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LOS ALAMOS SCIENTIFIC LABORATORY

of

THE UNIVERSITY OF CALIFORNIA

March 19, 1951 LA-1221

SERIES A

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NOTES ON THE RESOLVING POWER AND SPEED OF PHOTOGRAPHIC EMULSIONS

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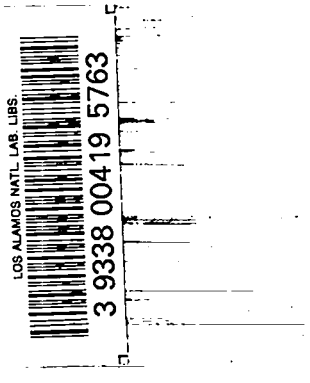

INSTRUMENTATION

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INSTRUMENTATION

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The need for emulsions of high speed and resolution for use with sweeping image cameras led to the study of a number of different types of emulsions. A special resolution testing camera was constructed, and sensitometric tests were made with a short duration light source. All films were developed in D-11 developer for four minutes at 68 to 70° F., except as noted.

The camera used to test the emulsion resolving power must, of course, be of the highest quality and should preferably be apochromatic so that emulsions of different spectral ranges can be used interchangeably. A reversed compound microscope optical system composed of an 8mm apo-objective and a low power ampliplan photographic eyepiece was used. The combination gives a magnification of about 1:50. Visual examination of the image with another microscope showed an optical resolution of about 1000 lines/mm. No color fringing or other evidence of chromatic aberration was found.

The test object is a positive transparency of the U.S.B.S. resolution test chart reduced to 1/2 or 1/6 size as required for a particular emulsion. The emulsion is held in the correct focal plane by means of a suitable light tight cover and pressure plate operating against the surface of a standard microscope cover glass. A revolving camera back permits four images of the test chart to be obtained within a 3mm diameter film aperture. Several exposures of an emulsion of unknown speed can quickly be made with this arrangement. An incandescent

light source (~2500° K) with an opal glass diffuser was used to illuminate the test chart of about 100:1 contrast.

A series of brass tubes with fine threads were used to mount the above components (see L.A.S.L. Drawing 21Y-80035). The critical adjustment of the focus was made by examination of a series of images on Eastman Spectroscopic Plates #649. The position giving the sharpest image was selected and all focus adjustments locked. Periodic rechecks of the focus were made to be sure that no change had occurred.

Several types of film were developed in both D-76 and D-11 to determine possible effects of developer on film resolution. In every case the resolution was the same for both developers. The values obtained were found to be quite reproducible and in good agreement with the available catalog specifications for the emulsions. An exception to this is the fact that no difference was found in the 548 and 649 Spectroscopic Plates. Table 1 is a summary of the results obtained.

This series of emulsions was exposed behind a step wedge using a condenser discharge in air as a light source, the bulk of the light being emitted in 20 μsecs. The densities obtained were read on an Eastman Transmission Densitometer. Figure 1 is a plot of all the densities obtained as a function of the logarithm of the relative exposure. Figures 2, 3, and 4 show the color blind orthochromatic and panchromatic emulsions respectively. Figure 5 shows the results obtained by filtering the light with a mercury green filter and developing for eight minutes. The above information gives a general picture

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TABLE 1

Resolving Power of Kodak Emulsions

Emulsion	Number	Color Sensitivity	Resolution Lines/mm	
			Catalog	Found
Spectroscopic Plate	649	GH	~1000	680
Spectroscopic Plate	548	GH	~ 500	680
Spectroscopic Plate	V	GH	160	165
Spectroscopic Plate	II	O	75	80
Duplicating Positive	5365	Blue	150	165
Kodagraph Print	5364	Blue	---	165
Sound Recording	5372	Blue	150	165
Kodalith	----	Pan	---	165
Micro-file	2042	Pan	180	165
Contrast Process	6111	Ortho	145	125
Fine Grain Positive	5301	Blue	90	80
Linagraph Survey	5254	Blue	---	80
Bi Pack	1236	Ortho	110	80
Linagraph Drift Survey	5368	Ortho	---	80
Shell Burst	5214	Pan	---	80
CTC Plates	----	Pan	---	80
Linagraph	5211	Ortho	---	60
Plus X	----	Pan	95	60
Duplicating Fine Grain	5303	Pan	110	60

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of the speed of the various available emulsions. It can serve as a preliminary guide for the selection of emulsions for specific needs.

