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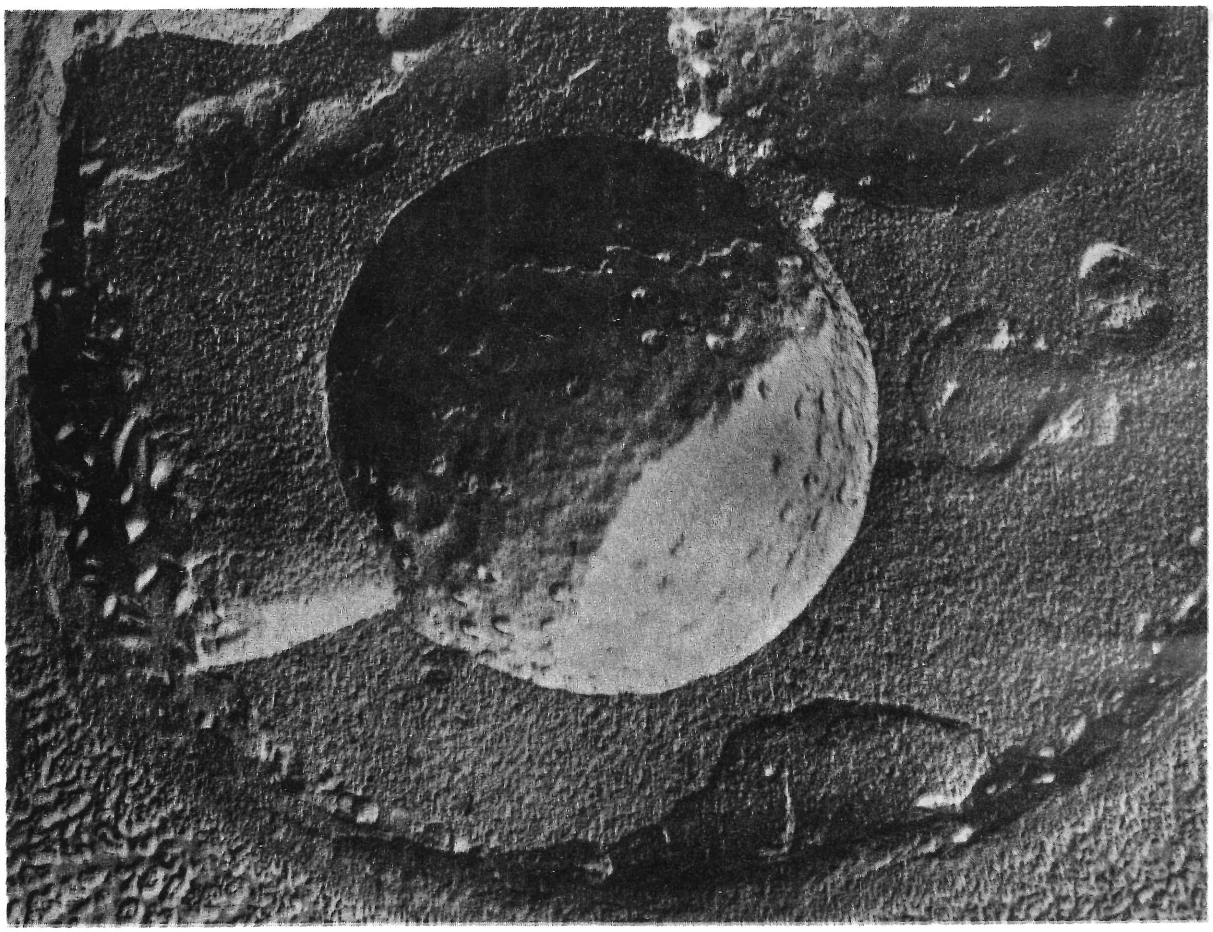
Texas Society for Electron Microscopy



RECENT BOOKS FROM HARPER & ROW

OCULAR HISTOLOGY: A Text and Atlas

By **Ben S. Fine, M.D.,** *Armed Forces Institute of Pathology, and The George Washington University – both in Washington, D.C.; and* **Myron Yanoff, M.D.,** *Medical School and Hospital of the University of Pennsylvania*

276 Pages. 490 Illustrations (19 in full color). 1972. $25.00

This new book provides a detailed introduction to contemporary histology and cytology of ocular tissues, emphasizing the human tissues. The approach is also new in that the structure of the eye is discussed from the three-tissue concept (a cytologic approach) which is complimentary to the older three-layered concept. Transmission electron microscopy of all the ocular tissues is described, a collated group of pertinent references in the field is provided, and correlation is made with clinical observation wherever possible. Scanning electron microcopy is also included.

DERMAL PATHOLOGY

With 17 Contributors. Edited by **James H. Graham, M.D.,** *College of Medicine, University of California at Irvine;* **Waine C. Johnson, M.D.,** *Temple University School of Medicine; and* **Elson B. Helwig, M.D.,** *Armed Forces Institute of Pathology.*

830 Pages. 879 Illustrations. 1972. $45.00

This highly illustrated book presents basic and modern concepts of dermal pathology including related anatomy, histology, electron microscopy, and histochemistry. Diseases which show similar histopathologic features are placed next to each other in order to stress the differential diagnosis and emphasize the differentiating features between these diseases. The scope includes cytodiagnosis, inflammatory dermatoses, granulomatous dermatoses, nevi and neoplasms, and reticuloendothelial and alternative dermatoses.

ELECTRON MICROSCOPY OF HUMAN BLOOD CELLS

By **Yasukazu Tanaka, M.D.,** *Veterans Administration Hospital, San Francisco; and* **Joseph R. Goodman, Ph.D.,** *School of Medicine, University of California.*

430 Pages. 349 Illustrations. 1972. $25.00

In an atlas-like presentation, this book illustrates and discusses the normal and pathologic aspects of the human blood cell. Presenting all human blood cell types with a description, morphology and cytogenesis of each, the text relates current concepts of function and disease, and includes techniques and solutions applicable specifically to hematological specimens prepared for the electron microscope.

ATLAS OF NEUROPATHOLOGY

By **Sumner I. Zacks, M.D.,** *University of Pennsylvania School of Medicine*

416 Pages. 341 Illustrations. 1971. $18.00

One hundred and fifty-one plates, representing over three hundred photographs of gross specimens, photomicrographs and electron micrographs, survey the world of neurologic diseases. All the plates have been carefully chosen to make the pathologic lesions readily evident. Brief case summaries, placing each lesion in clinical perspective, are also included.

AGENTS OF BACTERIAL DISEASE

By **Albert S. Klainer, M.D.,** *West Virginia University Medical Center; and* **Irving Geis,** *Medical Illustrator.*

Approx. 224 Pages. Approx. 100 Illustrations. 1973. Approx. $15.00

This new text presents a unique visual approach to the study of the common bacteria which cause human disease. It is profusely illustrated with scanning electron photomicrographs and detailed diagrammatic illustrations in order to permit rapid assimilation of the subject matter with a minimum of textual material. The photomicrographs provide stunning visual insight into the morphology of numerous bacteria.

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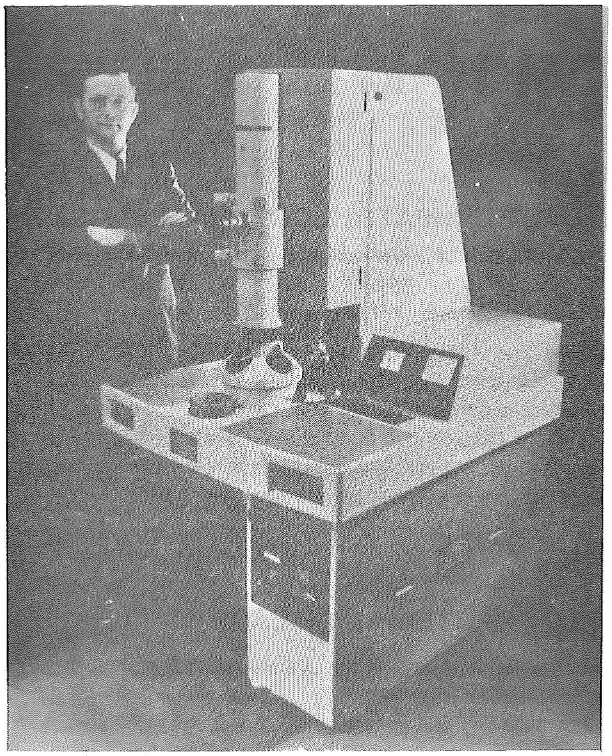

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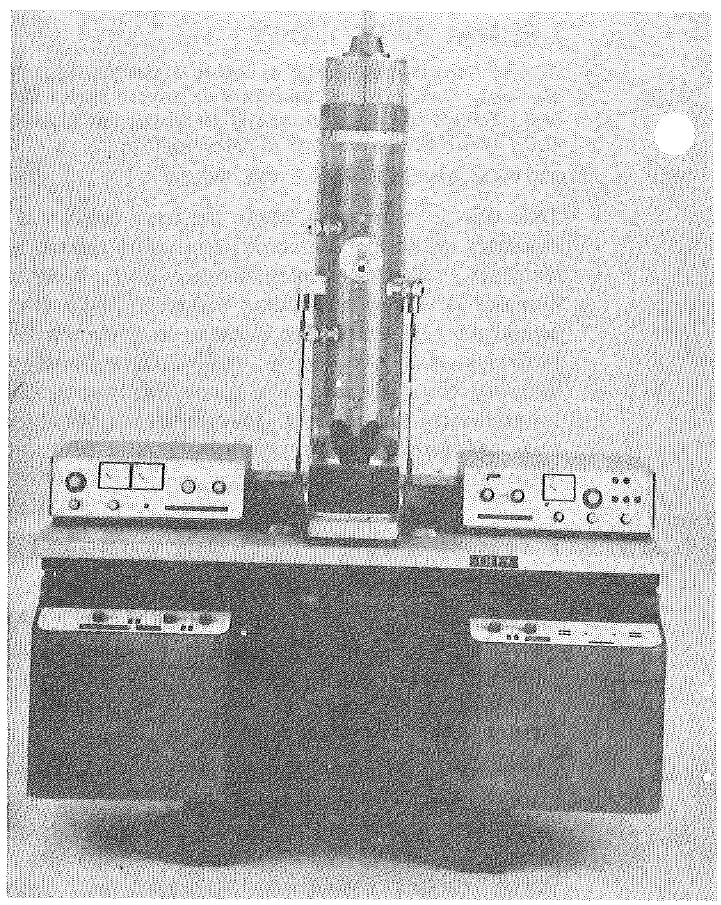

