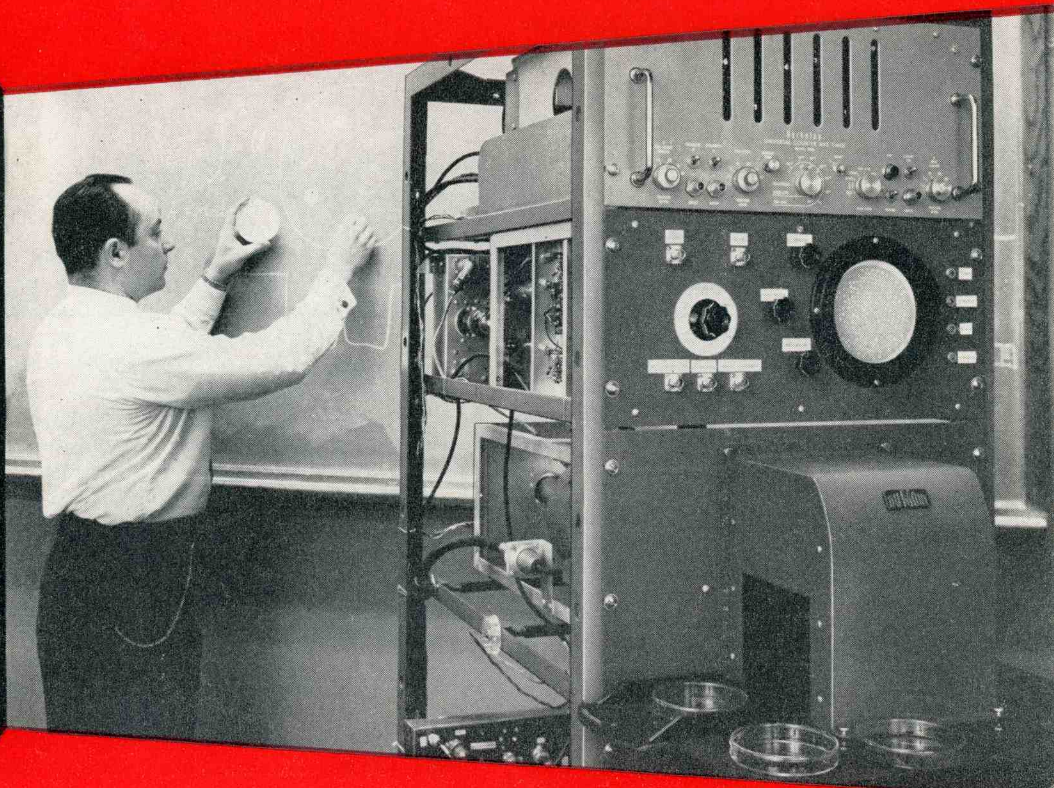
ISSUE 3

DU MONT Instrument Journal



DU MONT TECHNICAL PRODUCTS DIVISION

DU MONT Instrument Journal

A PUBLICATION DEVOTED TO ELECTRONIC INSTRUMENTATION AND RELATED FIELDS, PROVIDING THE LATEST INFORMATION ON DEVELOPMENTS IN EQUIPMENT, APPLICATIONS AND TECHNIQUES. PERMISSION FOR REPRINTING ANY MATERIAL CONTAINED HEREIN MAY BE OBTAINED BY WRITING TO THE EDITOR AT THE ADDRESS BELOW.

PUBLISHED QUARTERLY & COPYRIGHT 1957 BY
ALLEN B. DU MONT LABORATORIES, INC.
TECHNICAL PRODUCTS DIVISION
760 BLOOMFIELD AVE.
CLIFTON, N. J.

EDITOR - ARTHUR HOYT

ASST. EDITOR - RICHARD SPARNON

CONSULTING EDITOR - NEIL UPTEGROVE

On The Cover

Flying Spot Scanning is a unique and highly technical method of visual inspection and/or measurement, through instrumentation, in the microscopic and macroscopic fields. The cover shows the author of the feature article, "Techniques of Flying Spot Scanning", analyzing a scanning problem with the use of the Du Mont Iconumerator.

Next Issue

Issue 4 will feature the conclusion of the article "FLYING SPOT TECHNIQUES AND APPLICATION". The development story will be a technical discussion on the new Du Mont Type 405 Vacuum Tube Voltmeter.

Table of Contents

FLYING SPOT TECHNIQUES AND APPLICATION

by: H. P. Mansberg

Manager, Applications Engineering and Market Research

Allen B. Du Mont Laboratories, Inc.

Basic techniques for the electronic scanning of microscopic and macroscopic[1] fields are presented and applications to industrial inspection or measurement, biological and industrial laboratory instrumentation are discussed. Photometric considerations affecting the design of flying spot scanning systems provide a basis of comparison with other types of light sources. Equipment for automatic particle analysis is described and examples of solutions to problems of flaw detection, location, and measurement are discussed.

Although automatic manufacturing and production techniques are being applied on an ever increasing scale, advances in the techniques of automatic inspection and measurements have not been as rapid. It is well known that many routine visual inspection and measurement operations are particularly laborious, subject to fatigue, and often result in costly bottlenecks. As industrial and laboratory management become more concerned with this problem they seek methods of automating the visual inspection process. A number of mass production industries such as paper, sheet metal foil, and glass manufacturing companies produce their finished goods in roll or sheet form at high speeds. In a large measure most of these processes utilize automatic machinery, but they frequently require the use of trained observers for the detection of flaws in the material or to obtain data affecting quality control.

Examples Of Rapid, Economic Inspection

Consider for the moment that a single paper winding machine in a paper manufacturing plant may handle many thousands of feet of paper per hour, and that this paper is automatically cut into standard sized sheets of high quality writing paper. It is virtually impossible to visually detect flaws such as holes, tears, oil spots, etc., in the ribbon of paper as it is wound at high speed. Therefore, it is necessary to visually inspect the paper during the cutting or packaging process. When 100% inspection of the cut paper is economically unfeasible, then one must resort to methods of statistical quality control. A high speed automatic inspecting system capable of operation at the paper winding machine offers the benefits of increased quality, faster production, and decreased production cost.