A series of sensitometric strips of SB Panchromatic film were developed in DK-76, D-19, SD-19a, D-11, and D-8 developers for times ranging from 1 to 32 minutes. This was done in an effort to determine possible advantages of one developer over another. The developers ranged from the relatively slow, fine grained DK-76 to the most energetic D-8 process developer. Figure 6 shows the time--gamma curves for the five developers tested. It is seen that D-11, D-19, and DK-76 give almost identical results, for all practical purposes, with a background fog from 0.3 to 0.4 for development times from 4 to 32 minutes. These are excellent all purpose developers because of their high energy and good keeping qualities. Development cannot be prolonged beyond 1 minute in D-8 because of the heavy background fog produced. The keeping quality of this developer is very poor and it is of little use with high speed emulsions, except for very rapid processing.

Development in SD-19a is to be recommended where the utmost in speed is required from a high or medium speed emulsion. The figure shows the gamma infinity of this developer to be almost double that of the ones previously used. The background fog is no greater than that obtained with any of the other developers yet it increases the effective film speed by a factor of 2X to 4X. SD-19a has the possible disadvantage that it must be made up fresh for each lot of film to be processed but this tends to result in greater uniformity of results.

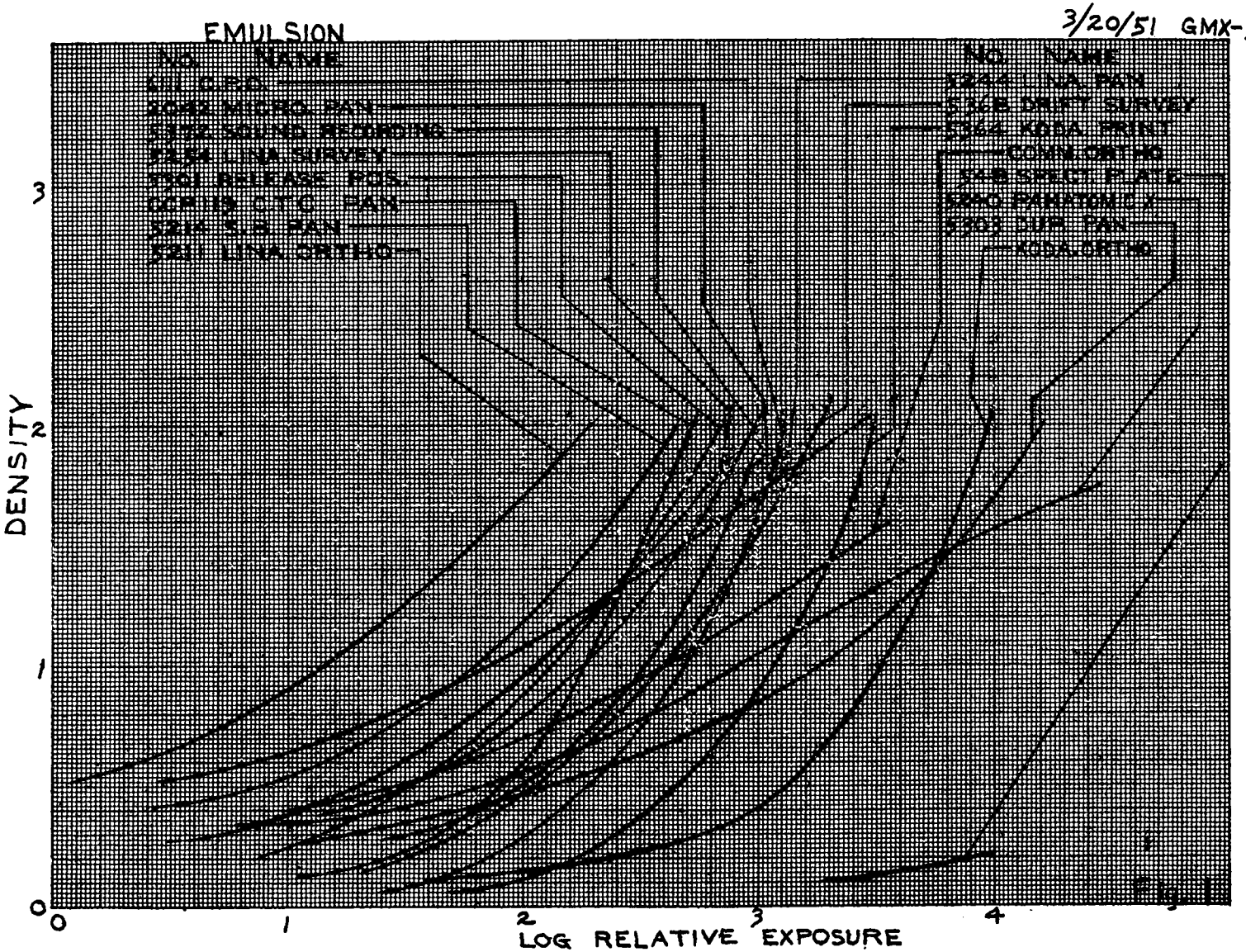

Fig. 1

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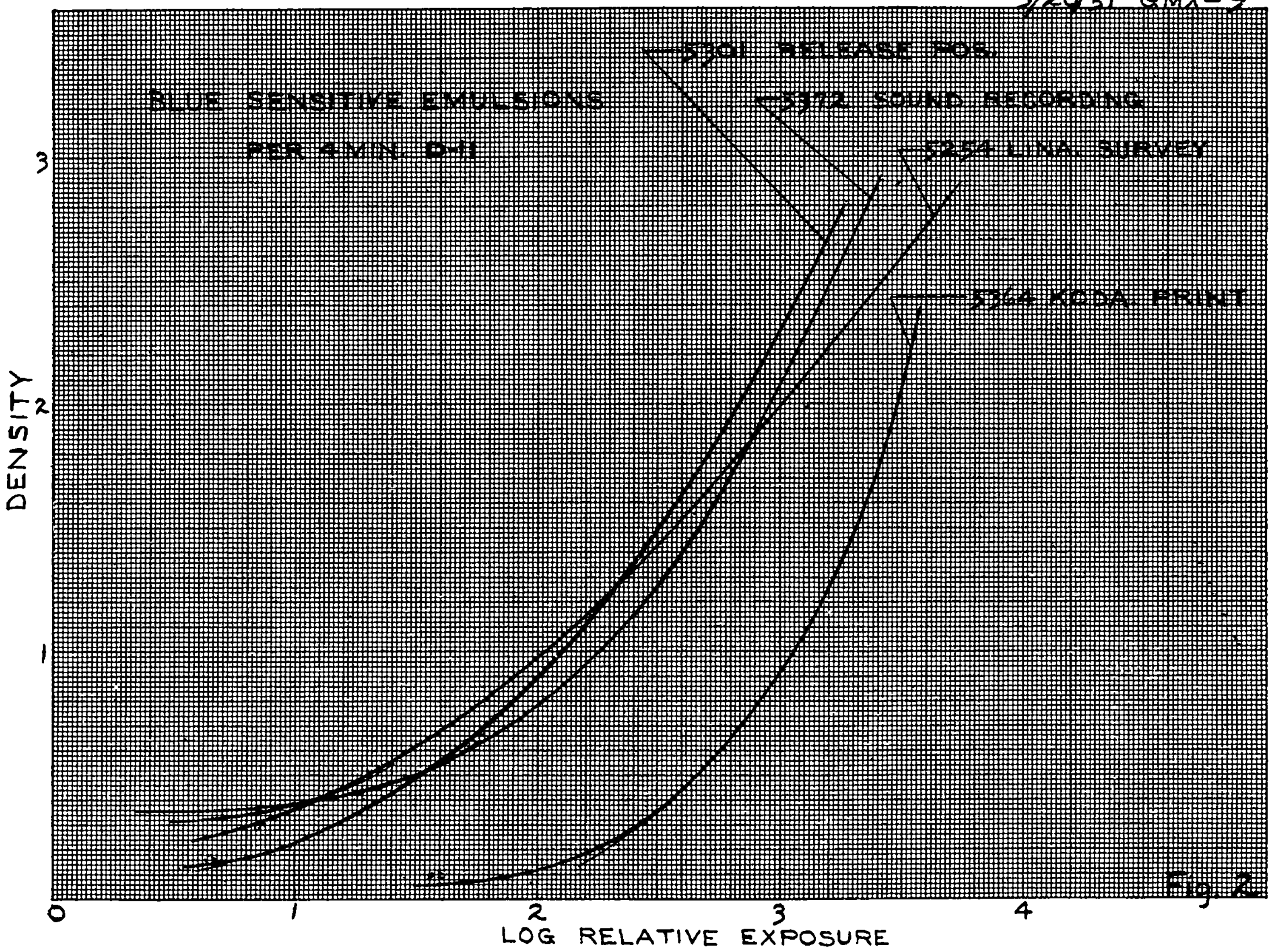

