



Photographic and Darkroom Techniques in Neurophysiology

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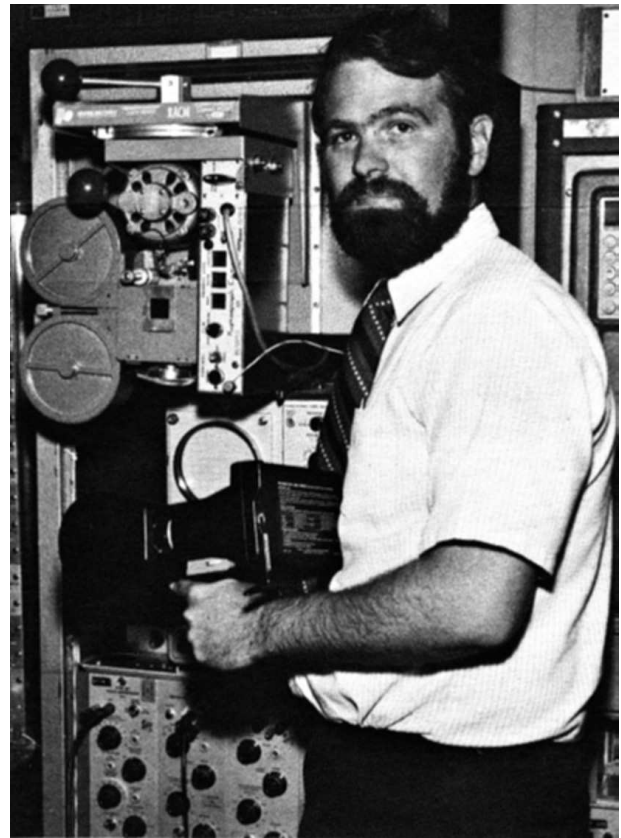
In the conduct of neurophysiologic experimentation, many of us tend to expend much of our time, effort, and limited funds on electronic apparatus designed to extract biological data from experimental animals. As a result, it is tempting to concentrate on the gathering of data with less effort expended on the production of permanent hard copy records that would be suitable for both data analysis and for eventual publication. It might, therefore, be pertinent to discuss a few approaches to the handling of data once it reaches the face of the oscilloscope.

In the handling of data, any or all of the following techniques may be utilized.

1. Storage of data on magnetic tape for later playback.
2. Generation of photographic records of data as it is presented on the face of the cathode ray tube (CRT).
3. Computer analysis of data either as it appears on the CRT ("on-line") or later as it is replayed from storage ("off-line").

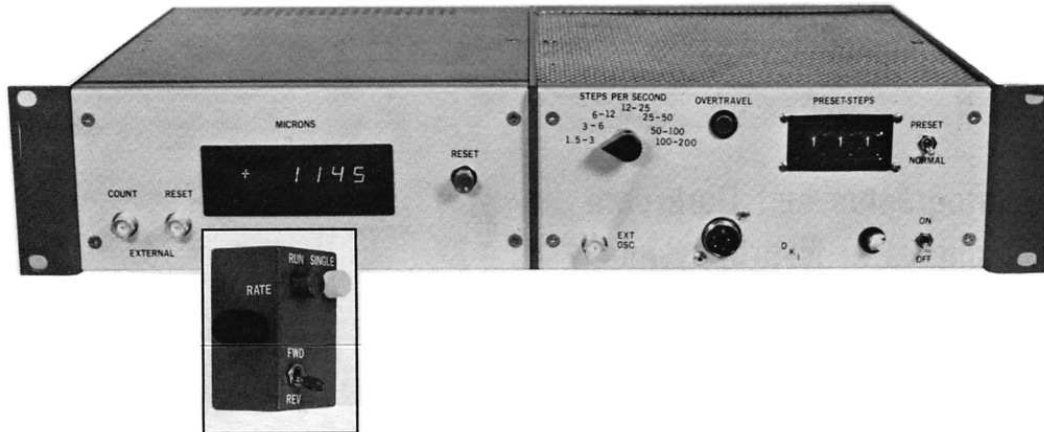
Utilizing any of these techniques, one will eventually have to photograph records from the CRT.