Similar situations arise in sheet

metal and glass manufacturing industries where production rates often far exceed economic visual inspection facilities. Glass manufacturing plants are particularly well suited for automatic inspection because the transparency of the medium is ideal for optical scanning techniques.

There is also a need for easing visual measurement tasks in many research laboratories in the fields of chemical, oil, plastics, pharmaceutics, biology and medicine. In some of these fields the analysis of fine particles and suspensions requires particularly arduous microscopic studies. In hundreds of biological, dairy, food industry, and water testing laboratories, the visual counting of bacterial colony growths on culture plates is a daily routine. Some biological research laboratories, particularly those devoted to cancer research, perform intensive microscopic studies of cell and tissue structure involving densitometric[2] and spectrophotometric[3] measurements.

In all of the fields mentioned, automatic scanning techniques can facilitate inspection and measurement, or provide the possibility of making measurements heretofore impossible. In some of these cases scanning techniques are already being applied with considerable success.

Flying Spot Cathode-ray Tube As Light Source

In this article we are primarily concerned with the use of the flying spot cathode-ray tube in automatic scanning systems. Although the cathode-ray tube and electronic scanning systems have become universally accepted methods of producing visual displays and television images, the use of such scanning systems for instrumentation and automatic processing of visual information may have a far more reaching effect than the mere extension of vision. The cathode-ray tube is an extremely useful light source for the optical scanning of either large or very small visual plane fields. It is not commonly realized that the fluorescent spot of a cathode-ray tube is a highly efficient light source of high intrinsic brilliance and very small spot size.

A photometric comparison of a cathode-ray tube light source with some commonly used light sources is shown in Table 1. Note that the luminous efficiency of the cathode-ray tube phosphor is on a par with one of the most efficient light sources — the high pressure mercury arc lamp. The intrinsic brightness, in candles per square centimeter, of a projection type cathode-ray tube spot exceeds the brightness of a 1,000 watt tungsten lamp. Of course, the total luminous radiation available from a 1,000 watt tungsten lamp far exceeds the luminous output of a cathode-ray tube spot, but the total area of the filament is much greater than the emitting area of the fluorescent spot.

Table I

Light Source	Efficiency Lumens/watt	Brightness Candles/CM²
Cathode-ray tube aluminized phosphor (P4)	63	3,000
100 Watt Tungsten lamp	13	500
1000 Watt Tungsten lamp	20	1,250
Normal Carbon arc	6	13,000
High intensity carbon arc	18	85,000
G.E. Type AH6 Mercury arc	65	30,000
Osram HB107 Mercury arc	10.5	100,000

Photometric comparison of a cathode-ray tube light source with some commonly used light sources.

Intrinsic Brilliance Of Light Source Important

For most scanning applications the intrinsic brilliance of the light source is a primary consideration. The larger the source is the more difficult the optical problems are in efficiently collecting and imaging the emitted light. To understand some of the relationships between the scanning spot size and brightness, the optical system and the image, let us discuss briefly the photometry of a flying spot system.

In a schematic representation of a flying spot scanner, Figure 1, the spot is assumed to have a small but finite area A, of brightness B, and it is assumed to produce Lambert's law radiation[4] (cosine distribution). The lens images the cathode-ray tube spot as a small area A^1 with an illumination E^1. It can be shown by the fundamental laws of optics that the illumination in the image plane is given by the following equation:

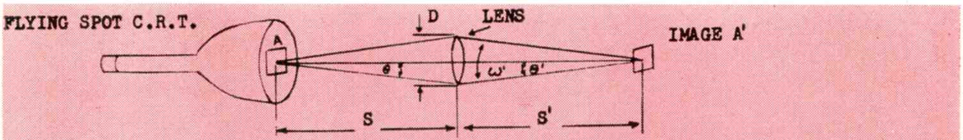
$$E' = \pi B \sin^2 \theta' = \frac{\pi B \sin^2 \theta}{m^2} \quad (1)$$

when the symbols are defined as in Figure 1.

The illumination of image A^1 depends entirely upon the brightness of the source and the angle subtended by the image to lens marginal rays, and not at all on the size of the source. If the optical system is fixed and the area of the source is increased without increasing its brightness, then the illumination of the image will remain unchanged although its size is increased. For maximum resolution it is usually desirable to use as small a spot image as possible, so an increase in the size of the cathode-ray tube spot or light source area would require a change in the magnification ratio $\frac{S'}{S}$. An increase in this ratio can be obtained only at a sacrifice in the size of the area that can be scanned. The aperture or f number of the lens is defined as its focal length divided by the effective diameter. When conventional optics are used in flying spot scanning systems, equation (2) may be substituted for equation (1).

$$E' = \frac{\pi B}{4f^2 (m+1)^2} \quad (2)$$

When m « 1, the illumination of the



A = AREA OF SPOT

A' = AREA OF IMAGE

B = BRIGHTNESS OF SPOT CONSIDERED AS A LAMBERT LAW RADIATOR

α' = ANGLE OF CENTRAL RAY ON OFF AXIS SYSTEM

n = INDEX OF REFRACTION

N.A. = NUMERICAL APERATURE = n sin θ

F' = FLUX (LUMENS) IN IMAGE PLANE

E' = ILLUMINATION AT A'

E" = OFF-AXIAL ILLUMINATION

$f\# = \frac{\text{FOCAL LENGTH}}{D}$

$m = \frac{S'}{S}$ MAGNIFICATION

$$E' = \pi B \sin^2\theta' = \frac{\pi B \sin^2\theta}{m^2} \quad (1)$$

$$E' = \frac{\pi B}{4f\#^2(m+1)^2} \quad (2)\ (3)$$

$$E'' = B'\omega' \cos \alpha'^4$$

$$E' = \frac{\pi B (N.A.)^2}{n^2 m^2} \quad (4)$$

$$F' = E'A' \quad (5)$$

$$\frac{S}{N} = \frac{\sqrt{F'}}{\sqrt{B.W.}} \quad (6)$$

Figure 1. Photometry of flying spot scanning systems.

image depends only on the brightness of the source and the f number of the lens.