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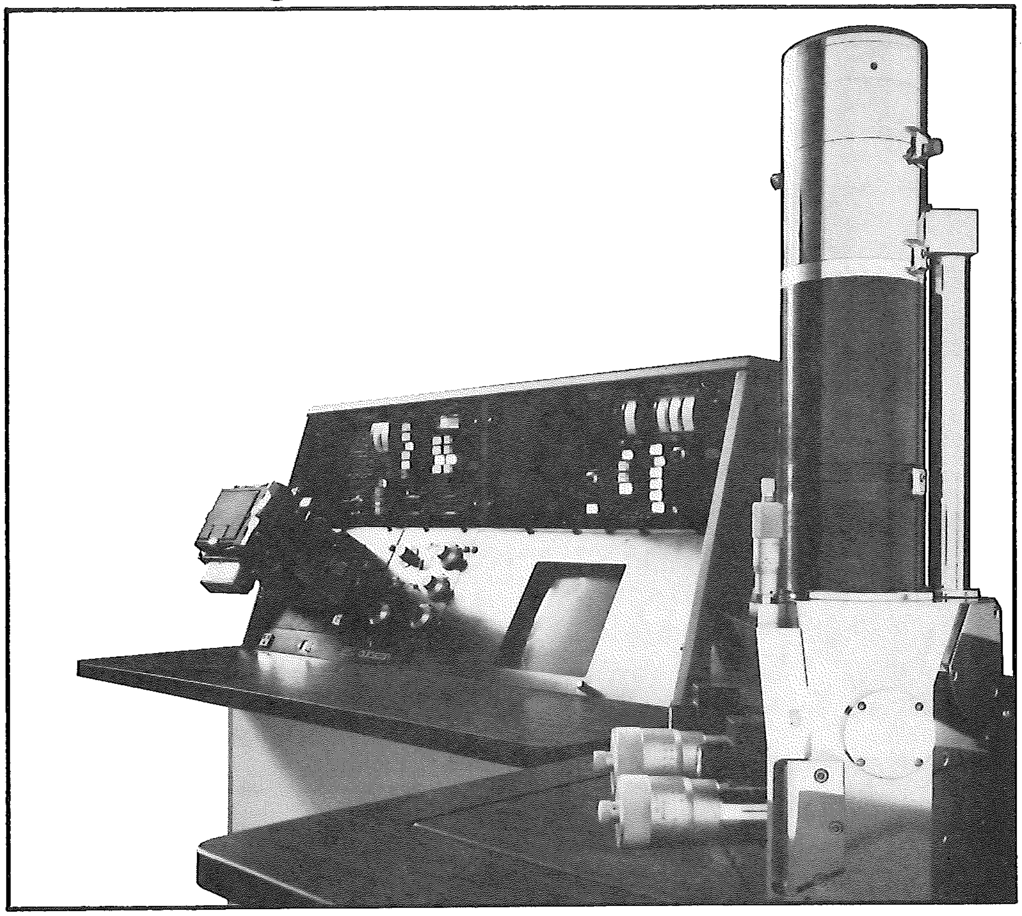

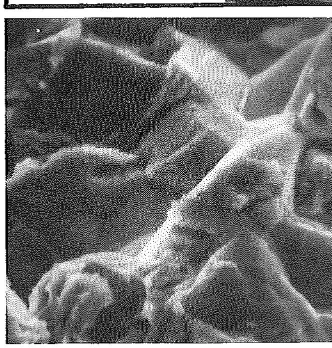

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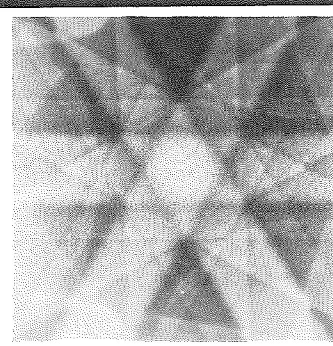

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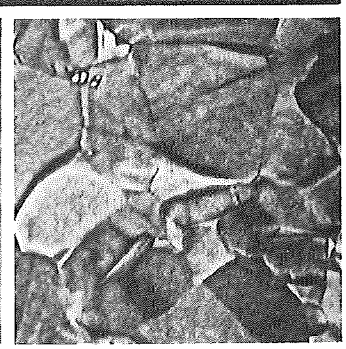

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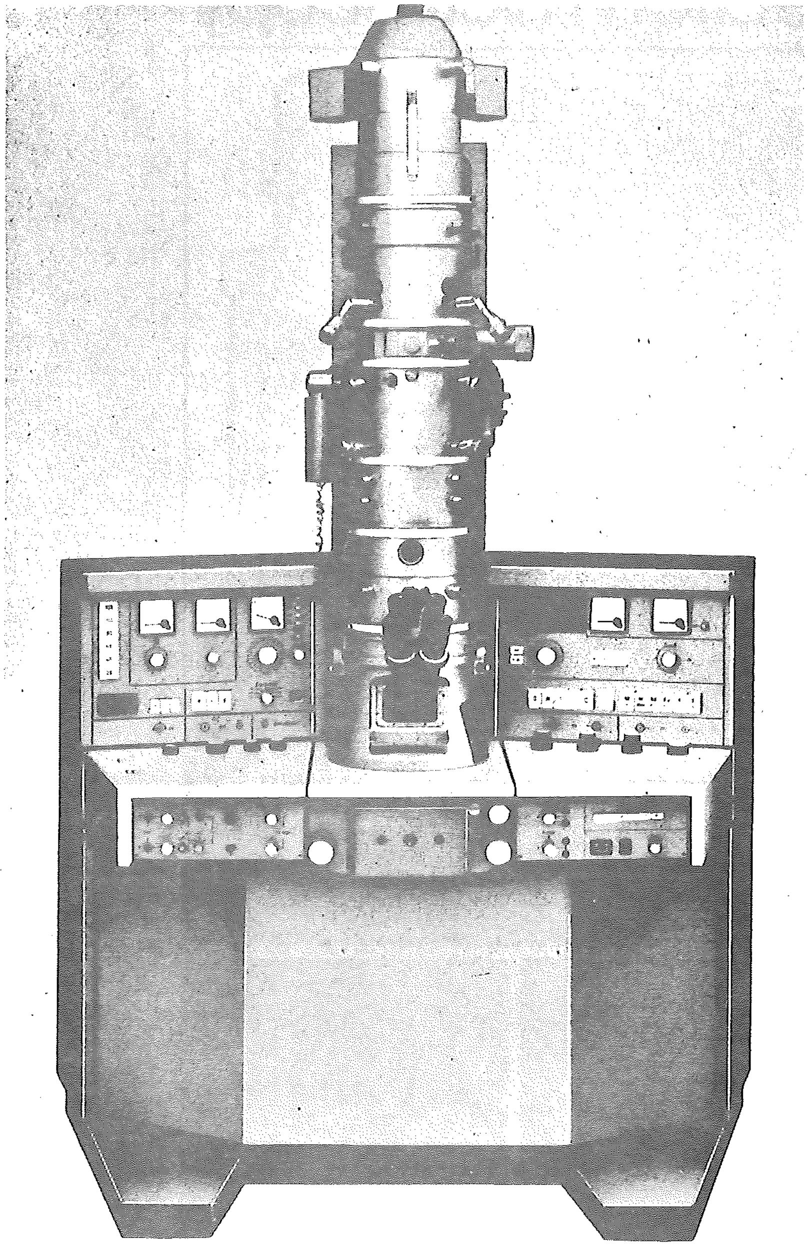

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WINTER 1974

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WELCOME

EMSA EXECUTIVE COUNCIL

The Texas Society for Electron Microscopy and I would like to express our deep personal thanks and gratitude to Dr. Russell J. Barrnett and the other members of the EMSA executive council for holding their annual winter business meeting in San Antonio during the TSEM-LSEM symposium.

It is indeed an honor and privilege to have such a distinguished group of scientists attend our annual symposium and to attend sessions where they will be presenting their latest research.

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Welcome Exhibitors

The Texas Society for Electron Microscopy would like to thank the following corporations which have exhibits at the TSEM-LSEM Winter Symposium.

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Editorial

For the Purpose of Dissemination of Research with the Electron Microscope

This title states precisely and exactly, the reason for Our Society. Given this as the reason for our existence, how do we as an E. M. Society go about the dissemination of research with the electron microscope. It seems to me that we have previously gone about our purpose in one main way and that is to attend and exchange information at our regular society meetings. The regular society meetings are an unquestioned success. There is currently some healthy discussion in Our Society about the types and number of meetings that we should have each year, but no one is debating the importance of this forum of information exchange. However, with the problems of travel funds, distances in Texas and the probable advent of gasoline rationing, we must seriously consider alternate ways to meet our purpose.

I submit that our Newsletter is a logical and effective vehicle to meet our aim.

The Newsletter:

1. serves the entire membership, not just those who attend the regular meetings.

2. publishes the abstracts of papers given at our meetings for all to read

3. is currently a self-paying newsletter which gives our corporate friends an effective and inexpensive means of communicating information about their developments and products to a select and appreciative readership.

4. offers a format for short communications of original research and technical developments and in this vain the editor would be happy to receive good brief articles of general interest to the membership at any time.

5. offers everyone in the membership a chance to exchange news items and opinions with the rest of his colleagues across the state.

6. can serve as a placement service for employment.

