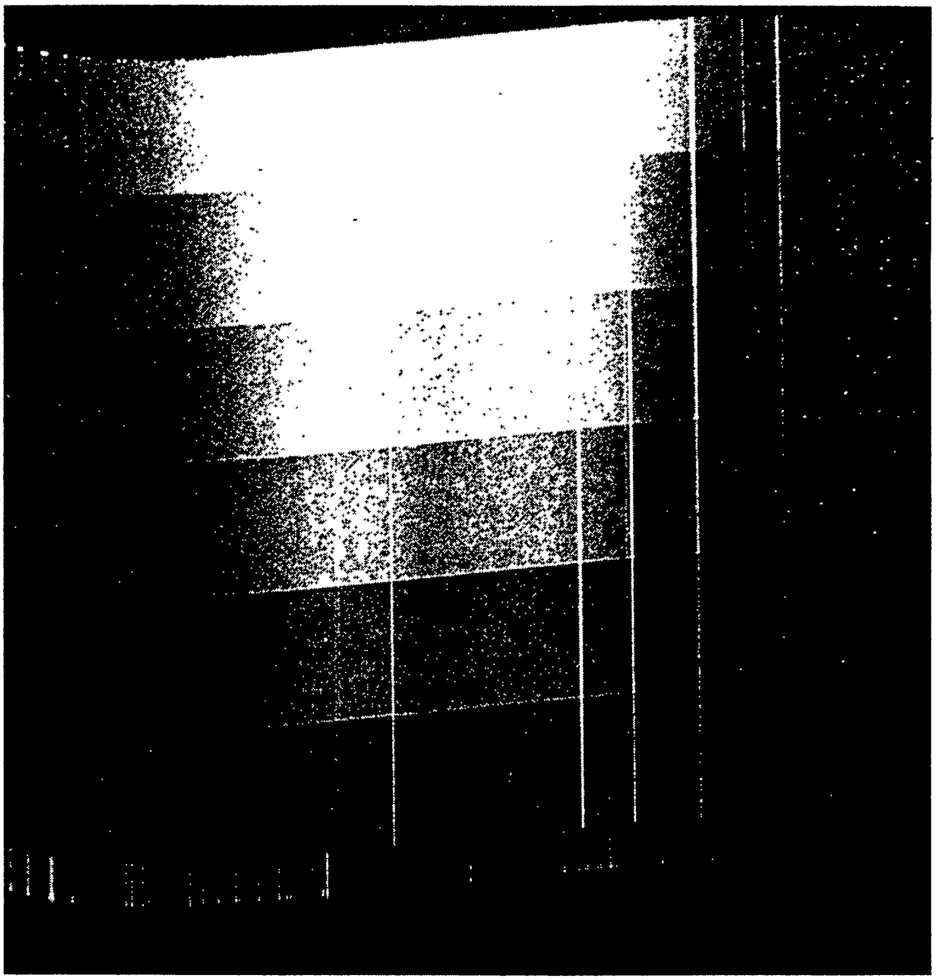

PLATE II

Plate developed in POTA shows total exposure gradation of 50:1.

plates processed in this developer can be remedied in reproduction by proper selection of film or paper.

In conclusion it should be added that the aforementioned POTA formula is not a universal developer. It will not replace D-19 or D-76 when subject material is within a normal brightness range. Yet because of its ability to retain information within an extreme brightness range and do so without change in minimum detectable intensity it does, therefore, fill a gap. For example, the separation of adjacent emission lines in low-dispersion spectrograms of binaries and the resolving of detail within the nucleus and spiral arms of galaxies are some applications in which POTA can be advantageous. Further experiments may add to the list.

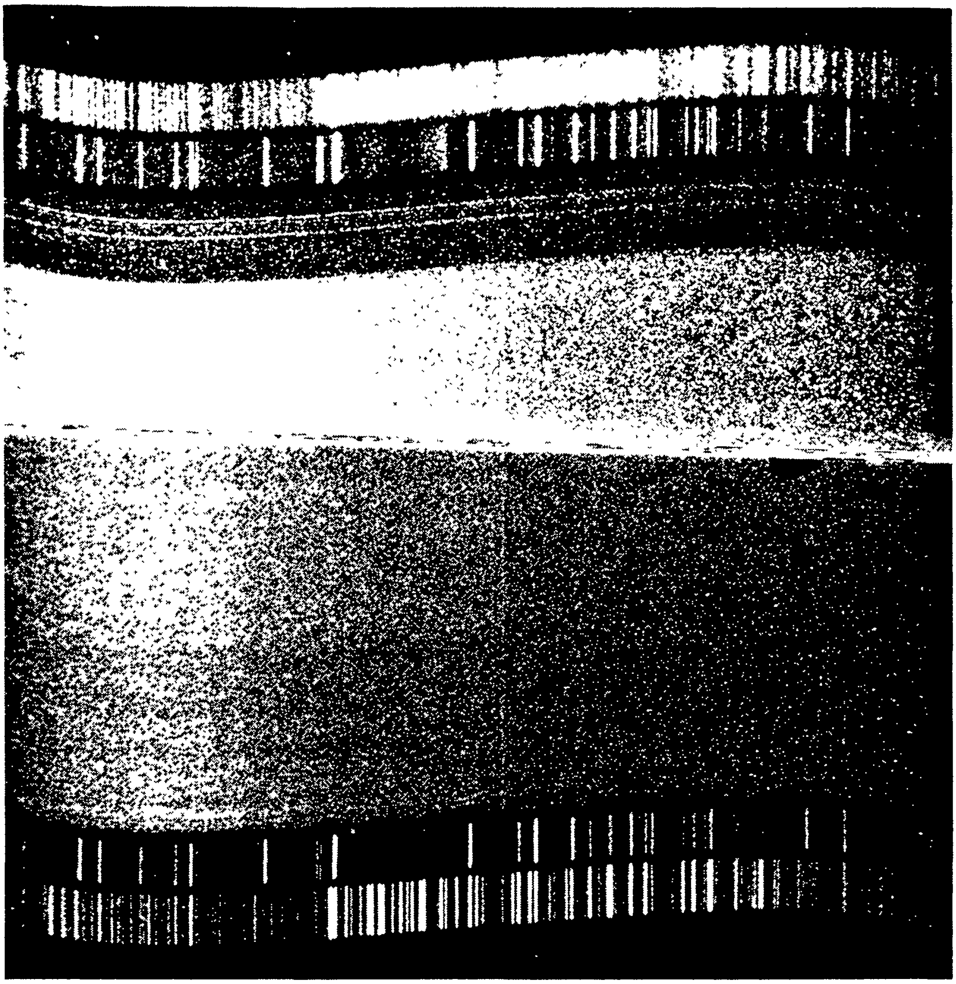

PLATE III
Comparison of plates developed in D-19 (top) and POTA (bottom).

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