A familiar example of this effect occurs when one determines the proper exposure to use in photographing either a distant scene or an object in the foreground. One only has to know the brightness of the scene as measured by a light meter, and the f number of the lens to provide the correct exposure regardless of the subject size or its distance from the camera. However, at a point in the image plane off the optical axis, the illumination differs from the axial illumination in accordance with equation (3).

$$E'' = B' \omega' \cos \alpha'^{4} \qquad (3)$$

This is known as the "cosine-to-the-fourth-power" effect and it is a factor which often has to be considered in the application of optical systems for scanning instrumentation.

Microscopic Optics For Small Areas

When very small areas are to be scanned, microscope optics are substituted for the more common photographic objective lenses. The light gathering power of a microscope objective lens is always expressed in terms of the numerical aperture. This quantity is defined as N.A. $= n \sin \theta$, where n is the refractive index[5] of the medium (for air, $n = 1$), and θ is the angle subtended by the lens-to-object rays.

The illumination in the image plane may be defined by equation (4), which shows that it is directly proportional to the square of numerical aperture and inversely proportional to the square of the magnification.

$$E' = \frac{\pi B (\text{N.A.})^2}{n^2 m^2} \qquad (4)$$

These photometric concepts are important when a scanning system providing the highest possible signal-to-noise ratio is to be designed. The total flux, in lumens, available in the image plane is given by equation (5), which shows that it is equal to the illumination multiplied by the area of the image.

$$F' = E' A' \qquad (5)$$

For a multiplier phototube, the commonly used detector in a flying spot scanning system, the signal-to-noise ratio of a signal is directly proportional to the square root of the flux in the image plane, and inversely proportional to the square root of the bandwidth of the system. As a result, the information produced by a scanning system is more easily processed when the brightness of the source is increased and the scanning rate is reduced.

Some of the advantages of the use of a cathode-ray tube over other sources in scanning systems are the very high scanning speeds possible, the ease of modulating the spot intensity, and adaptability to scanning either large or very small areas. Another advantage, in some applications, is the constant color temperature of the spot with changes in intensity. By comparison, the color of an incandescent source shifts toward shorter wavelengths as its intensity is increased.

Considerations In Design Of Basic Elements Of Flying Spot Scanning Systems

Figure 2 shows the essential elements of a flying spot scanning system for both transparent and opaque materials. The cathode-ray tube, objective lens, light collecting system, and multiplier phototube detector should be considered an optical-electronic transducer. The output of this transducer may be connected to various signal modifying circuits, logic circuits, control circuits, or display units depending upon the desired function.

For example, if it is necessary to just detect flaws or particles on the surface being scanned, an amplifier and perhaps a trigger generator are required to provide visible or audible indication of the presence of a flaw, or the signal may be used to operate

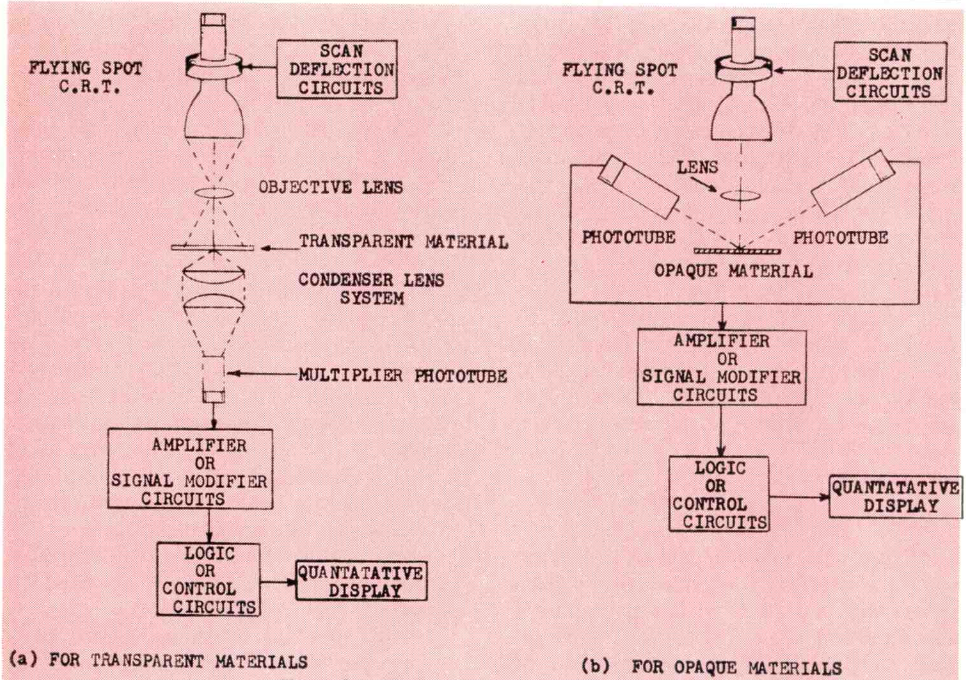


Figure 2. Basic flying spot scanning system.

a control relay. On the other hand if it is necessary to count or to measure the size of flaws or particles, logic circuits of increased complexity are necessary to process the signal or pulse information.

When scanning transparent materials the optical system can be made highly efficient, yielding a high signal-to-noise ratio, with condenser lenses suitably chosen to collect light from the field scanned. The condenser lens system is usually designed to image the exit pupil of the objective lens on the photocathode. This produces a defocussed area of illumination on the photocathode so that the motion of the scanning spot in the image plane does not produce at corresponding motion on the photocathode. For critical applications such motion would lead to undesirable signal modulation due to slight non-uniform photocathode sensitivity.

If the material to be scanned is stationary, the cathode-ray tube must produce a two dimensional scan. This scan may be of any form desired, although in most systems a linear raster scan as used in television is generally preferred.