Fig. 2

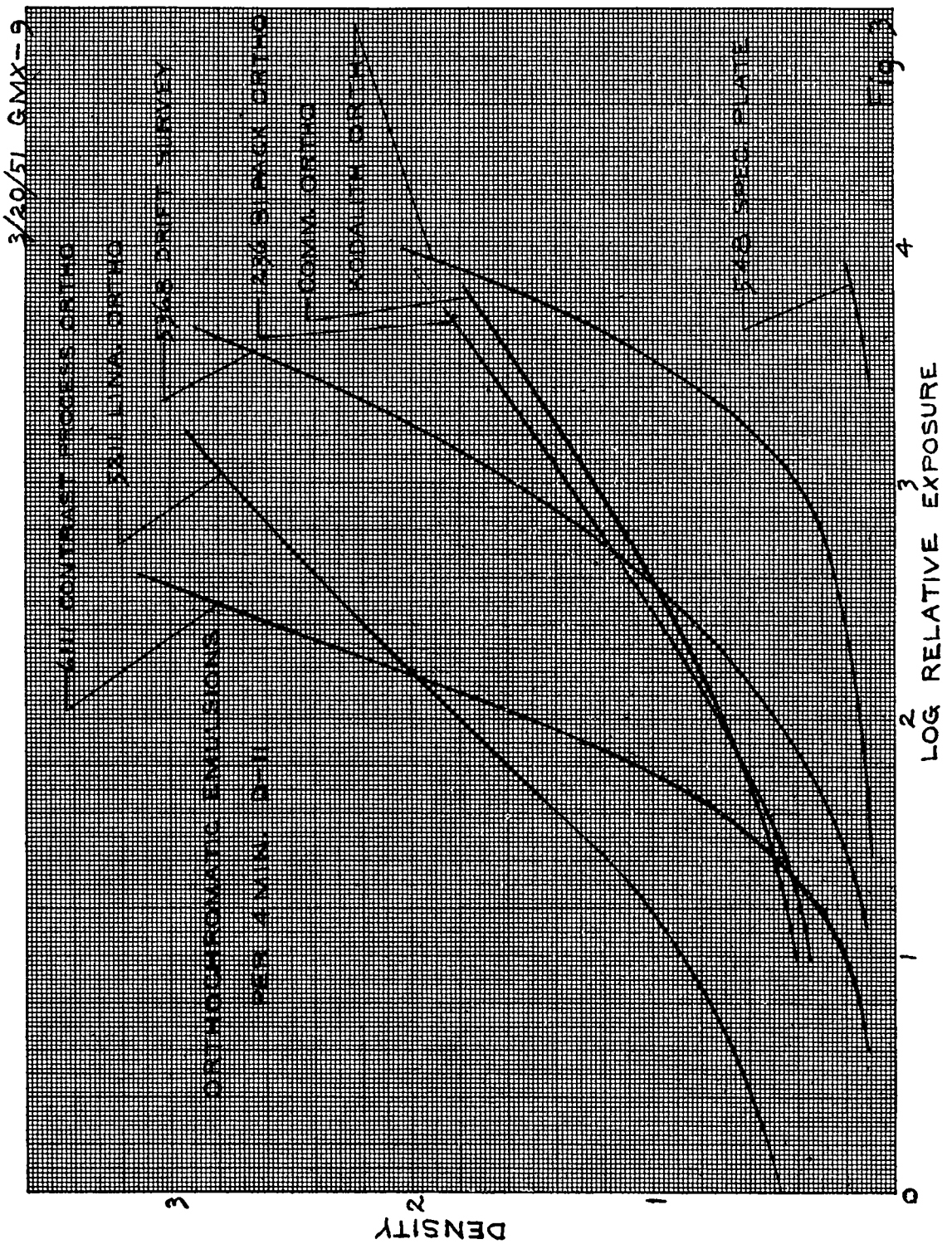
3/20/51 GMX-9
ORTHOCHROMATIC EMULSIONS
PER 4 MIN. D-11
FULL CONTRAST PROCESS ORTHO
FULL TONE ORTHO
SLOW SPEED PANCHROMATIC
FAST PANCHROMATIC
DENSITY
LOG RELATIVE EXPOSURE
0
1
2
3
4

