

SCIENCE EDUCATION

Physics Doctorates

A study of doctorate production in the United States since 1920 has been made by Lindsey R. Harmon and Herbert Soldz (available as Publication #1142, National Academy of Sciences-National Research Council).^{*} It is based on the records maintained by the Academy's Office of Scientific Personnel, with support from the US Office of Education and the National Science Foundation.

The number of doctorates awarded in physics has shown a fairly steady annual increase, with the major exception of 1944-47 when the effects of wartime interruption of education

remained steady at eighteen to nineteen percent.

The fields of doctorate specialization have been tabulated since 1957, and are detailed in Table 2. The authors were able to include 1962 data shortly before press time. Nuclear and particle physics accounted for almost one-third of the theses.

The University of California at Berkeley is by far the largest producer of physics PhD's not only over the past decade, but over the past forty years as well. Geographically, Cambridge is the top source, thanks to the activity at MIT and Harvard. The top ten sources since 1920 appear in Table 3 which shows their over-all production, and their output in the period 1950-61.

The mean lead time from bachelor's degrees to PhD degrees in physics was 7.4 years over the entire period studied.

Mathematicians took 8.2 years and chemists only 6.5 years. Education degrees took the longest—14.9 years.

Summer Programs

The Commission on College Physics has announced the following conferences for college physics teachers to be held during the summer of 1964:

Florida State University, June 16-July 10: electricity, magnetism, and classical electromagnetics with its implications for atomic structure. Professor R. A. Kromhout, Florida State University, Tallahassee, Fla.

Montana State College, August 3-28: particular topics in electricity and magnetism. Professor K. E. Davis, Reed College, Portland, Ore.

Wesleyan University, August 9-28: selected topics in electromagnetic theory. Dr. W. L. Parker, Reed College, Portland, Ore.

University of Colorado, August 3-28: kinematics and dynamics of a particle, rotational dynamics, and special relativity. Professor Malcolm Correll, Hellems 16E, University of Colorado, Boulder, Colo.

Southern Methodist University, August 17-September 5: kinematics and dynamics of a particle, rotational mechanics, and special relativity. Dr. C. B. Clark, Southern Methodist University, Dallas, Tex.

The conferences are supported by the National Science Foundation, and per-diem (\$15 maximum) and travel allowances are available. Requests for application blanks, which must be returned by March 31, and inquiries should be addressed to the individual conference directors listed above.

A summer research-participation program for faculty members of small colleges is being offered by the Department of Physics and Astronomy at the University of Maryland. A total of ten college teachers will be selected, and each will be assigned to one of the University's research

Table 1. Doctorates

Years	Physics Degrees	Physical Science Degrees
1920-29	651	3485
1930-39	1336	7514
1940-49	1483	9622
1950-59	4972	25177
1960-61	1176	6411

were felt. The largest number of physical science degrees was in chemistry, for each of the decades studied. The proportion of degrees in physics has

^{*} Some of this material also appeared in "Physics PhD's . . . whence . . . whither . . . when?" by L. R. Harmon, *Physics Today*, Oct. 1962, p. 21.

Table 3. Top Ten Producers of Physics PhD's

University	1920-61	1950-61
U. Cal. Berkeley	717	458
MIT	563	356
Harvard	506	330
U. Chicago	458	184
Cal. Tech	368	172
U. Michigan	367	161
Cornell	363	188
Columbia	335	214
U. Illinois	313	203
U. Wisconsin	284	152

Table 2. Fields of Specialization for PhD's in Physics

Specialty	1957	1958	1959	1960	1961	1962	1957-1962
Astronomy	9	20	22	10	19	30	110
Atomic & Molec. Phys.	58	61	59	56	65	84	383
Elec. & Magnetism	13	7	7	10	19	26	82
Mechanics	6	1	4	1	4	6	22
Acoustics	6	16	10	8	9	9	58
Fluids	—	—	1	7	25	26	59
Optics	2	3	9	6	7	7	34
Thermal Phenomena	—	—	—	3	2	5	10 ¹
Elementary Particles	45	47	49	50	73	132	396
Nuclear Physics	4	10	—	2	2	—	18 ²
Nuclear Structure	101	101	111	125	117	159	714
Solid State	91	106	121	142	123	184	767
Theoretical Physics	64	79	90	107	109	30	479
Other Physics Fields	37	31	30	39	21	35	193
Physics, General	26	22	10	8	7	32	105
Total	462	504	523	574	602	765	3430

¹ This field added in Feb. '60, so probably understated because earlier forms were still used after that.

² Recoded as Elementary Particles or Nuclear Structure, except for 18 which could not be recoded.