The size of the smallest particle or flaw which must be detected generally determines the maximum area of material which may be scanned with a single cathode-ray tube. This is because of the limitations of finite cathode-ray tube spot size. The best commercially available flying spot cathode-ray tubes produce a spot size of the order of 100 microns[6] diameter.

These flying spot scanning tubes are available up to 7″ diameter faceplate sizes and it is generally feasible to produce a scanning pattern of approximately 1000 lines on the faceplate area. It is theoretically possible to produce an area resolution of over a 1000 x 1000 picture elements on such a tube (one million picture elements), but in practice the actual resolution is limited by a number of complex factors.

One limiting factor is the light distribution of the spot itself which is not uniform due to the structure of the phosphor. Resolution is also effected by internal reflections in the faceplate which produce halo rings around the spot. Another limitation is the decay or persistence time of the phosphor which adversely affects the rise and decay times of a signal pulse. The material being scanned sometimes produces artifacts[7] in the signal which prevent use of the maximum possible resolution of the cathode-ray tube and lens system. Empirically it has been found that when the scanning system is required to produce accurate counts of particles or flaws, the size of the scanning spot should be two to four times smaller than the minimum sized flaw or particle.

Method Of Scanning According To Use

When the scanned material is in uniform motion, the cathode-ray tube is usually provided with only a single dimensional scan. It scans in a direction perpendicular to the motion of the material at a repetition rate which would provide the desired number of scanning lines per inch of material. When completely opaque materials must be scanned in order to detect or measure surface defects or particles, a system such as shown in Figure 2B is often used. Since the phototube detectors must collect light reflected by the surface of the material, the nature of the reflecting surface determines the number of phototubes required to produce an adequate signal. When the opaque surface is relatively small, then a much more efficient optical system, such as illustrated in Figure 3, is preferable. Here a spherical mirror collects reflected light rays over nearly 180°, producing a much higher signal-to-noise ratio than can be obtained by a number of phototube detectors. The particular system shown in Figure 3 was used in one application to scan the surface of a small opaque dish supported by a transparent plate. The front surface mirrors and condenser lenses shown were used to facilitate a compact mechanical design.

In some scanning applications, color discrimination may be used to enhance the signal-to-noise ratio. A typical spectral emission curve of a short persistence phosphor used in flying spot scanning tubes is shown in Figure 4. Portions of this spectrum may be utilized to obtain increased contrast for colored materials. In one application, for example, selective color filters appropriately placed between the scanning cathode-ray tube and the material provided a method of counting particles of one color in

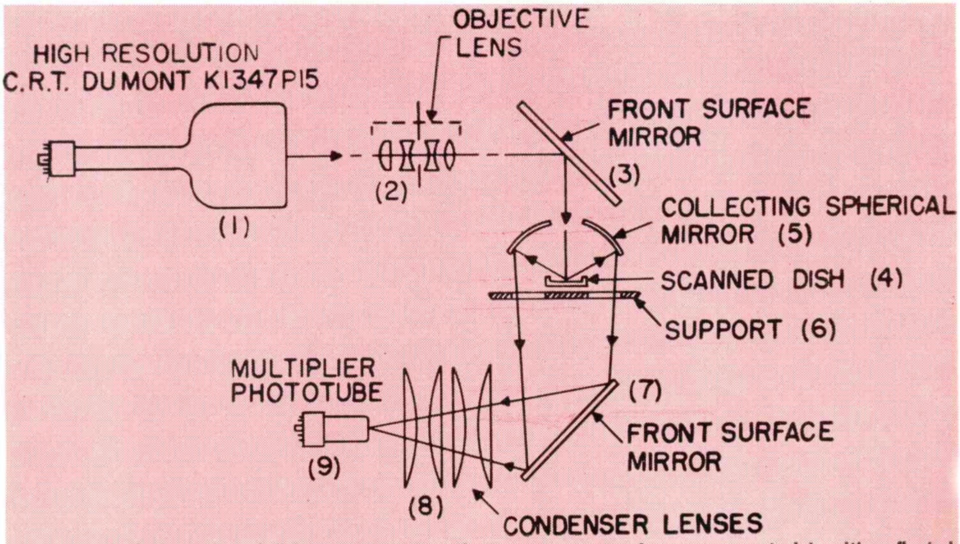


Figure 3. Optical system of flying spot scanner single spot system, for opaque material, with reflected light collecting mirror.

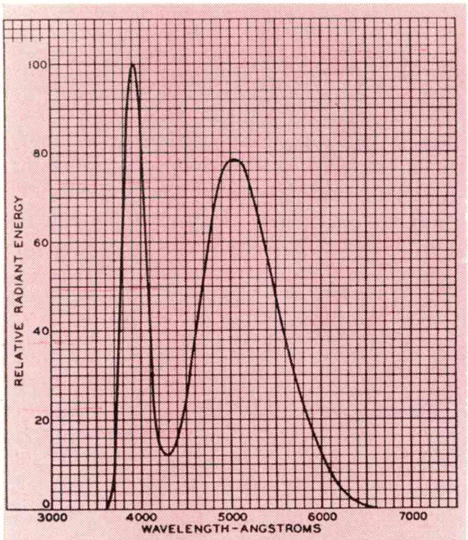


Figure 4. Curve showing spectral emission of short persistence phosphor.

the presence of particles of another color.

Types Of Scanning Used For Inspection Or Measurements

As previously mentioned, the flying spot scanner and multiplier phototube may be considered an optical electronic transducer which requires the use of various auxiliary circuits to perform certain operations. Let us assume that the problem is one of counting a random sized group of particles distributed on a plane surface.

If one uses a spot scan in a linear raster imaged on the surface containing the particles as in Figure 2, he must then choose the proper logic and quantitative display circuits. Connecting the phototube amplifier output to a counter results in the problem illustrated by Figure 5. Obviously the small spot will intercept each particle many times, producing counts proportional to the total area of all the particles.

Using successively larger "slit" scans reduces the count per particle, but it also causes a loss in resolution so that some particles are intercepted simultaneously. It is possible to make a fairly close approximation of the actual number of particles by calculation from the data obtained in several successively larger "slit" scans.