Fig. 3

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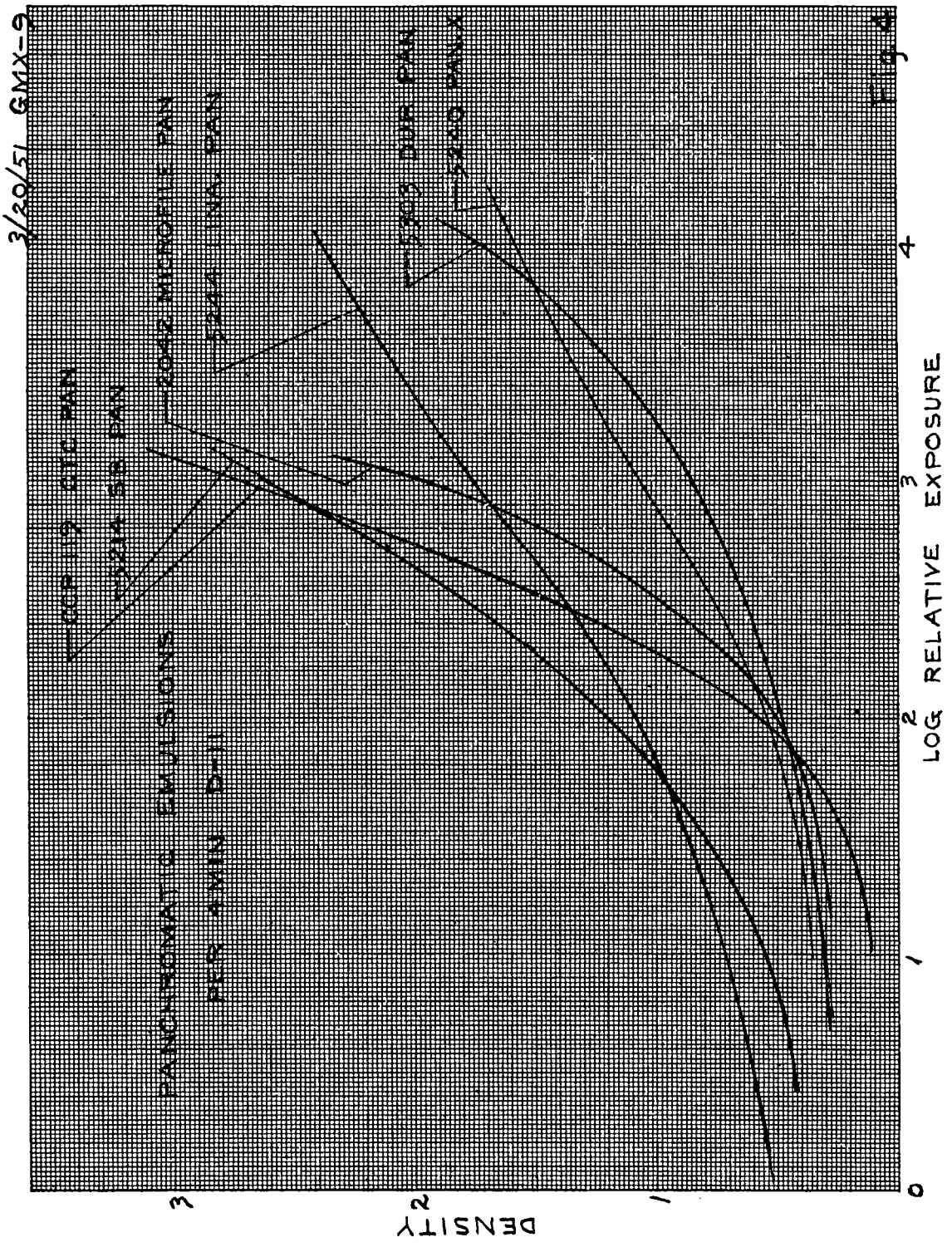