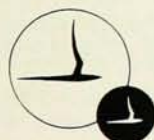
THIS is a RESEARCH TOOL?

It is not as sophisticated as our electron microscope or our hypersonic shock tunnels, perhaps, but it is of use to a Cornell Aeronautical Laboratory physicist as he pursues a research program of his own choosing. In this program Laboratory funds are being used to study water surface behavior under controlled conditions. With a modified Doppler radar we are trying to identify primary back-scattering elements in the wave surface and determine their behavior as the scale of wave motion is changed. Waves generated at one end of a long tank spend themselves on a "beach" at the other end. The rake is used to shape the beach.

Unlike this project, most of our 250-or-so projects have sponsors. But the fact that we are willing and able to support many of the research ideas of our technical staff with our own funds is one of our hidden strengths. It is one reason some of the best men in your field stay with us, and it has repeatedly paved the way to seven-league strides in science.

Some of the fields in which we are making strides today are computer sciences, applied physics, electronics, operations research, aerodynamic and applied hypersonic research, flight research, applied mechanics, vehicle dynamics and systems research. The coupon below will bring you an interesting briefing on this community of science.

Some positions are available at our Washington Projects Department as well as in Buffalo.



**CORNELL AERONAUTICAL
LABORATORY, INC.**
of CORNELL UNIVERSITY

J. T. Rentschler

MW

CORNELL AERONAUTICAL LABORATORY, INC.
Buffalo, New York 14221

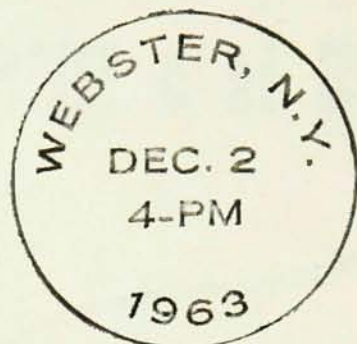
- ☐ Please send me a copy of your factual, illustrated prospectus, "A Community of Science," and an application blank.
- ☐ I'm not interested in investigating job opportunities now, but I would like to see your latest "Report on Research at CAL."

Name.....

Street.....

City..... Zone..... State.....

An Equal Opportunity Employer



"What on earth would I be doing in Webster, N.Y.?"

That would depend on the day of the week. And on your interests and capability. And what you like to do for recreation.

On a business day, in all probability you would be at work on one of Xerox Corporation's advanced projects in data storage, transmission, retrieval and display systems; or print-out from analog and digital inputs; or a method of forming micro-miniature electronic circuits which incorporate given capacities and resistances . . . or contributing to the development of high-speed imaging systems which can transmit and record information more than 20 times as fast as conventional facsimile systems.

There is literally no *end* to graphic communications, and the opportunities that exist for skillful, resourceful, imaginative scientists at our modern research and engineering facilities in Webster, a suburb of Rochester.

You would be working alongside talented and capable colleagues, sharing an opportunity for the highest order of professional fulfillment, in an atmosphere of mutual respect and recognition.

You would be part of a company which is a leader throughout the world in the rapidly evolving, dynamic field

of graphic communications . . . Xerox already has specific plans for new products and services to be introduced within the next five years . . . and is now researching projects for introduction within ten years.

This is the "workaday world" of the Xerox scientist and engineer—an exciting, challenging world of opportunity.

But say it's a weekend or evening. In all probability you would be taking advantage of the many cultural and recreational facilities this area offers.

From the shores of Lake Ontario on the north to the scenic beauty of the vineyard-studded Finger Lakes to the south, opportunities for skiing, skating, swimming, boating, golf, summer cottage living, and weekend outings are unmatched.

There are 42 golf courses in the Rochester area. Western New York has 7 ski centers. Rochester supports two orchestras: the Philharmonic and the Rochester Civic Orchestra, and the famed Eastman Theater plays host to distinguished visiting artists throughout the season. There are fine museums, including the George Eastman House of Photography, the Museum of Arts and Sciences, and the Memorial Art Gallery.

Opportunity knocks twice when you

join the Xerox organization, offering new opportunities for your talents . . . opportunity, too, for enjoyable personal living. *What on earth would you be doing in Webster, N. Y.?* You'd be doing fine!

You are invited to inquire about major assignments at Xerox in the following specific areas:

Research Department Manager—Ph.D. to manage creative, imaginative group engaged in exploring new imaging technologies.

Physicists and Physical Chemists—for fundamental studies in materials science, gaseous electronics, electrostatics, and solid state research.

Organic Chemists—for development of novel photoconductive materials and devices.

Paper Chemists—Ph.D., to do exploratory studies in paper technology.

Engineers—B.S. or M.S. in chemical or electrical engineering to work on data storage, transmission, display and retrieval systems.