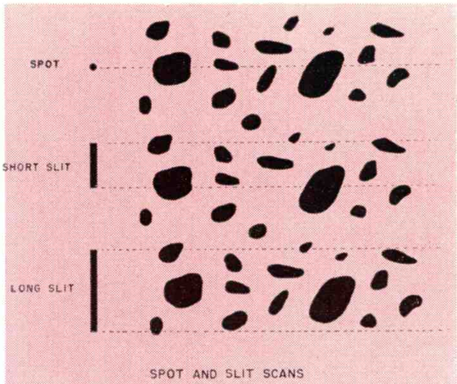


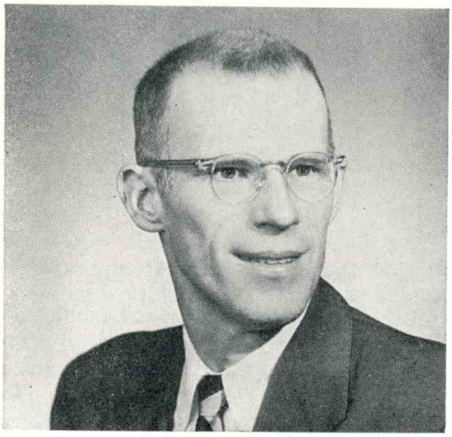
Figure 5. Spot and slit scans.

Conclusion of this article and the referenced bibliography to appear in the next issue.

Glossary of Terms

1. **macroscopic:** objects or fields large enough to be seen by the naked eye, as opposed to microscopic.
2. **densitometric:** measurement of optical density. Density is the logarithm of *opacity,* and opacity is the reciprocal of transmittance.
3. **spectrophotometric:** measurement of the spectral distribution of light, or light measurements that compare intensities at various wavelengths or colors.
4. **Lambert's Law of Radiation:** diffuse radiation, or radiation which is equal in all directions. Although the radiant energy of such an emitter is equal in all directions, the intensity in any direction varies as the cosine of the angle made with a normal to the emitting surface.
5. **refractive index:** the ratio of the velocity of light in free space to the velocity in a given medium.
6. **micron:** unit of length equal to 1/1000 of one millimeter (0.001 mm).
7. **artifact:** a structure or object which is not normally present in a material.

Who and Why



J. R. DANNEMILLER

Our sales representative for the Ohio and Michigan area is J. R. "Danny" Dannemiller. One of the most recent additions to the Du Mont sales representative clan, "Danny" maintains an office at 3955 Lee Road, Cleveland, Ohio, another at 1204 N. Woodward Avenue, Royal Oak, Michigan. The following biographical sketch reveals how "Danny" almost missed being an electronics engineer.

J. R. Dannemiller was born in Akron, Ohio on October 26, 1921. He attended public schools in Akron and upon graduation from high school, "Danny" entered Purdue University — majoring in Mechanical Engineering. Four years later (1943) he received his bachelors degree, and upon graduation Uncle Sam came beckoning and "Danny" was soon in the U. S. Navy. After four months of training in Naval Propulsion Equipment he was commissioned an Ensign in the U.S.N.R.

With commission in hand he received orders to report to the U. S. N. Radar School at Harvard University and Massachusetts Institute of Technology. Good fortune had arrived. To this day "Danny" can't figure out why a Mechanical Engineer was sent to an electronics school. Thirty out of a class of 300 had such orders. There was some joking about throwing the papers down a ladder and selecting them in that manner. The course was not an easy task and after eight months of intensive training he was sent to the Brooklyn Navy Yard where he spent the duration of the war teaching operation and maintenance of Radar Equipment. Just after the war his longing to go to sea was finally satisfied. He was sent to Japan to work with the U. S. Naval Technical mission. While in Japan, he had a very interesting time gathering information on infared communications and some land mine detection equipment.

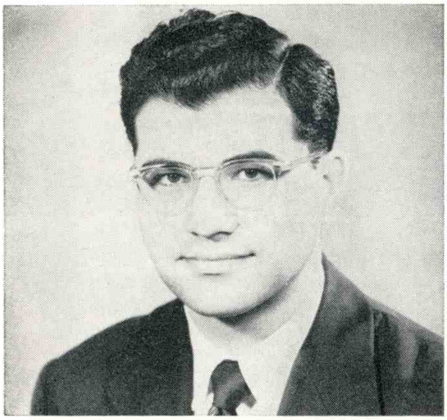
Following his discharge from the service, Danny began his post war plunge into industry. He served a short stint with Sylvania Electric, doing mechanical design work on air transportable radar. From there he went to Glenn L. Martin as an electronics engineer working on various guidance control and stability aspects of the Viking, Gorgan IV and Matador missiles.

In the Fall of '47 "Danny" returned to Ohio to Case Institute of Technology, where he received his masters degree in physics. It was at this time he began laying the foundation for his present business. By spring of 1948 the business was in full operation. In February 1956 "Danny" joined the Du Mont sales organization.

Although he managed to avoid marriage to the ripe old age of 29, "Danny" was finally corraled by his charming wife, Phyllis. Since their marriage in 1950 they have been blessed with five children — the fifth just making our deadline.

It's a privilege to have Danny working for our side.

NEW APPOINTMENTS



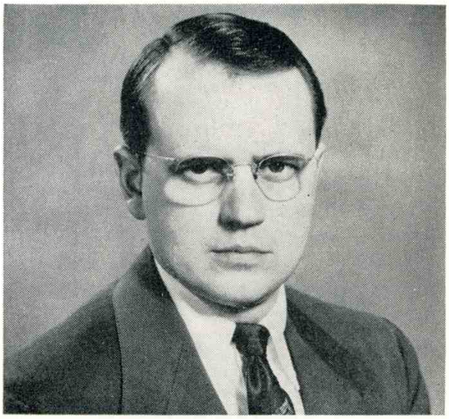
MORTON G. SCHERAGA

Morton G. Scheraga has been appointed Instrument Product Manager replacing Emil G. Nichols who resigned. Mort will now be responsible for the co-ordination of sales, engineering and manufacturing of oscilloscopes, associated electronic test equipment and systems.