7. prints the minutes of the business meetings, statements of society policy, the financial condition of the society, and the membership directory.

8. prints announcements of forthcoming meetings and events.

Our Newsletter offers you all these things and all you must do is use it. Yes, use it to your advantage. Remember doing research means little unless you communicate your findings and ideas.

You can serve yourself and the purpose of the Texas Society for Electron Microscopy by communicating your area news and research reports to the Newsletter editors. Let us make the Newsletter a viable and vigorous alternative to accomplish our purpose.

IVAN L. CAMERON

Newsletter Editor

PRESIDENT'S MESSAGE

Our first meeting of the current year was held at a dude ranch in Bandera with about ninety people in attendance. This type of informal meeting was held on a trial basis in order to feel the pulse of the membership. Based on other people's comments, I went away feeling that the meeting was a huge success and that this type of meeting should become an annual event. If you have any comments concerning this meeting or its equivalent, I would appreciate it if you would drop our Newsletter editor a personal comment.

The present meeting is the winter symposium with L. S. E. M. Bob Dyer and Joe Mascarro have been doing a lot of ground work to gather up a bus load of L. S. E. M. people to bring to this meeting. I trust that the T. S. E. M. will be equally enthusiastic. Many contacts have been made to commercial people and it appears that we will have approximately twelve commercial exhibitors at this meeting.

Many times at the recent ASCB meeting in Miami Beach, I overheard favorable comments about the T. S. E. M. I'll have to admit I wasn't too surprised to hear these good comments about our society, but when you continue to hear them for several days from people all over the country, it makes you proud to be a member of T. S. E. M. This outstanding reputation has only been gained by very hard and diligent work from many executive committees during the past nine years of the society. The individual names are of course too numerous to list, but if we continue to have strong executive committees, I am sure we will continue to have a strong and active state society.

I would like to once again express my personal thanks to all of you who have had a part in the success and growth of our society and trust that future committees will carry on the good work.

ROBERT A. TURNER

President

T. S. E. M. MINUTES

The T. S. E. M. business meeting was held Saturday, September 29, 1973 at 12:30 P. M., at the Mayan Dude Ranch, Bandera, Texas. President Robert Turner presided. The minutes of the last meeting were read and approved. The treasurer's report was read and approved.

R. Turner reported on the meeting of regional E. M. society officers at the E. M. S. A. meeting in New Orleans.

R. Turner led a discussion about the number of T. S. E. M. meetings per year.

R. Turner initiated a discussion of awards to be given at the Spring meeting. Col. Leibovitz moved that T. S. E. M. provide all students presenting papers at that meeting with expense money prorated according to need and actual expense as documented by the student's advisor and, additionally, give awards, specifically including a plaque, for the best presentations. The motion was amended to exclude aid from individuals holding doctorates. The motion passed unanimously.

The meeting adjourned at 1:10 P. M.

JERRY BERLIN

Secretary

FINANCIAL REPORT

T. S. E. M. Fall Meeting

Bandera, Texas

September 28-30, 1973

Receipts:

A.	Regristration fees and dues	$ 316.50
B.	Dues received during pre-registration	35.00
C.	Corporate support of Newsletter	
	1) Fullam	150.00
	2) Zeiss	50.00
	3) Ladd	50.00
	4) Harper and Row	150.00
	5) Siemens	50.00
	6) Kent Cambridge	50.00

Disbursements:

A.	Newsletter	$ 300.00
B.	Mailouts	200.15

Summary:

Total receipts	$ 851.50
Total Disbursements	500.15
Bank balance prior to meeting	2,251.65
Proceeds of meeting	351.35
Bank balance after meeting	2,603.00
Dues collected after meeting as of November 20, 1973	105.00
Total in checking account	2,708.00

Certificate of deposit	1,000.00
Total Assets	$3,708.00

ANNOUNCEMENTS

The spring meeting is intended to be a workshop-graduate student meeting to be held at Texas A & M University, May 17th and 18th, 1974. Papers will be presented by graduate students only and they will also chair each session. This meeting is intended to appeal to the graduate community by providing inexpensive housing and meals. In addition, TSEM is currently working on an award program to be given to outstanding student presentations. Details will follow in subsequent announcements.

W H I T H E R E D U C A T I O N ?

Part Two

"Those who can, do;
Those who can't, teach;
And, those who can't teach,
Teach teachers."

--Professor X, in, This Beats Working For A Living.

There is the old saw that, given enough time, a chimpanzee will eventually play the Star Spangled Banner on the piano. In a somewhat similar sense, given enough time, most students can master almost all of the skills presented to them in their formal educational years, and even beyond. The difference, of course, between the chimp and a student is that the chimp will not have known what he has done, whereas, the student will.

There are probably two major reasons why more time is not taken during the formal educational years to teach those skills. Language, art and mental skills seem to parallel the development of motor abilities in most individuals. We seem to assume that as physical abilities progress, our instructional level in academic skills should keep pace. They do in most cases, but where exceptions arise, the students are usually passed on anyway because: 1) emotional maturity, which often parallels their peer rank and order, has seemed more important to maintain and nurture than extend the effort, where needed, to continue development of manual and mental skills, and 2) the emphasis has seemed to be on obscuring individual performance, that is, excellence in individual skills. Thus, grading systems have tended to resort to pass-fail rather than specific ranking. Even professional schools, some of high reputation, have not had departmental exams for many years.

Therefore, to hold a student back because of poor skills performance is to suggest that the student cannot master the real intent of education, his social maturity!

Should a technological end point be the common goal for any and all levels of education? If one is highly trained, does this mean also that he is unable to think, or vice-versa? One of the common complaints from traditional-type educators is that we should not just train the student but also teach him how to think, and along with this expose him to the thinking of others. I believe we do this, in some cases, perhaps unconsciously, even when we train him. I also believe these educators have had their observations obscured by the overwhelming influence of "educationists". By training the student, in effect, we are liberating him from his peer pressure, the need to depend on his friends, gang, or the mob. He will be able to depend on himself, to sell himself, alone. You cannot destroy the thinking capacity by training a student in skills, be it manual or mental. And, I view the cry for "humanistic education" more in the light of compulsive-type Deweyism than in the light of a directly beneficial education. I quote from one of John Dewey's books, "Experience and Education" written in 1938:

> It is, then, a sound instinct which identifies freedom with power to frame purposes and to execute or carry into effect purposes so framed. Such freedom is in turn identical with self-control; for the formation of purposes and the organization of means to execute them are the work of intelligence. Plato once defined a slave as the person who executes the purposes of another, and as has just been said, a person is also a slave who is enslaved to his own blind desires. There is, I think, no point in the philosophy of progressive education which is sounder than its emphasis upon the importance of the participation of the learner in the formation of the purposes which direct his activities in the learning process, just as there is no defect in traditional education greater than its failure to secure the active co-operation of the pupil in construction of the purposes involved in his studying. But the meaning of purposes and ends is not self-evident and self-explanatory. The more their educational importance is emphasized, the more important it is to understand what a purpose is; how it arises and how it functions in experience.

Out of this has grown a sense of personal freedom of the student in education which has degenerated into a "permissiveness-allowing students to decide what and how much they are able to learn" - producing, according to Harvard Professor B. F. Skinner, not "free and happy students, but truants, dropouts and vandals". This obsession with the 'comprehending student' has had its consequences at the level of professional schools, also. Dewey was intent upon introducing scientific subject matter through its relationship with everyday social application. This, he said, was "sound educational principle".

As a result, the so-called humanities took precedence in fundamental education. How could the student understand the social applications of science if he did not know what the social problems were? And, of course, the educationists knew what these social problems were. So, the students have spent an inordinate amount of time "studying" formally what their everyday experience taught them. Thus, students are required, in many places, to take only 9 hours of biological sciences as entrance requirements to medical school. Consequently, when they enter medical school they are confounded by the crush of material to be learned, the interminable number of facts, which are integral to their peculiar learning experience, heard or seen for the first time often in such rapid fashion as to be meaningless in value.

If education is, essentially, learning how to live effectively, that is, successfully, within our environment, then we should ask ourselves, by what regimen, or order do we live? The Judeao-Christian ethic notwithstanding, this regimen is not a primary concern with brotherhood or of social concern. There is a time for contemplation of the navel, or of meditation with your favorite Guru, but, friend, it does not bring home the bacon. Even the early-formed hippie communes found that out. They soon became transformed into small capitalistic enclaves. And, they quickly learned the value of acquiring skills.

As social beings, we are creatures of habit, for therein lies our sense of day to day security. There is nothing inherently bad in that; in fact, it is fortunate that we do exist in this way. That is not to say we are unable to "think", to analyze differences or changes and to act accordingly. In fact, what most of us do when confronted with changes or threats of change to our habits is to adjust ourselves to such changes or to control the changes sufficiently so as to minimize their effect.

Therefore, we live according to a repetition of pattern with a mastery over these patterns.

The pre-Dewey educational experience, that is, traditional education, was geared to meet that modus vivendi. Remember how we learned to spell from spelldowns - rote learning. The three Rs were the essential ingredients of a curriculum loaded with drill, drill and more drill. We also memorized whole passages from novels until we could spit them back on cue, flawlessly. Perhaps their greatest significance came much later in life, that is, our conscious thinking about their relevance. Most of them were reminders of the qualities of thinking, courage, industry and humor. They reminded us of how to live. And what is mathematics? A highly disciplined subject which invites the highest measure of training. But, it is more than that too. It is a way of thinking!

Our schools have never been deficient in skills training. At all levels, the student has been and continues to be schooled in doing; its called arts and crafts in the primary grades, laboratory in the upper grades. Further, there has always been the opportunity for the student to be exposed to philosophy, theory courses, music appreciation, etc. as separate courses. The problem has arisen that these humanistic subjects have been highly touted as the cure, the saving-grace, of the social ills of society. There is not one inkling that that is true.