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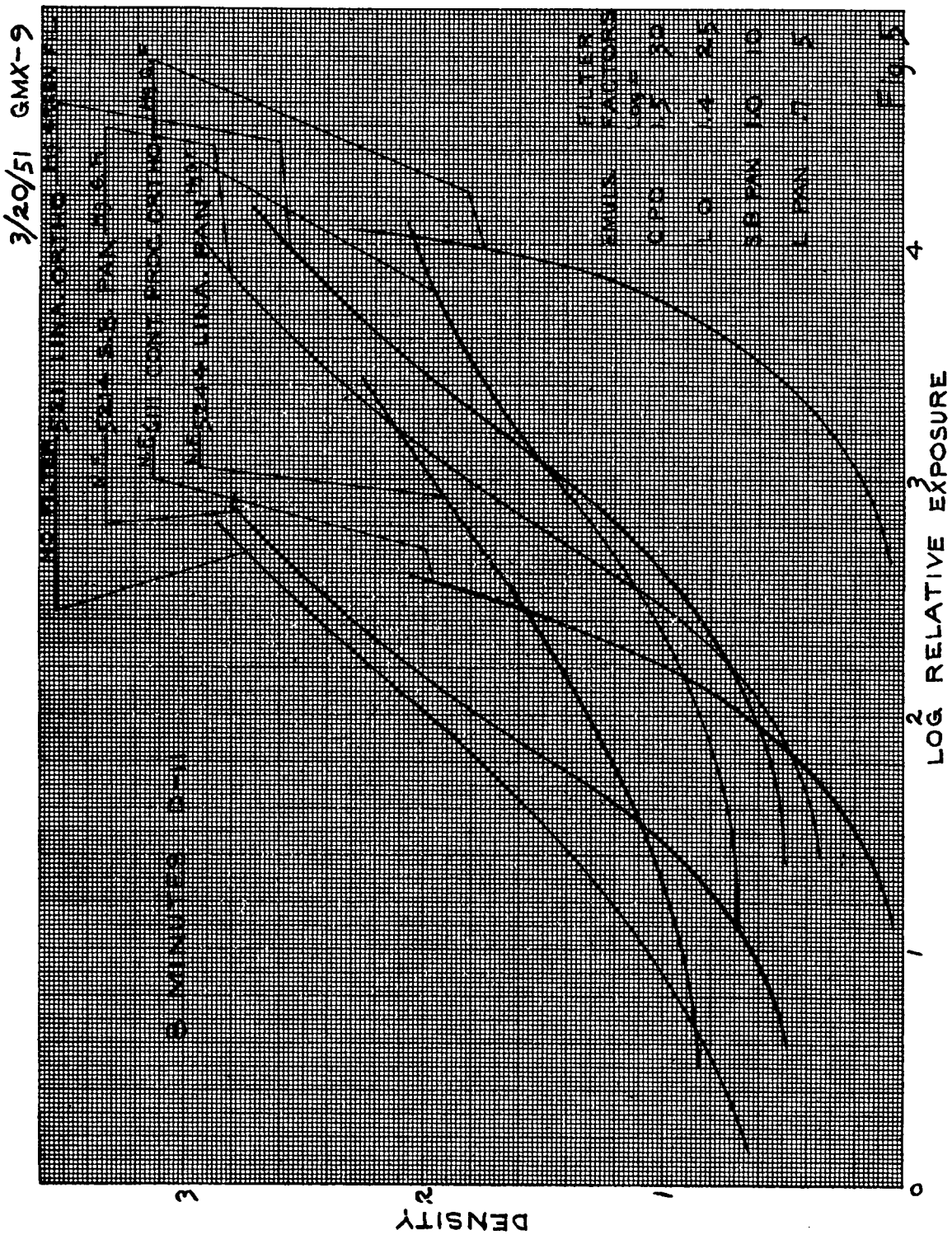