An employee of Du Mont since 1945, Mort began his tenure with the company as a development engineer for the Television Receiver Division, and a short time later he became market research engineer for the Technical Sales Department. From 1952 to May 1956 Mort served as Assistant Sales Manager, prior to taking over the duties as Sales Manager of the department. He relinquished the sales managers duties to Brewster W. "Bo" Jameson upon announcement of his new position.

A graduate from the City College of New York in 1944, with a bachelor of science degree in electrical engineering, Mort continued his studies at New York University and recently received a masters degree in industrial and managemeent engineering.

Mort's extra-curicular activities includes membership of the Tau Beta Pi and Eta Kappa Nu fraternities, and senior member of the Institute of Radio Engineers.



WILLIAM G. FOCKLER

The Technical Products Division has announced the appointment of William G. Fockler as chief engineer, replacing Arthur J. Talamini who resigned recently. Bill's new duties make him responsible for the engineering of all products in the department. The appointment is in keeping with the Du Mont policy of promotion from within the company.

Bill joined Du Mont immediately after graduation from West Virginia University in 1945, where he earned a Bachelor of Science degree in Electrical Engineering. Hired as a junior engineer, he was assigned to the Instrument Development Section and in a very short time advanced to senior engineer of the same section. In 1950 he became head of the section, being responsible for the design of general-purpose oscilloscopes and indicators employing high voltages. In November, 1952, he became assistant chief engineer, directly in charge of the engineering of commercial line instruments and accessories. Bill maintained this position until his recent appointment.

Bill's extra-curricular activities include an associate membership of the IRE and AIEE.

Because of his extensive knowledge of the demands and problems of the industry, it was an easy task for management to select Bill for the position.

OSCILLOSCOPES INVADE THE AUTOMOTIVE INDUSTRY

Electronic test equipment has made a successful plunge into the automotive industry. With the development of the Du Mont EnginScope, quick and accurate fault finding tests of engines are easily made. The following discussion reveals a few paramount features of the scope and how they are achieved.

The EnginScope in itself is not new. Du Mont has been producing electronic analysis equipment since the early days of World War II. Since then, Du Mont has manufactured analyzers on special order for Curtiss-Wright, Sperry Gyroscope Company, and the latest for Socony-Mobil Oil Company.

Although the cathode-ray engine analyzer had a great many advantages over other types of testing equipment, it had been hindered in the past by the necessity of considerable training before the user could interpret the various patterns. The present design has eliminated this problem, and a minimum of training is required to operate the EnginScope efficiently.

Du Mont EnginScope

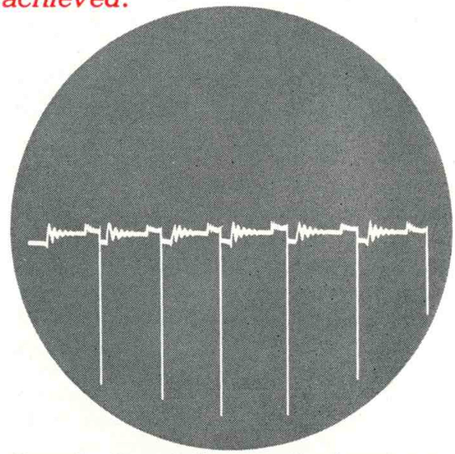


Figure 1. Shown is the conventional parade scan. With the use of this method it would be difficult to determine the fault due to the condensed display.

Automotive test equipment to-day uses two types of scanning methods; an older, conventional type, "parade sweep" and the newer raster scan—or as it is known to EnginScope users—the Du Mont "SuperScan".

The parade sweep shows the entire ignition cycle of all cylinders on a single horizontal line (see Figure 1). Because of the condensed display, considerably more time is required to interpret the display, and in many cases important details are obscured. Also, it is difficult with parade scan to compare one cylinder with another.

The SuperScan, on the other hand, shows each cylinder's operation on a separate line. After the pattern for number one cylinder is displayed, the next pattern in firing order is brought back to the left side of the screen and positioned lower so that it lines up

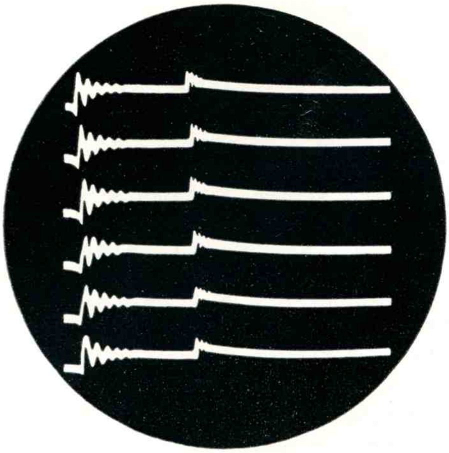


Figure 2. The Du Mont SuperScan offers easier viewing with each cylinder phenomena on a single line.

directly beneath the first pattern. The remaining cylinders follow the same procedure. Each cylinder pattern takes up the full width of the screen for quick and easy observation. Figure 2 reveals how clearly each cylinder pattern is displayed, and the ease of comparing one cylinder with another.

A Choice Of Two Types Of Patterns

Two types of patterns are possible with the EnginScope — primary and secondary patterns. The secondary pattern is recommended for general testing purposes because more information is available as to what is happening directly at the spark plugs. However, if the user desires to use the primary, the display is obtained by connecting across the condenser.

The secondary picture on the screen is obtained by connecting two leads from the scope to designated points on the engine. The procedure used is quick and efficient. By using a clip-on connector, the leads are attached over the insulation of the lead from the coil, and the #1 cylinder lead, thus the ignition system is not disturbed. Conditions can be viewed and the entire analysis performed without even stopping the engine.

This shows the signal at the spark plug. All cylinders are viewed because the signal is picked up as it comes out of the coil before it is distributed to the individual spark plugs by the rotor.