The greatest real change which has taken place in the field of education over the last 50 years has been that of accumulated knowledge. What should take precedence is a gleaning from this vast amount of material that which must be learned as representative of, or as cues to, the unlearned or untouched material. Learning by analyses or by understanding the whys or wherefores of whatever is not necessarily sacrificed by skills training. On the contrary, one must recapture the faith that the human mind is not so intolerably gullable that it cannot select proper judgement values or appreciation levels from its training in manipulative skills.

If, therefore, priorities are to be made between training in skills on the one hand and social concepts on the other, I would still favor the former.

The reason is that out of training some direct applicable value is always obtained. Out of the other there is always the possibility of a wasted effort, an effort the benefit from which not even the student is often able to predict. The former tends to be inspired by need, the latter by leisure!

Ward Kischer

The present bibliography was compiled by graduate students in Botany 394, a course on freeze-etching and scanning electron microscopy given by Dr. G. T. Cole at the University of Texas at Austin.

The bibliography is formatted, edited and processed by Ruben Ramirez-Mitchell, Cell Research Institute, University of Texas, using the CDC 6600/6400 computer system at The University of Texas. The references are part of a data base on scanning electron microscopy and freeze-etching for future use with a retrieval system of limited capabilities being written in Fortran IV and Basic.

The bibliography will be made available to any interested party in the form of printed computer output, or punched cards.

References already published by Dr. G. L. Colborn (TSEM, 4, 1973) and keywords present in the original bibliographies are not included in the present listing.

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REPLICA TEM FRACTOGRAPHY

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With the development of replication techniques suitable for rough surfaces, the transmission electron microscope (TEM) became a practical tool for the study of the fine-scale topography of fracture surfaces. Widespread application of this tool rapidly expanded the understanding of the micromechanics of fracture and during the early 1960's the topographic features characteristic of the basic fracture mechanisms were well documented(1-4). With this foundation, replica TEM fractography developed into one of the major laboratory techniques for basic fracture research and service failure analysis.

The principal replication techniques applicable to rough fracture surfaces are the two-stage, plastic-carbon technique and the direct carbon technique. The first has found the widest application and consists of preparation of a relatively thick, negative plastic replica of the surface, shadowing and carbon coating of the plastic, and finally dissolving the plastic to free the carbon film for direct examination in the TEM. In the second technique the fracture surface is shadowed and carbon coated. The direct carbon replica is then floated from the specimen by suitable etching or electrolytic polishing procedures. Other specialized techniques, such as oxide replicas, have also been employed in certain cases. The details of fracture surface replication techniques are thoroughly described in the literature(1,2,5).

In the very general sense, the fine-scale topographic features of fracture surfaces may be considered in three classes, each characteristic of a basic fracture mechanism. Fracture by the initiation, growth, and coalescence of microvoids results in the frequently observed "dimpled" topography. Cleavage fracture is characterized by flat, transgranular facets, often marked by "river patterns". Fatigue crack propagation in many materials produces characteristic "fatigue striations" on a microscopic scale. Aside from the features associated with basic fracture mechanisms, intergranular fracture is characterized by a unique fine-scale topography comprised of readily recognized intergranular facets. The metallurgical literature from 1963 to date contains extensive information on the application of electron fractographic techniques. Among these many publications the interpretation of particular fine-scale topographic features is thoroughly described and many instances of the contribution of fractographic observations to the understanding of fracture mechanisms and processes are reported. The proceedings of three ASTM symposia held in recent years serve as a cross-section of published literature in this area(6-8). It is not the intent of this article to review the progress of electron fractography and its associated literature, but rather to present selected data from particular studies to illustrate the applications of replica TEM fractography.

The most commonly encountered fracture mechanism is that of microvoid growth and coalescence (MVC). Examples from a study of the influence of microstructural features on this fracture mechanism are shown in Figures 1 through 4. Each of these figures illustrate variations of the dimpled topography characteristic of MVC. Detail features of individual dimples often provide evidence of initiation of microvoids at discreet second-phase particles or inclusions, see Figure 1. A point of interest is illustrated by the mixture of dimple sizes evident in Figure 1. Such topographic features are characteristic of a microstructure consisting of large, widely spaced constituents along with small, uniformly distributed particles. The mixture of dimples of widely varying size is evidence of early void initiation at large precipitates with resultant extensive growth of those few voids. Final fracture occurs by initiation and limited growth of a large number of microvoids. Figure 2 illustrates a case of fracture by extensive growth of a relatively few voids resulting in large uniform dimples. In this particular case, growth of individual voids occurred without any apparent interaction with finely dispersed precipitate particles. In a high-purity Al-4.2% Cu specimen, solution treated and overaged, fracture occurred by mixed transgranular and intergranular modes. Fractographs representative of each mode are shown in Figures 3 and 4. Large uniform dimples characterized the transgranular positions while the intergranular portion provided an example of the initiation and growth of numerous microvoids at grain boundaries.

A recent in-depth investigation of service-induced cracking in forged aluminum alloy compressor discs of a helicopter gas turbine engine produced some interesting observations on the fractographic aspects of fatigue crack propagation. Extensive examination of replicas from a large number of service-induced cracks revealed a predominance of a "step-type" topography which could not be readily classified. Examples of these features are shown in Figure 5. Some indefinite indications of fatigue crack propagation were observed at isolated locations on certain crack surfaces and classic fatigue striations were observed only at the extremities of the longest crack examined. A series of laboratory fatigue tests were conducted on specimens of the disc material and the resulting fracture surfaces were examined by replica TEM techniques. As illustrated in Figure 6, a distinct transition from well-defined fatigue striations to a "step-type" topography was observed to occur with a decrease in crack propagation rate. This observation established that the service-induced cracking occurred by high-cycle fatigue and also provided evidence of a different micromechanism of fatigue crack formation at low propagation rates. Tests in humid air indicated that the presence of moisture shifted the transition toward higher crack propagation rates.

Replica TEM fractography played an important role in a recent investigation of the failure of two closure studs of a nuclear reactor pressure vessel. Selected fractographs from this study are shown in Figures 7 and 8. In these failures, sub-critical cracking occurred at the thread roots in service and terminal fracture occurred on application of a pretensioning load during a head removal operation. The material for the studs was a 12% Cr quenched and tempered alloy steel (A 437-B4B). Metallographic examinations of specimens from the studs revealed an abnormal microstructure characterized by a nearly continuous grain boundary phase. Mechanical property tests established that the tensile strength exceeded the specified minimum value by a substantial margin and that the fracture toughness was too low for the intended service.

In the fractographic examination of the failed studs it was observed that the fracture initiation zones were completely intergranular and corrosion of the individual intergranular facets was evident, see Figure 7. These observations, together with the metallographic data and service history of the studs, indicated that the sub-critical crack growth occurred by intergranular stress-corrosion cracking.

The mechanical test program included Charpy impact tests on specimens from the service studs and from material with a normal microstructure. At all test temperatures the values of absorbed energy measured for the stud specimens was significantly lower than that for the normal material. The fracture surfaces of representative specimens tested at 70°F were examined to provide a comparison of the fine-scale topographic features. The fracture surface of the specimen of the normal material was completely transgranular and characterized by a mixture of cleavage facets and dimples, see Figure 8a. These features are typical of fracture in alloy steels within the temperature range of the ductile-brittle transition. In contrast, the fracture surface of the specimen from a service stud was predominantly intergranular as illustrated in Figure 8b. This observation, together with mechanical properties data and metallographic observations provided evidence that the presence of intergranular microconstituents can contribute to a significant decrease in fracture toughness of a class of alloy steels frequently employed for critical bolting applications.

Although the purpose of this article was to illustrate the application of replica TEM techniques to fracture analysis, some mention must be made of fractography by means of the scanning electron microscope (SEM). A substantial part of the basic research related to interpretation of fine-scale fracture surface topography was done prior to the introduction of the SEM as a readily available investigative tool. Thus, initially, the term "electron fractography" implied utilization of replica TEM techniques. Today, with the recent developments in scanning microscopy, and the rapid increase in availability of the SEM for metallurgical application, some distinction must be made between SEM and TEM techniques for fracture analysis.

A particular advantage of the SEM is that metallic fracture specimens may be examined directly, eliminating the need for preparation of replicas. Secondly, the inherent wide range of magnification is particularly useful in fracture analysis. On the other hand, replica TEM techniques provide for significantly higher resolution. Thus the two electron fractographic techniques are complementary, with the SEM providing for rapid examinations in the low to intermediate magnification range (10X - 5000X) and replica TEM providing for high resolution and clarity of detail.

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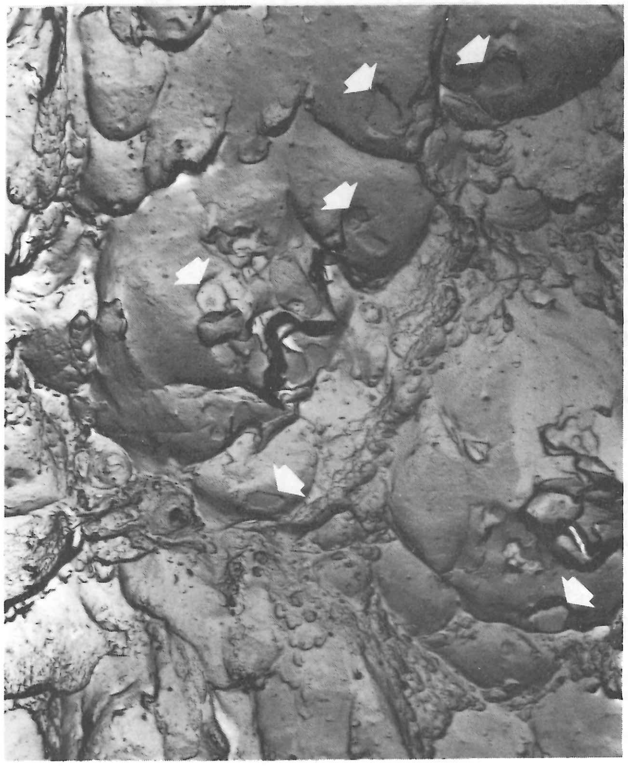