Thus, in the present discussion, less emphasis will be placed on tape recording and computer techniques, and I will concentrate on processes involved in the direct photographing of the CRT and the handling of the exposed film within a darkroom. Regarding the storage of data on magnetic tape, however, a few comments may be in order. At present, numerous tape recording systems are available commercially. These systems range from relatively inexpensive cassette tape recorders to laboratory instrumentation recorders costing upwards of \$15,000-\$20,000. In general, cassette units still appear to lack the frequency responses required for the recording of high frequency neurophysiologic events such as action potentials.



These recorders may be useful when one desires only to record relatively slow events such as spontaneous EEC activity or evoked potentials. One is left, then, with reel to reel recorders as the only viable method of tape recording. In general, an expenditure somewhere between \$5,000-\$10,000 will purchase an adequate four channel, M inch tape, direct record (DR) -frequency modulation (FM) unit. The availability of both FM and DR may be desirable as FM recording is useful for relatively slow data (below 100 Hz) while direct record is useful for data of higher frequencies (20 Hz - 20 K Hz). The investigator will obviously have to tailor his tape recording devices to his laboratory needs and finances.

Regardless of whether a laboratory is equipped with a tape recorder or with computer analysis, one
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NEW PRODUCTS Model 607WCP Stepping Hydraulic Microdrive

ELECTRONIC CONTROL SECTION

This 19" rack mounted unit comes equipped with a remote control box (hand-held) on an 8 foot cable. Panel mounted controls include:

- (1) Seven position rate switch with selectable rates from 1.5 to 200 steps per second.
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- (4) Over travel indicator flashes when hydraulic cylinder has reached the allowable extent of travel in either direction.
- (5) Micron counter (option) will indicate micron steps in either direction (5 digit LED display). May be re-set at any time to zero. Plus and minus indication when passing through zero.
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- (7) Counter has provision for computer interface via rear panel connector. neuroscience by providing the highest quality and most complete range of stereotaxic instruments in

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Operating controls included on this box are:

- (1) Single step button.
- (2) Multiple step button. (Run)
- (3) Step rate vernier control.
- (4) Forward-reverse switch.

HYDRAULIC SECTION

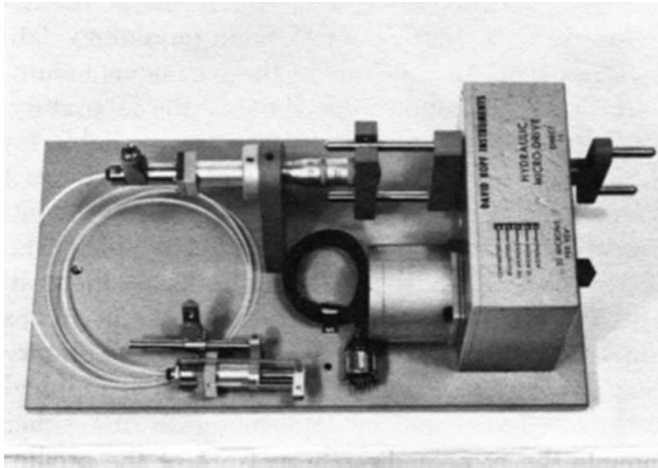
(See Photo Page 3)

Features miniature cylinders which can be used in chronic or acute applications.

- (1) Cylinders have rolling diaphragms to provide absolute separation of air and fluid.
- (2) Master and slave cylinders have 1:1 ratio and are connected by heavy walled flexible Teflon tube.
- (3) Wafer is used because of its compression factor and low coefficient of expansion at room temperature.
- (4) Total backlash on final drive will approximate 4 microns.
- (5) Veeder Root cumulative counter provided.
- (6) Full 25mm travel.
- (7) Refill standpipe provided so instrument may be serviced without disassembly.

Write for detailed specifications. Price of complete system is \$2930.00. Delivery 90 days.

NOTE: All earlier 607 and 1207 micro-drive systems can be retrofitted to accommodate the new electronic control and monitor. This system will accept 115 volt 60 Hz or 230 volt 50 Hz without the use of auxiliary transformer. Please specify when ordering.