Constant Line Length An Important Feature

Under ordinary circumstances, when the engine speed is increased, the pattern on the screen shrinks accordingly. This would inconvenience the user because the condensed display would be difficult to interpret, it would be necessary to readjust the controls, and a comparison to other cylinder phenomena would require longer study and observation.

To counteract the shrinking problem an automatic compensation circuit has been included. This consists of a constant current pentode tube, and a feedback circuit comprising a peak detector tube and two rectifier tubes. If, for example, the pattern on the screen is displayed from an engine that is idling, the line length will remain at the designated length. If the engine speed is doubled, the bias of the constant current pentode tube is halved — assuring a constant voltage to the condenser to which it normally feeds. This portion of the circuit maintains the linearity.

The feed-back circuit is responsible for the maintaining of the constant line length. With the doubling of the engine speed, the peak voltage is automatically reduced to one-half of its original output. The bias of the pentode tube is also halved and the overall flow of current is doubled — due to the increase of speed. Thus the output signal remains constant regardless of the varying engine speeds.

Automatic Tilt Adjustment

As the pattern appears on the screen there is a normal tendency for it to appear on a slant (see Figure 3). Accurate readings can be made while the pattern is on this slant, but it would be an inconvenience for the user to have to observe the pattern in this position. To correct this, an automatic tilt adjustment is incorpor-

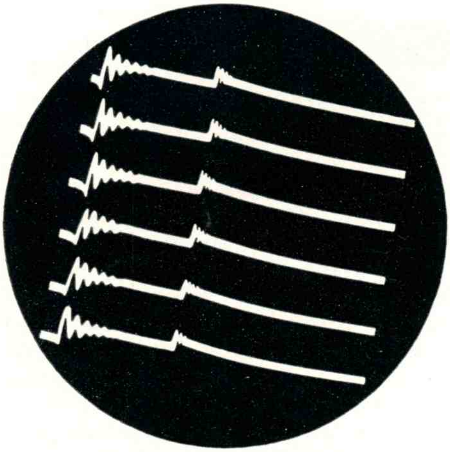


Figure 3. Before the tilt adjustment was incorporated in the circuit, the pattern appeared on a slant, as shown, thus inconveniencing the use.

ated into the circuit to correct the sloping base lines. Circuit-wise, the tilt adjustment is functioned by merely applying a desired amount of horizontal sweep into the vertical sweep, using a cathode follower for isolation. An internal adjustment is provided.

Industrial Version Available

An industrial version of the EnginScope, the Du Mont Type 2662, is specifically designed for engines with a low RPM rate. The circuitry of the 2662 is similar to the EnginScope except for a few time-constant changes in the circuit, provisions for synchronizing off either ignition polarity and the type of cathode-ray tube used. The time-constant changes are made necessary by the slower speed of the industrial engines — sometimes below 150 RPM. Magneto ignition systems frequently fire the spark plug with alternating polarity, hence synchronization provisions are included. Where the EnginScope uses the medium persistence cathode-ray tube, the Type 2662 has to use a tube with long persistence to eliminate low-frequency flicker. Otherwise the Type 2662 is similar to the commercial EnginScope and performs essentially the same functions.

Automotive Electronics Has Proven Its Worth

Both the Enginscope and the Type 2662 offer more than just an ignition check. With the use of available accessories the following engine checks can be made . . . intake or exhaust valve operation; abnormal noises or vibration; the time of fuel burning of each cylinder; and the timing of an engine.

The EnginScope and the Type 2662 can accomplish an accurate engine check more quickly and efficiently than any mechanical type of test. Although skepticism was noticeable when such a device was first conceived, the performance of this new modern method of engine testing has gained confidence rapidly, and the Du Mont EnginScope is becoming a familiar sight in automotive repair shops across the country.

New Feature

A new feature, for engineers and other technical people, will become a regular part of our format beginning with the next issue of the *Du Mont Instrument Journal*. At last you budding inventors and editorial writers will have a place to have your work (or opinions) recognized.

The feature, to be called "The Engineer Says —", will be devoted to articles written by technical people on any subject they wish to have the world become aware of. Maybe you have discovered an unusual application that will interest other technical people, or a process, or a circuit, or— just any technical discussion that should be read by 40,000 other people in this field of endeavor.

Maybe you're real mad about something pertaining to the engineering profession that you would like to try to correct, some general subject that your colleagues should look into and think about. This is the place to have it read.

Send your written contributions to the Editor, *Du Mont Instrument Journal,* Allen B. Du Mont Laboratories, Inc., 760 Boomfield Avenue, Clifton, N. J.

EDITOR'S PAGE

This page is, in our mind, slightly mis-named. We would rather think of the Editor's Page as a Readers' Page. Your comments, suggestions, complaints, compliments, etc. are graciously accepted, and when feasible are printed here for our other readers to enjoy. Let's hear from **you.**

Letters to the Editor

Dear Sir:

Our Engineering Department has sent to me a copy of Issue No. 2 of the "Du Mont Instrument Journal" and I have read with much interest the article entitled "Developing High-Speed Film Used in Recording Oscilloscope Traces" . . . pursuant to enlightened self-interest, we would like to call to your attention the fact that Du Pont manufactures film type 928 "Superior 4" panchromatic negative, which is similar in its characteristics to the Eastman material dealt with in the article.

. . . In any case, we would like for you to know that another product is available which can serve well for recording oscilloscope traces. We would recommend that it be developed in exactly the same manner used in developing the Eastman Product . . .

Very truly yours,
F. G. Headley
Motion Picture Products
Sales Supervisor
(E. I. Du Pont de Nemours & Co.)

Editor's Note: Even though we are not primarily in the film business, we have a technical interest in it when it comes to photographing oscilloscope traces. We suggest to anyone interested in obtaining more information on such photography, over and above that which appeared in the article mentioned, contact Mr. Headley — who works for another good company.

Dear Sir:

My compliments on your most interesting and enlightening article in Issue 2 on "Developments in Photographing Scope Traces."