Figure 1. Fractograph from notched-tensile specimen of 2017 aluminum alloy aged 10 hrs at 450°F. Arrows indicate void initiation sites. 2000X

Figure 2. Large uniform dimples in fracture surface of a 6061 aluminum alloy notched-tensile specimen. 2000X

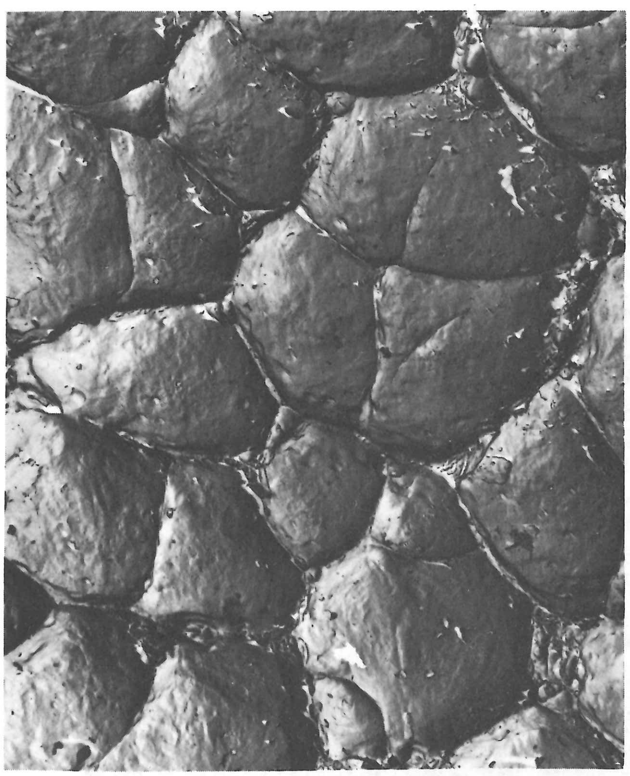


Figure 3. Transgranular portion of fracture surface of overaged Al-4.2% Cu notched-tensile specimen. 2000X

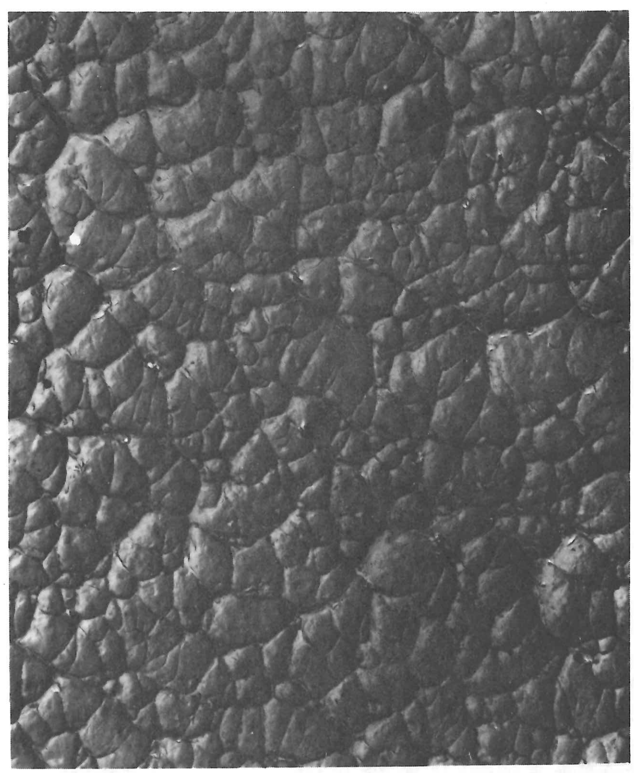
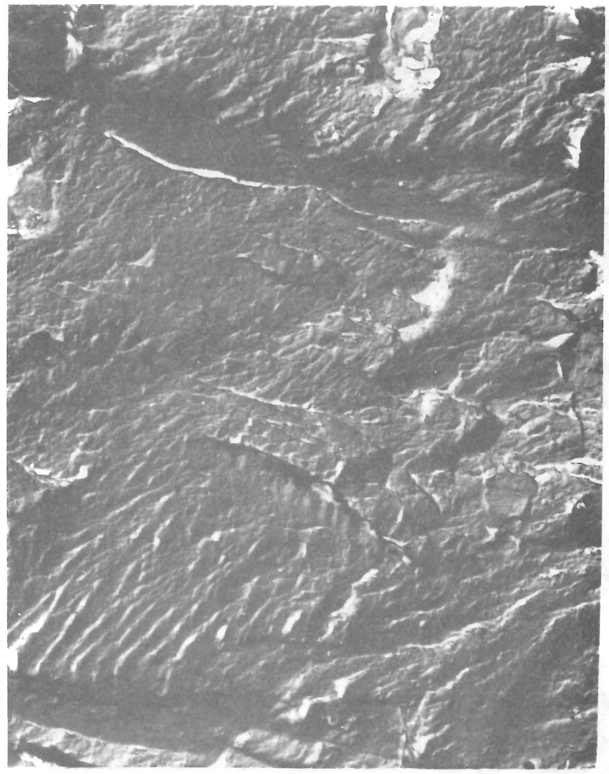


Figure 4. Small uniform dimples on portion of an intergranular facet. Same specimen as in Figure 3. 2000X

3000X



2000X

Figure 5. Examples of "step-type" topography of service-induced cracking in forged aluminum compressor discs.

(a) da/dN = 3.4μ-in./cycle

(b) da/dN = 1.2μ-in./cycle

Figure 6. Fractographs from selected locations in fracture surface of laboratory fatigue test specimens. 3000X

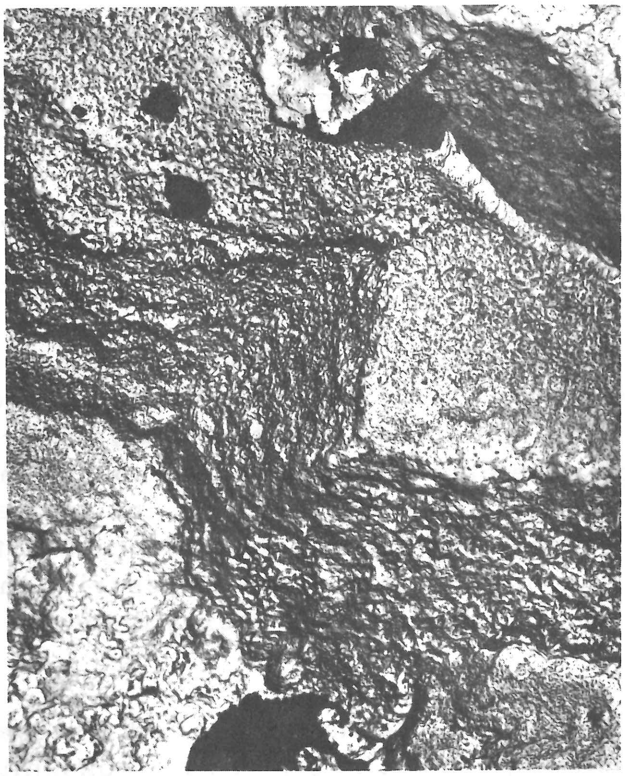


Figure 7. Fractograph from fracture initiation zone of A-437 pressure vessel closure stud. 2000X

(a) Normal material. Mixed dimples and cleavage facets. 2000X

(b) Abnormal material. Predominance of intergranular fracture. 2000X

Figure 8. Fractographs from Charpy impact specimens of A-437 stud material broken at 70°F.

THE SEM + X-RAY SPECTROMETER COMBINATION

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The purpose of this article is to illustrate the use of the X-ray spectrometer as an accessory to the scanning electron microscope, and it is principally intended for those unfamiliar with this analysis technique. The X-rays generated by impinging the electron beam on the specimen have two characteristics: a unique wavelength and a unique energy for each element; thus, spectrometers are of two types, designed to determine one of these unique X-ray characteristics. The terms in common use to describe the two types of spectrometers are wavelength dispersive and energy dispersive (sometimes called non-dispersive).

Each type of system has its advantages and disadvantages. Wavelength dispersive spectrometers (WDS) are usually time consuming to use, but may be used to do rather accurate quantitative work, and may be used on all elements from Boron (At. No. 5) up. Energy dispersive spectrometers (EDS) may generally be used quite rapidly, are generally less quantitative, and cannot be used for the lighter elements (B, C, O_2, N_2, F) which are often of great interest. The EDS X-ray detector, additionally, requires liquid nitrogen cooling at all times, which may, or may not, be convenient. (The detector is a lithium doped silicon diode.) Besides rapidity of use, the EDS has a distinct advantage for use with the scanning electron microscope, in that it may be used at low magnifications (< 200 X) whereas the WDS usually must be used at magnifications of greater than 200 to 400 X. This last limitation comes about because the specimen in a WDS must be on a circle with the analyzing crystal and the detector (the Rowlands circle) for the spectrometer to be "fully focusing." Semi-focusing WDS's do not have this limitation, but are less sensitive than fully-focusing designs.

Two geometries for fully focusing WDS are possible with the scanning electron microscope. In one design the Rowlands Circle is vertical, and the specimen is held perpendicular to the electron beam, the z-axis position usually being determined by an auxiliary optical microscope. This is the traditional microprobe geometry, and has the advantage of allowing several spectrometers to be used simultaneously. The other approach is to leave the specimen at an angle to the beam (usually 45°), the normal position for scanning electron microscopy, and to lay the Rowlands Circle down to accommodate this geometry. The latter approach allows fewer spectrometers to be simultaneously used, but does allow normal scanning work to proceed.

The following illustrations were made with a system of the latter design discussed (WDS, non-vertical geometry), and were chosen to illustrate the simultaneous high resolution scanning microscopy capability of the SEM + spectrometer combination. In work from which the illustrations were chosen, there was a distinct advantage to having both a high resolution photograph of a non-homogeneous object together with an X-ray map (showing geographical distribution) of the elements composing the object.