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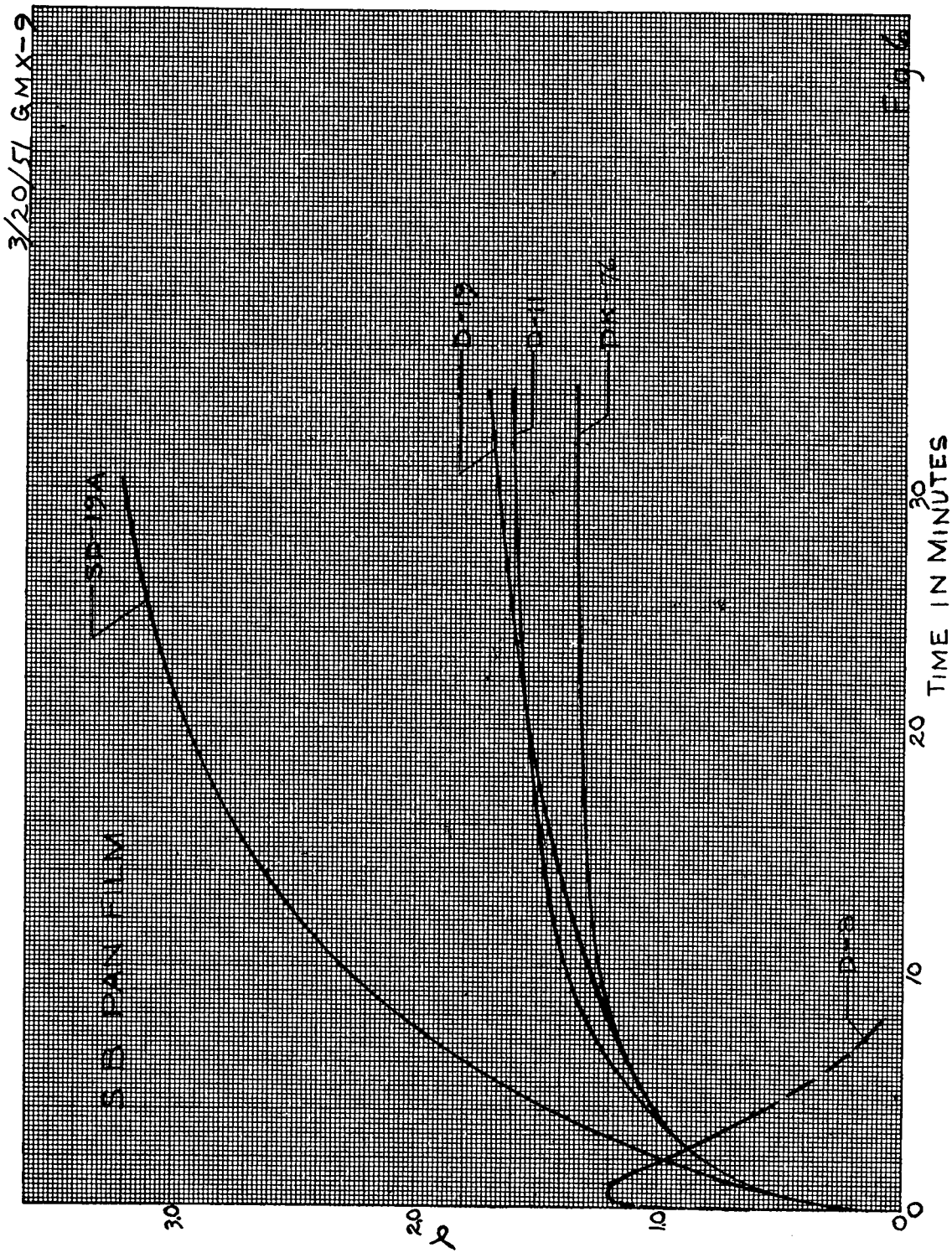

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