May I also compliment you on the erudition you display in tossing out such a succinctly definitive, even though relatively unknown, word as "diorthotic," which you used in your "Ed's. Note" following Captain Jones' letter. (P. 15)

However, to use your own terminology, gleamed from the same note, may I call to your attention another "honest-to-gosh goof". Actually there are two of them, or rather the same type of grammatical error appearing in two different sentences. On P. 4, second sentence under "Speed vs. Granularity": " . . . the density difference which is desired between . . ." I have figured three ways in which this sentence could be recast to make it grammatically correct. The simplest method would be just to delete "which is." In the last sentence column 1, P. 5 we find "none have." (sic)

Don't be discouraged by the discovery that you have another diorthotic reader. Your Journal is a splendid publication. Keep up the good work.

Karl A. Windesheim
Assoc. Prof., Speech
University of Illinois

Whew! Thanks! Ed.

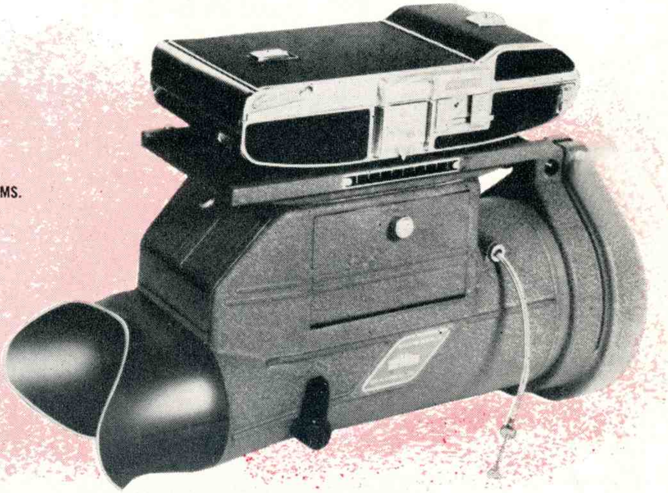
Binders Anyone?

Orders are now being taken for handsome red vinyl plastic binders to accommodate issues of the Instrument Journal. Anyone desiring a binder please write out a check or money order for $1.50, payable to: Allen B. Du Mont Laboratories, Inc. and send it to the Editor, Du Mont Instrument Journal, Allen B. Du Mont Laboratories, Inc., 760 Bloomfield Avenue, Clifton, N. J. Please do not send cash.

For the record...

it's IMMEDIATE-PRINT scope photos

with the DUMONT® 302



- NOW, ULTRA-FAST TRANSPARENT POLAROID-LAND FILM FOR HIGH SPEED RECORDING!
- CONTACT AND PROJECTION PRINTS... NO IMAGE REVERSAL.
- EASY, INEXPENSIVE CONVERSION TO VARIETY OF STANDARD ROLL AND CUT FILMS.
- CLICK-STOP SLIDE PERMITS MULTIPLE EXPOSURES ON SINGLE FRAME FOR GREATER FILM ECONOMY AND EASY, DIRECT WAVEFORM COMPARISON.
- FULL BINOCULAR VIEWING SIMULTANEOUS WITH RECORDING.
- MOUNTS QUICKLY AND EASILY ON ANY STANDARD 5" SCOPE. NO ADDITIONAL SUPPORTS REQUIRED.
- EASY ACCESS FOR LENS AND SHUTTER ADJUSTMENT.
- BUILT-IN DATA RECORDING SYSTEM.

SPECIFICATIONS

- Wollensak-Du Mont 75 mm f/2.8 three element lens, or 75 mm f/1.9 six element lens.
- Image reduction ratio 2.25:1.
- Alphax #2 shutter, bulb and 1/25 to 1/100 sec. with f/2.8 lens. Alphax #3 shutter, time, bulb and 1 sec. with f/1.9 lens.
- Writing rate dependent upon film used.
- Mounting clamp for use on any standard 5" scope bezel.

Type 302 with f/2.8 lens	**$314.00**
Type 302 with f/1.9 lens	**391.00**

The Du Mont Type 302 Recording Camera provides the most convenient and flexible means for applying the many advantages of the immediate-print Polaroid-Land process to oscilloscope recording.

And now the utility of the Polaroid-Land process has been greatly extended with the development of the new Polaroid-Land projection film — a transparent base material with a specified **emulsion speed of 1000** (ASA).

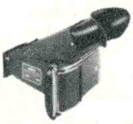
This new film not only permits contact and projection prints, and eliminates image reversal, but also enables use of the Polaroid-Land process in recording ultra-high-speed phenomena — even single transients.

Utility of the 302 is further broadened by the availability of adapter backs which permit the camera to use various standard roll and cut films. **Write for full information...**

WHATEVER YOUR REQUIREMENTS... DU MONT HAS THE CAMERA

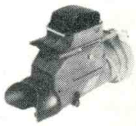
TYPE 352

High-speed, single frame 35 mm featuring automatic film advance. 8 frames/sec. automatically. Wollensak f/1.5 lens. **$648.00**



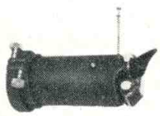
TYPE 339

Immediate-print type utilizing Polaroid film. Special f/2.8 lens for distortion-free images. Binocular viewing of screen. Designed for use with 3" oscilloscopes. **$246.00**



TYPE 299

General-purpose camera accepting backs for roll-film, film-pack, or cut film. Converts to Type 302 for Polaroid recording. f/1.9 lens **$369.00**, f/2.8 lens **$292.00**



TYPE 296

Low-cost, general-purpose single-frame camera. Uses standard casette wound 35 mm film. Corrected f/2.8 lens. Viewing port. **$164.50**

TYPE 321-A

Permits either continuous or single-frame recording. Perforated or unperforated film or paper in 100 or 400 foot reels. Variable film drive speeds from 0.8 to 10,800 in./min. 321-A with f/1.5 lens **$1270.00**, 321-A with f/2.8 lens **$1120.00**. (50 cps models available)

DUMONT® *WRITE FOR COMPLETE DETAILS...*

TECHNICAL SALES DEPARTMENT, ALLEN B. DU MONT LABORATORIES, INC.

CLIFTON, NEW JERSEY