Figure 1a shows an area of crack initiation in a basaltic rock which has been loaded in mechanical properties evaluation testing. The object of the investigation was to determine if the cracks were initiating in a particular mineral specie, and if so, what that specie was. X-ray maps of several elements unique to particular mineral species were used to differentiate the species being observed. Figures 1b and 1c show only two of the several observed, calcium and magnesium.

The weld shown in Figure 2a has three structures. At the top is the weld metal, at the bottom is the base metal on which the weld material was being laid, and in between there is the heat affected zone (HAZ). The two X-ray maps show a wide distribution of tungsten in the weld, including the HAZ, but none in the base metal. The nickel map shows that the welding process has not removed nickel from the HAZ.

In a study of the effect of inclusions on the initiation of fatigue cracks in steel, it has been necessary to characterize the inclusions as to size, shape and chemistry. Figure 3a shows an inclusion which, although predominantly calcium-aluminum oxide, is not homogeneous, containing also iron and magnesium. Note that the inclusion is poorly bonded to the matrix steel, and that it has not deformed as the steel was rolled into the bar from which this specimen was made (rolling direction from right to left in the photograph).

NOTE: All illustrations taken from project work done at SwRI's Scanning Electron Microscope Facility, which is equipped with an ETEC SEM and wavelength dispersive spectrometer.

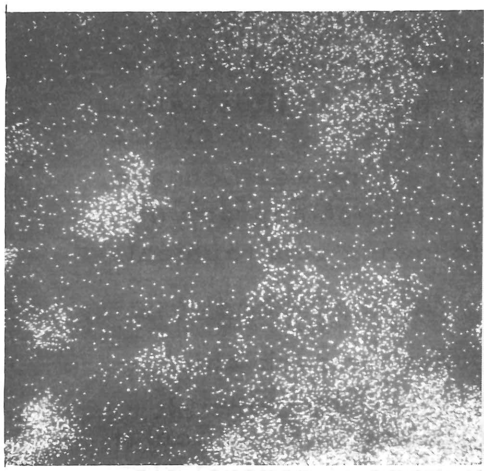


Figure 1b. Calcium distribution (pyroxene).

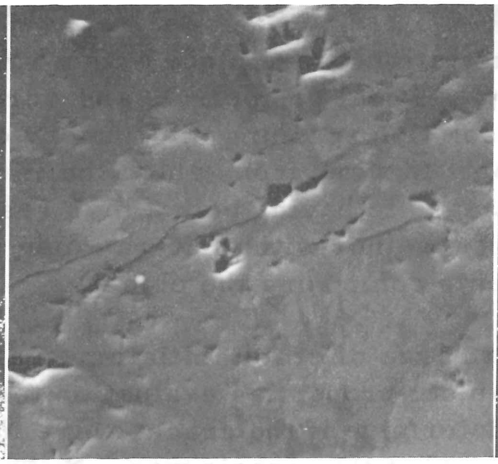


Figure 1a. Dresser Basalt (600 X); light areas are pyroxene, dark areas feldspar. Crack initiated near small white dot on left center of photograph.

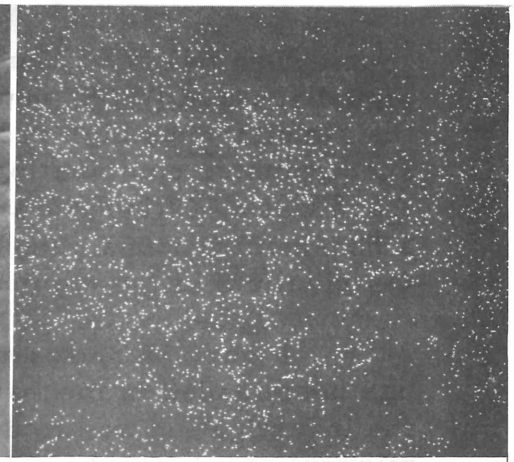


Figure 1c. Sodium distribution (feldspar).

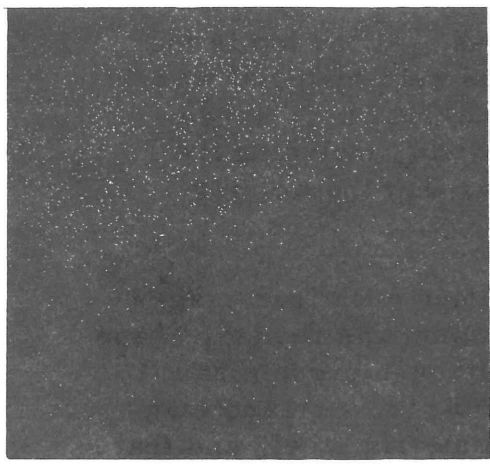


Figure 2b. Tungsten distribution.

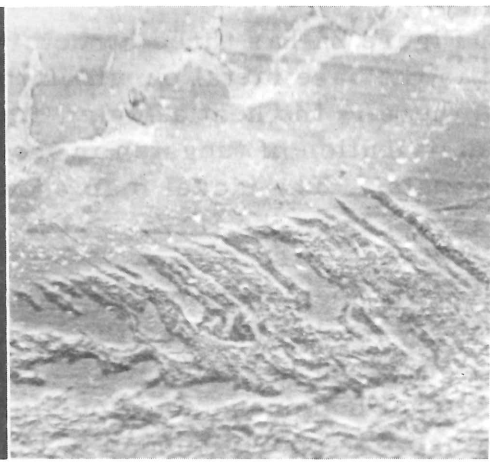


Figure 2a. Hard-facing weld (800 X) containing tungsten at top, with base metal at bottom separated by heat-affected zone.

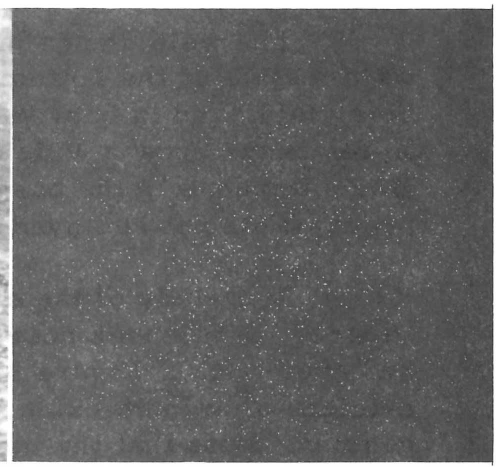


Figure 2c. Nickel distribution.

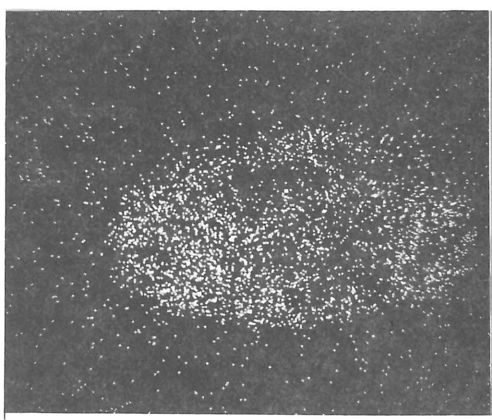


Figure 3b. Calcium distribution.

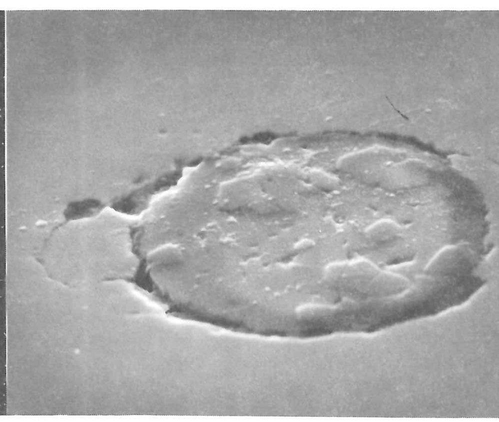


Figure 3a. Inclusion in 4340 steel (2016 X).

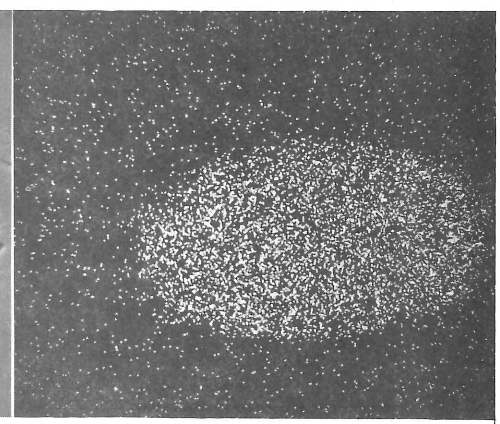


Figure 3c. Aluminum distribution.

1. Ochromonas danica, a chrysomonad alga. Nuclear pores are clustered on the surface of the nucleus (n) juxtaposed to the dictyosome (d). A characteristic continuity of the outer membrane of the nuclear envelope with the membrane enveloping the chloroplast, called the chloroplast endoplasmic reticulum (cer), can be seen. ch, chloroplast. X 13,800.

2. Microcystis aeruginosa, a toxic blue-green alga, which is engulfed and digested by the chrysomonad, Ochromonas danica. In this cross-fracture of the cell, gas vacuoles (v), photosynthetic lamellae (pl) and a crystalloid (c) can be resolved. X 20,000.

3. Ochromonas danica, a chrysomonad alga, demonstrating continuity of the outer nuclear membrane and the membrane enveloping the chloroplast (cer). Also note the concentration of nuclear pores on the surface of the nucleus (n) adjacent to the dictyosome. X 10,800.

4. A surface fracture of proliferating Golgi cisternae in the chrysomonad alga, Ochromonas danica. X 23,000.

5. Surface fracture of the wall of a Penicillium conidium revealing the arrangement of 'rodlet fascicles'. The latter are considered to be chitinous components of the wall. X 31,900.

6. Cross fracture of a conidium of the human pathogenic imperfect fungus, Geotrichum candidum. n, nucleus; l, lipid; w, wall. X 13,200.