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Aktiebolaget G. L. Jacoby - Postgiro 942, Stockholm 23, Ynglingagatan 14, Postfack 23014, Sweden, Norway, Sweden, Denmark, Finland.

Schuco International London, Ltd. Halliwick Court Place, Woodhouse Road, London N-12, England. U.K.

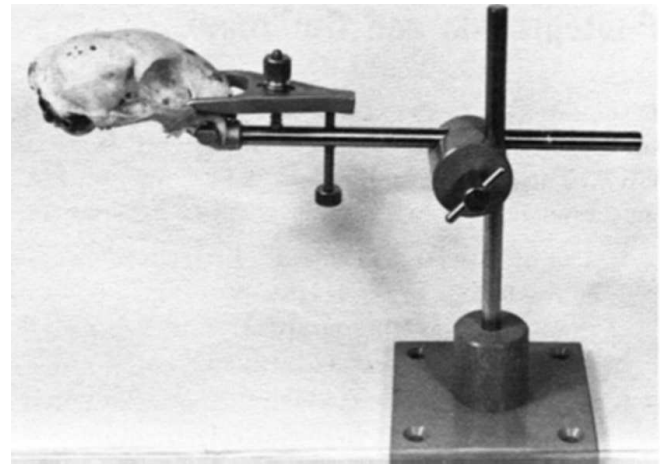
Ets, Roucaire S.A. 20, Avenue de l'Europe, B.P. 65, 78 - Velizy, France. France.

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It has been brought to our attention that on the 1260 and 1460 Electrode Carriers, where Kel-F bushings are used in construction, that the electrode holder portion of the manipulator is essentially "floating" electrically. In those applications where noise pick-up may be problem, we recommend that the carrier be grounded at the point where the electrode holder mates with the carrier.

It is our desire and intent to publish material which is of general interest to those individuals working in the neuroscience field.

We look to those individuals like yourself who are working in this field as a potential source of information which will be of interest to others in the research and academic community.



Cat Surgical Head Holder

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We have redesigned our Model 345 Cat Surgical Head Holder to give the investigator greater flexibility in the selection of skull sizes that can be accommodated.

This unit locates in the hard palate and teeth. An adjustable infra-orbital clamp is provided to firmly locate the head.

The unit is shown mounted in the Model 310 Universal Stand, or it may be mounted on any combination of standard laboratory clamps. The 345 may also be utilized as a head holder with spinal investigation units.

The 345 is priced at \$170.00. Delivery 30 days. In a similar vein, we also now have available, on special order only, a surgical head holder for Rhesus monkeys. Mounting provisions are the same as for the 345.

We hope you will take the opportunity to use our publication to disseminate any information which would be of interest to other investigators. Please contact our Editor.

For those of you who may have had difficulty in obtaining atlases, we have found that the Krieger Publishing Company, Inc., P.O. Box 542, Huntington, New York 11743, maintains stocks of a substantial number of out of print books and may be a useful source.

Our next display will be at the Winter Conference on Brain Research in Steamboat Springs, Colorado, January 19-26. We will have the new electronic micro-drive, described on page 2, on display at that time.

Photographic and Darkroom...

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is seldom able to avoid the fact that data will eventually have to be photographed, usually from the CRT. This photographing of data from the CRT may be accomplished by any or all of three means:

1. Use of a Polaroid camera when data is needed immediately, when relatively small amounts of data need be photographed, and when darkroom facilities may not be available.
2. Use of a regular 35 mm single-lens-reflex (SLR) camera when one has relatively small amounts of data to photograph and thus exposes few frames of film (250 frames maximum).
3. Use of a motor-driven oscilloscope camera where 100 to 200 feet of film may be loaded and used during any one photographic session.

Regarding Polaroid photography, it may be stated that there is an almost endless assortment of Polaroid cameras available ranging to over \$1,000 depending on the conveniences desired. A large assortment of these cameras are available.¹ In addition, Polaroid has recently introduced the CR-9 oscilloscope camera. This latter camera is light weight, portable, easy to operate and relatively inexpensive. It is also extremely convenient to use if the laboratory has more than one oscilloscope from which the investigator may wish to photograph.² The CR-9 utilizes the standard Polaroid film pack, type 107 (ASA-3,000) and produces a print of fairly high quality.