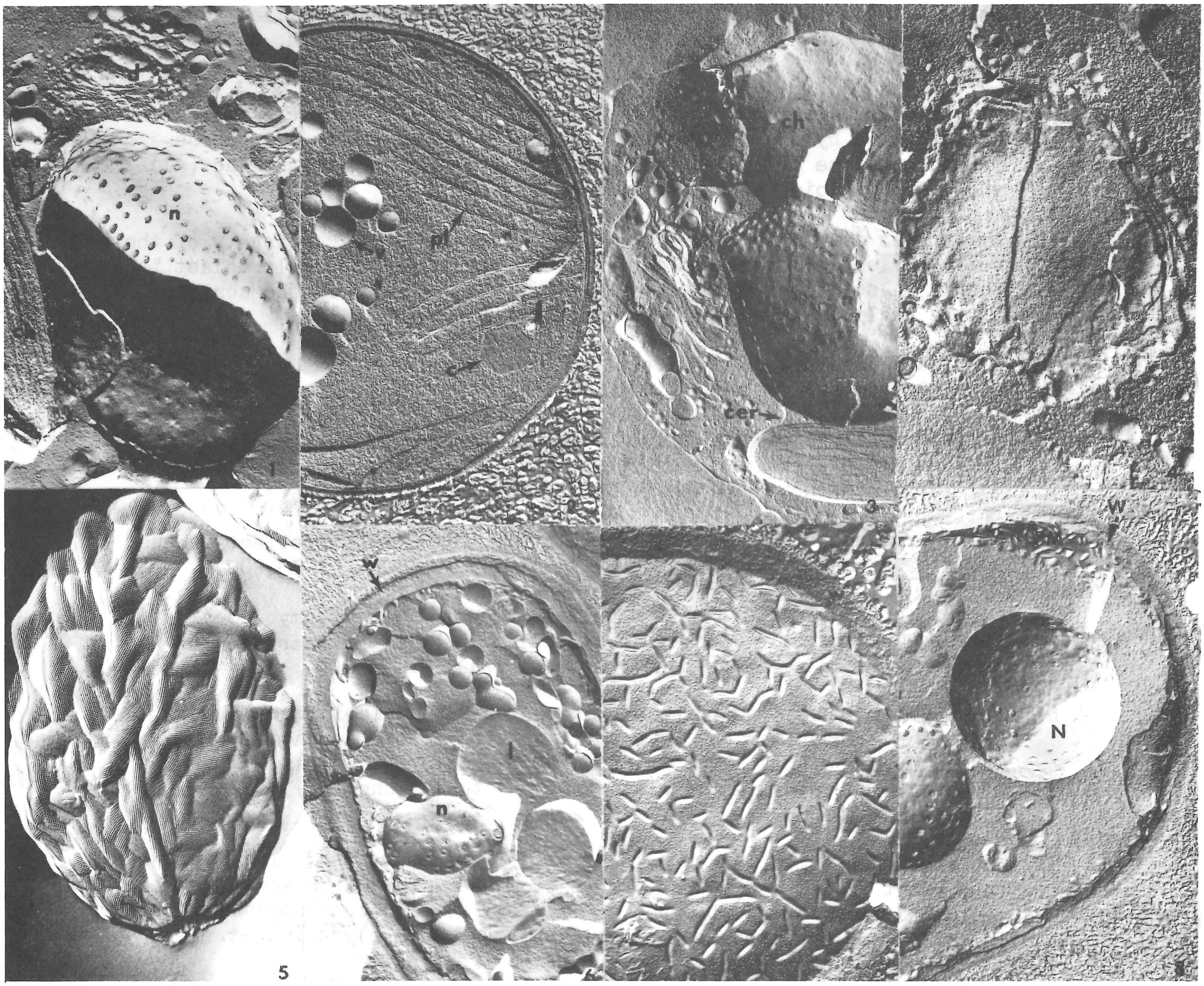
7. Convex surface fracture of the cell membrane of the ascomycetous fungus, Ceratocystis radicicola, revealing a high concentration of tubular, plasmalemma invaginations. w, wall. X 26,000.

8. Cross fracture of a conidium of Ceratocystis radicicola revealing plasmalemma invaginations on a small portion of the surface fractured plasma membrane (pm). The function of these invaginations is under investigation using the complementary fracture technique. n, nucleus; w, wall. X 14,400.

This work was performed with a Balzers BA 360M freeze-etch device which was bought with a grant from the Research Corporation (BH 752) and University of Texas Biomedical Sciences Support Grant in July, 1972. The Ochromonas and Microcystis cells were prefixed in glutaraldehyde and then glycerinated. All other material was only glycerinated prior to freezing.

Garry T. Cole

University of Texas at Austin



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AREA NEWS

College Station

TEXAS A & M UNIVERSITY:

Recent Publications:

Mayer, R. T. and E. L. Thurston 1973. An improved method for standardization of microspectrofluorometers stain tech. (In press).

Thurston, E. L. 1973. Morphology, fine structure, and ontogeny of the stinging emergence of Urtica dioica. Am. J. Bot. (In Press).

Vinson, S. B. and J. R. Scott 1973. Parasitoid egg shell changes in a suitable and unsuitable host. J. Ultrastructure Res. (In press).

El Paso

THE UNIVERSITY OF TEXAS AT EL PASO:

New Equipment:

Zeiss EM-10 Transmission Electron Microscope.

Recent Publications:

Ellzey, Joanne Tontz 1974. Ultrastructural observations of meiosis within antheridia of Achlya ambisexualis. Mycologia, 66: (In press).

____________________ and Christina D. Chavez 1974. Detection of isocitrate lyase in Achlya flagellata. J. Iowa Academy of Science. (In press).

Houston

BAYLOR COLLEGE OF MEDICINE:

New Equipment:

Philips 201 Electron Microscope

New Members of TSEM:

David Murphy

Seminar Given:

Presentation at Freiburg, Germany, to the International Study Group for Cardiac Metabolism on cardiac hypertrophy, September 26, 1973. Presentation at Amer. Soc. Cell Biol., November 17, 1973--Margaret A. Goldstein.

Recent Publications:

Schwartz, A., L. A. Sordahl, M. L. Entman, J. C. Allen, Y. Reddy, M. A. Goldstein, R. M. Luchi, and L. E. Wyborny. 1973. Abnormal biochemistry in myocardial failure. Am. J. Cardiol. Symposium, D. T. Mason and R. Zellis, Eds., Am. J. Cardiol. 32: 407-422.

Schwartz, A., R. M. Lewis, J.C. Allen, M. L. Entman, E. P. Bornet, J. L. McCans, J. M. Wood, Y. S. Reddy, L. E. Wyborny, N. Y. Giri, and M. A. Goldstein. 1973. Biochemistry and morphology of experimental occlusive-and anoxic-induced myocardial ischemia. Am. J. Cardiol., (In press).

Goldstein, M. A. 1973 Nuclear pores in ventricular muscle cells from adult hypertrophied hearts. J. Mol. Cell. Cardiol., (In press).

Goldstein, M. A., L. A. Sordahl and A. Schwartz. 1973. Ultrastructural analysis of left ventricular hypertrophy in rabbits. J. Mol. Cell Cardiol., (In press).

Goldstein, M. A., W. C. Claycomb, and A. Schwartz. 1973. DNA synthesis and mitosis in well-differentiated mammalian cardiocytes. Science, (In press).

M. D. ANDERSON HOSPITAL:

Recent Publications:

Dmochowski, L. 1973. The viral factor in the genesis of breast cancer: Present evidence. Triangle 12(2):37-47.

Miller, M. F., P. T. Allen, and L. Dmochowski. 1973. Quantative studies on Oncornaviruses. J. of General Virology. 21:57-68.

Hiraki, S., R. W. Van Pelt, and L. Dmochowski. Preliminary electron microscope study on viruslike particles in a spontaneous mammary tumor of Collared lemming. Cancer Research. (In press).

Hoshino, M. and L. Dmochowski. Electron microscope study of antigens in cells of mouse mammary tumor cell lines by peroxidase-labeled antibodies in sera of mammary tumor-bearing mice and of patients with breast cancer. Cancer Research. (In press).

TEXAS CHILDRENS HOSPITAL:

Seminar Given:

Don B. Singer, M.D., "Lysosome Storage Diseases."

Recent Publications:

Singer, Don B. 1973. Fatal x-linked reticuloendothelial syndrome. J. Pediatrics. 83:549.

THE UNIVERSITY OF TEXAS MEDICAL SCHOOL AT HOUSTON:

New Members of TSEM:

Mrs. Jane Crick

Recent Publications:

Davis, L. L., J. G. Wood, and R. A. Turner. 1973 Histochemistry and cytochemistry of the developing rat adrenal medulla. Texas Reports on Biology and Medicine. (In press).

Dodson, R. F. and J. G. Wood. 1973. Concentric membranous bodies in central nervous tissue. Cytobios. 7:61-69.

Szamier, R. B. and M. V. L. Bennett. 1973. Rapid degeneration of ampullary electro-receptor organs after denervation. J. Cell Biol. 56:466-477.

Wood, J. G. and R. E. Buckley. 1973. Dopamine and adenosinetriphosphatase changes in the corpus striatum of the rat. Experientia 29: 834-837.

Wood, J. G. The effects of niamid and reserpine on the nerve endings of the pineal gland. Z. Zell. Forsch. (In press).

Wood, J. G. and H. Randall Matthews. 1973. Selective metal reactions for biogenic amines. Amer. Soc. Cell. Biol. (In press).

Lubbock

TEXAS TECH UNIVERSITY:

New Members to TSEM:

Steve Raiquel who trained in Dr. Berlin's lab was hired as an E. M. technician, and Marsha Rossi was hired as an E. M. technician.

New equipment:

ISI Mini SEM, LKB-Huxley Ultramicrotome, Denton Vacuum Evaporator, Zeiss Universal Microscope.