Some investigators find that where small amounts of data are to be photographed and a high quality negative is desired, a regular 35 mm SLR camera mounted in front of the CRT and connected to the CRT with a light-proof cone works very well. The investigator is limited, with most cameras, to the use of 20 or 36 exposure rolls of perforated film. Of commercially available films, Kodak Tri-X appears to produce the best results and is probably the film of choice when an SLR camera is utilized for CRT photography.³ One advantage to the use of a 20 or 36 exposure roll of film is that the small Honeywell Nikor developing tanks and reels may be used. The 35mm x 36 exposure tank and reel are compact, use a minimum of chemicals, and once the film is loaded, the rest of the developing process may be conducted outside the darkroom.

When one generates enough data such that it is impractical to use either a Polaroid or a 35mm SLR

camera, the alternative is a motor-driven oscilloscope camera. Indeed, most neurophysiology laboratories seem to have one of these cameras mounted on an oscilloscope somewhere in the laboratory. A variety of CRT recording films are available for these cameras in perforated and nonperforated 35mm rolls, 100 to 200 feet in length. At present, two such oscilloscope cameras are available.⁴ The Grass C-4 camera is the older design of the two. The camera is quite bulky and noisy but it has proven itself to be a reliable piece of laboratory instrumentation. The C-4 camera is not supplied with a reflexor housing and therefore one either mounts the camera directly in front of the oscilloscope screen or else purchases additional components to mount the camera vertically above a rackmounted oscilloscope to interface it to the scope with a reflexor housing.

Perhaps the most commonly used system of components for interfacing the vertically mounted C-4 camera to the CRT is that manufactured by Bioelectric Instruments.⁵ This system consists of an ACM-1 auxiliary camera mount and the Reflexor Oscilloscope Camera Mount. In addition, I have found it convenient to add the RACM rotary auxiliary camera mount⁵ so that the camera may be rotated 90° on the camera's optical axis to shift the orientation of moving film to the sweep on the CRT. If funds are not available for the Reflexor unit, it is possible to use the C-4 camera mounted directly in front of the oscilloscope without the Bioelectric interface.

The alternative system to that described above is the Nihon Koden, Model PC-2A oscilloscope camera. This is a complete unit, and does not necessitate purchase of the Bioelectric components. The camera is of newer design than the Grass C-4 camera, but not having used the instrument myself, I cannot comment on its quality or durability. The PC-2A may be mounted horizontally or vertically and will accept perforated or nonperforated films up to 200 feet in length. It may be explored as an alternative to the older C-4 camera.

Having decided to utilize either the Grass or the Nihon Koden camera as the basic mode of laboratory photography, one soon becomes involved in film selection and processing. Neither the corner drug store nor the campus photography service are often willing to handle 100 foot rolls of film. In the past, the film of widest use was Kodak Linograph Ortho (SO-234). This was a negative film that was specifically designed for oscilloscope photography.

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This film has recently been discontinued and has been replaced by Kodak 2495 RAR film/11 have not yet had the opportunity to use this film as I am still using my supply of Linograph Ortho. However, according to Kodak, 2495 RAR is an improved version of Linograph Ortho with a polyester support, is fast drying, and is more resistant to cracking and tearing than was Linograph Ortho.

Like Linograph Ortho, 2495 RAR may be developed using Kodak D-19 developer. The development time should be approximately the same as for Linograph Ortho (7 to 12 minutes), however, the exact time for your particular situation must be obtained by trial and error. In using 2495 RAR with either the Grass or the Nihon Kodan cameras one should specify a film number to get perforated or nonperforated film on various types of spools. This film is available in 150 foot rolls. The entire 150 feet (although loaded as a unit) does not have to be photographed in its entirety before it may be processed. On both cameras, the take-up reel can be removed at any time, the exposed film processed, an empty take-up reel placed on the camera, and another length of film photographed. Once a length of film has been exposed, the film must be processed in a darkroom, a considerable chore since film lengths of up to 100 feet or more are involved.

At present, I know of three techniques by which these lengths of film may be handled. First, one may use the manually operated Morse G-3⁷ developing tank. This device although compact in size and inexpensive is somewhat difficult to use and frequently does not produce consistent results. The second method of developing long rolls of film is to use the Smith Film Developing Outfit⁸ The Smith unit consists of a stainless steel tank (similar in design to the plastic Morse tank) with a synchronous induction motor mounted on top. The unit produces quite consistent results and with a little practice easily handles film lengths of up to 100 feet. The Smith outfit is available only on special order.

The third film processing device is the Honeywell Nikor Film Processing Machine. This unit is similar in construction to the small Nikor film developing tanks except that the spiral film wheel and the tanks have been expanded in size to hold lengths of film of up to 100 feet. This system, although moderately expensive is quite easy to use as developing times remain the same regardless of the length of

film being processed. The major disadvantages of the system, however, are that it is bulky, it requires larger amounts of solution and requires a considerable amount of darkroom space. To use this system, one should have access to a darkroom of approximately 6x7 feet which contains a 2 x 6 foot sink and a table of similar size. The actual processing is done with the tanks in the sink and the table is used as a loading and drying area.⁹

After processing, one is left with long rolls of negative film. In this form the data is quite suitable for visual analysis but one may encounter problems in preparing data for publication. When printed directly, the resulting print contains data in the same format as it appeared on the oscilloscope: i.e. white traces on a black background. If one desires prints that contain black traces on a white background, inter-negatives of those portions of the film which one intends to publish will have to be made. It is possible, however, using Kodak 2496 or 2498 RAR films to process the film to produce a reversal such that inter-negatives would not be necessary. This reversal method of processing, however, is more complicated than the direct processing of 2495 RAR film and it may be easier to have inter-negatives made of those portions of film which one desires to publish.

It is impossible in this short space to cover all available information on this subject. In closing, I would like to list several additional publications obtainable from Eastman Kodak Company which maybe of interest to the laboratory worker.¹⁰

This article should not be construed as an endorsement of any manufacturer's equipment or supplies, but is being presented as a guide to assist researchers in the collection of experimental data.

Footnotes

1. 32 cameras from seven manufacturers are listed in *Industrial Photography*, August, 1973, Reprints of this list (Reprint #F5427) are available from Polaroid Corporation, Product Information Department, 549 Tech Square, Cambridge, Massachusetts 02139.

2. CR-9 is available from: Allied Electronics, 2400 West Washington Blvd., Chicago, Illinois 60612, Edmund Scientific, 101 East Gloucester Pike, Barrington, New Jersey 08007, Integrated Controls, Inc., 3045 Moore Street, San Diego, California 92110, and Bio/Physics System, Inc., Baldwin Place Road, Mahopac, New-York 10541

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Footnotes... (Continued from page 5)

3. Most CRT recording films are available in 100 to 200 foot lengths for use in 35mm cameras. Tri X is available in 100 foot lengths for CRT use.
4. C-4 available from the Grass Instrument Company, Quincy, Massachusetts, Nihon Kodon PC-2A manufactured by Kosyo Company, Ltd., Japan. Sales and service available from Tech Serv., Inc., 5301 Holland Drive, Beltsville, Maryland 20705.
5. Bioelectric Inst, 155 Morine Street, Farmingdale, New York 11735.
6. Pamphlet P-232 from Eastman Kodak Company, Rochester, New York 14650.
7. Morse Controls, Inc., Hudson, Ohio.
8. Philadelphia Air Transport Company, Norris-

- town, Pennsylvania.
9. Honeywell Photographic, Denver, Colorado 80217. Publication N-1000 describes Honeywell Nikor film processing machines.
10. Additional help and information is available from Eastman-Kodak Instrument Product Group, Eastman Kodak Company, 343 State Street, Rochester, New York 14650. Pamphlets of specific interest to you might be the: #P-37 Pamphlet, Kodak films for cathode-ray tube recording. #P-55, Rapid access-recording Shell-burst films. #P-73, RAR 2496 film. #P-74, RAR 2498 film. #P-232, RAR 2495 film. #P-130, Basic Oscillography. #J-1, Processing Chemicals and formulas. #J-7, Processing long rolls or spiral reels. The "complete index to all Kodak information publications is the #L-5 pamphlet.