New Orleans

TULANE MEDICAL SCHOOL:

Mr. Joe Mascorro, formerly from UTMB in Galveston, was recently elected Secretary of LSEM and will also serve on the Executive Committee of LSEM for 1974. Joe had been serving as Acting Secretary of LSEM during 1973.

Recent Visitors:

Dr. Keith O'Steen, Department of Anatomy, Emory Medical Center, Atlanta, Ga. (and formerly from UTMB in Galveston) presented a Distinguished Scientist Lecture on "Structure and Function of Eyes Without Photoreceptors."

Dr. F. J. Unterharnscheidt, Naval Aerospace Medical Research Laboratory, New Orleans, La. (and formerly from UTMB in Galveston) also presented a Distinguished Scientist Lecture on "Boxing: Historical and Medical Aspects."

Recent Publications:

Mascorro, Joe A. and Robert D. Yates. 1973. Catecholamine storage and release in the abdominal paraganglia: Ultrastructural observations. Louisiana Society for Electron Microscopy, Fall Proceedings.

San Antonio

THE UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER:

Recent Publications:

Dung, H. C. 1973. Electron microscopic study of involuting thymus of "lethargic" mutant mice. Anat. Rec. (In press).

Shiino, M. and E. G. Rennels. Paracrystalline aggregates of microtubules of anterior pituitary cells in the chinchilla (Chinchilla laniger). Am. J. Anat. (In press).

Shiino, M., A. Arimura, and E. G. Rennels. The effects of blinding, olfactory bulbectomy, and pinealectomy on the anterior pituitary cells of the rat. Am. J. Anat. (In press).

Cameron, I. L., W. A. Pavlat and E. Urban. Adaptive responses to total intravenous feeding. J. of Surg. Res. (In press).

Winborn, W. B., L. L. Seelig, Jr., and E. Weser. 1973. Differentiation of parietal cells in the stomach of the rat. Anat. Rec. 175: 471.

Winborn, W. B., L. L. Seeling, Jr., H. Nakayama, and E. Weser. 1973. Hyperplasia of the gastric glands after small bowel resection in the rat. Gastroenterology. (In press).

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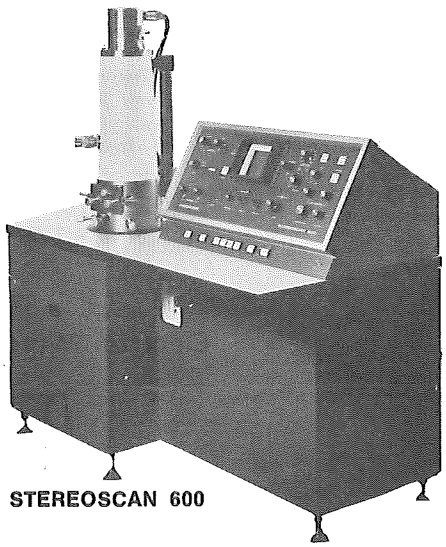

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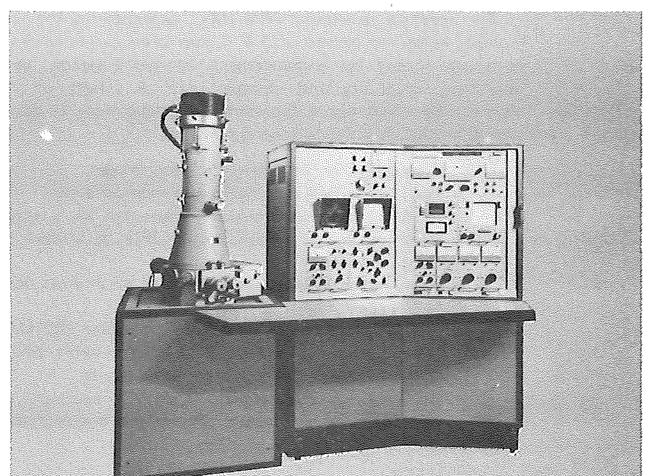

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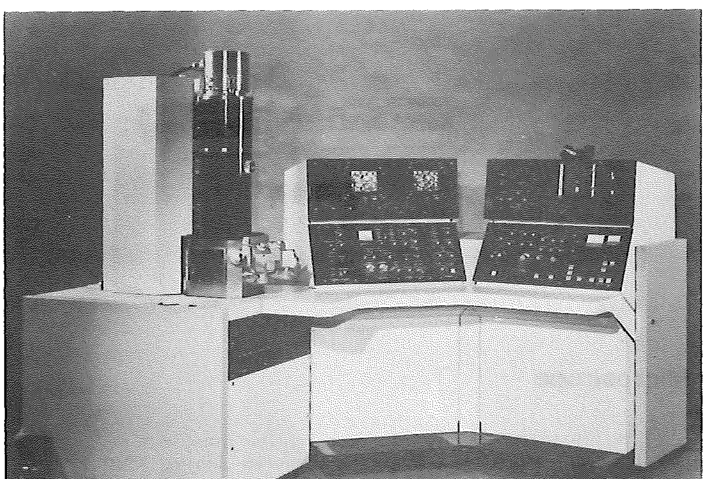

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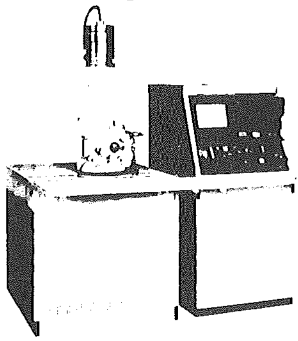

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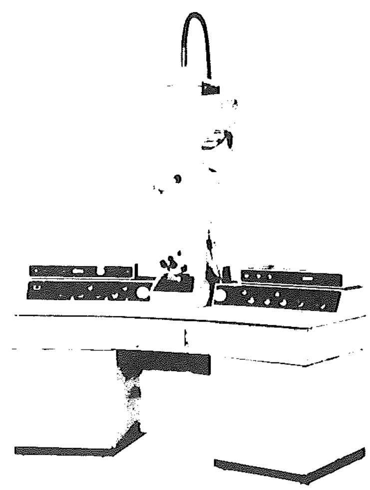

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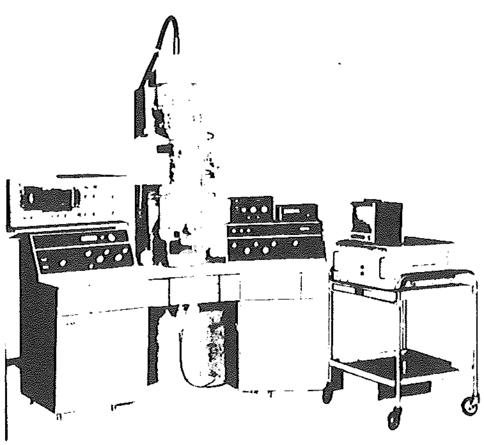

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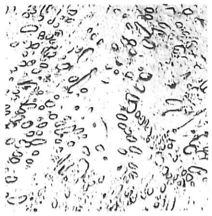

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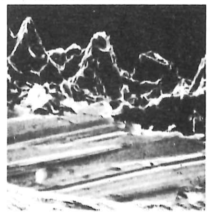

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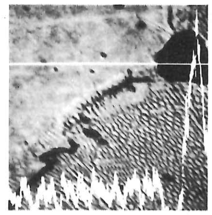

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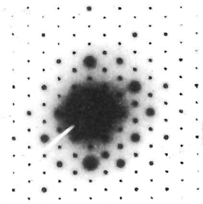

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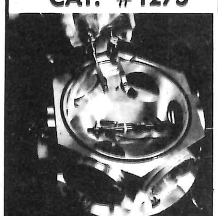
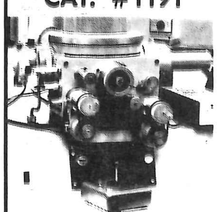


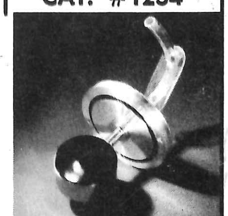
SEM JOYSTICK STAGE CONTROL
CAT. #1191



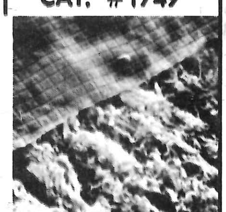
MATERIALS
FOR
EVAPORATION REPLICATION
SPECIMEN PREPARATION
PARTICLE DISPERSIONS
CALIBRATION AND RESOLUTION STANDARDS
CHEMICAL REAGENTS AND SOLVENTS
EVAPORATORS AND EVAPORATION ACCESSORIES
SPECIMEN GRIDS AND SCREENING
SUBTRATES APERTURES
SCISSORS TWEEZERS DUSTERS TOOLS
CONTAINERS — PLASTIC AND GLASS

WRITE FOR CATALOG

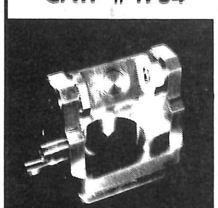
FREEZE DRYING STAGE
CAT. #1254



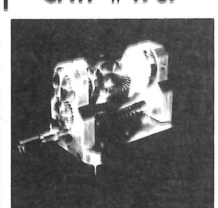
RESOLUTION AND CALIBRATION STANDARD
CAT. #1749



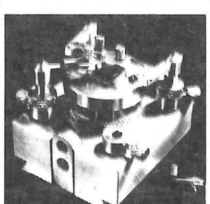
TILTING HOLDER
CAT. #1754



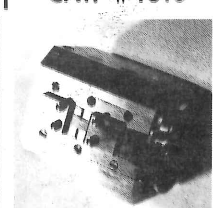
ROTARY TILTING SUBSTAGE
CAT. #1737



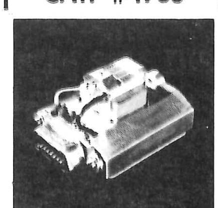
SEMI CONDUCTOR SUBSTAGE
CAT. #1810



TENSILE SUBSTAGE
CAT. #1813



HOT-COLD STAGE
CAT. #1756



CHUCK-JAW HOLDER
CAT. #1811