Also, B.S. in mechanical or electrical engineering for manufacturing divisions.

For immediate attention, send your resume today to Mr. Lee B. Sundsted, Xerox Corporation, Dept. PT-3, P.O. Box 1540, Rochester 3, New York. An equal opportunity employer.

groups. Stipends and travel expenses will be provided by the National Science Foundation.

Applications should be directed to the Department of Physics and Astronomy, University of Maryland, College Park, Md.

This year's Brandeis Summer Institute on Theoretical Physics, to be held June 22 through July 31 on the Brandeis campus, will consist of lectures on high-energy physics and general relativity. The lectures will be at the intermediate to advanced graduate level, and the speakers will be K. Johnson (MIT), J. Schwinger (Harvard), and S. Weinberg (Berkeley), on high-energy physics; and H. Bondi (London), F. Pirani (London), and A. Trautman (Warsaw), on general relativity.

No tuition will be charged. Support for the institute is provided by the National Science Foundation and the North Atlantic Treaty Organization, and pre- and postdoctoral fellowships are available to participants from both the United States and Europe. Application forms and further information can be obtained from Mrs. Nita Goldstein, Summer Institute Secretary, Physics Department, Brandeis University, Waltham, Mass. 02154.

The Massachusetts Institute of Technology is offering a special 1964 summer program on noise and vibration reduction to be held August 17 to 28 under the direction of Leo L. Beranek. For further information, write to the Director of the Summer Session, Massachusetts Institute of Technology, Cambridge, Mass. 02139.

Nuclear structure and electromagnetic interactions will be the topic of the 1964 Scottish Universities' Summer School, which will meet from July 26 to August 15 at Newbattle Abbey near Edinburgh. The course, which is part of the NATO program of advanced study institutes, will consist of about three lectures a day, plus occasional seminars. The provisional panel of lecturers includes: B. F. Bayman (Princeton), G. Bishop (Orsay), A. de Shalit (Rehovoth), A. Ferguson (Harwell), E. Hayward (NBS, Washington), J. R. Huizenga (Argonne),

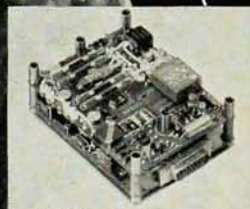
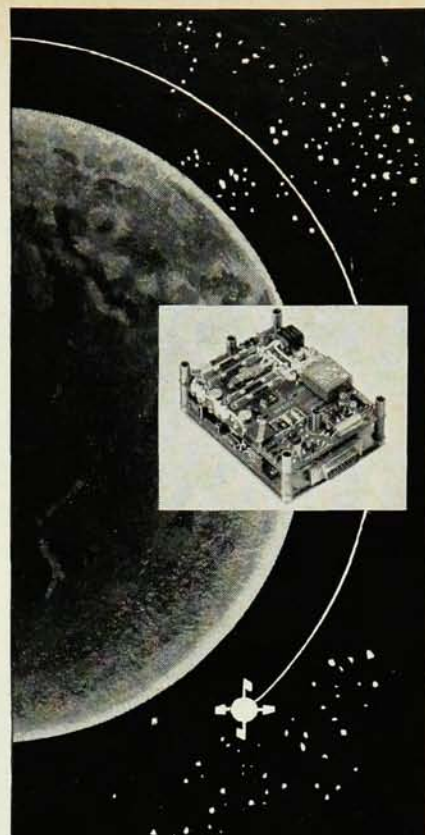
J. V. Kane (Bell Labs), A. E. Litherland (Chalk River), and J. O. Newton (Manchester).

Further information and application forms (due by April 8) can be obtained from Dr. J. G. Rutherglen, Department of Natural Philosophy, University of Glasgow, Glasgow W.2, Scotland.

The Latin American School of Physics for 1964 will deal with various aspects of space physics and will take place from July 6 to 31 at the University of Tucumán in Argentina. The names of four of the five lecturers have been announced. C. Varsavsky of the University of Buenos Aires will offer a theoretical course in Spanish on magnetohydrodynamics; E. Schatzman of the Institut d'Astrophysique in Paris will lecture in English on solar physics, including the quiet sun, solar activity, solar flares and radio bursts, and acceleration of particles; and W. Webber of the University of Minnesota will give a course on the physics of interplanetary space, including the outer corona, the solar wind, plasma and fields, and modulation and propagation of cosmic rays and solar energetic particles. The fourth course, physics of the magnetosphere, will be divided into two parts: the first, dealing with the geomagnetic boundary, perturbations and hydromagnetic waves, and trapped radiation, will be given (in English) by W. Hess of the National Aeronautics and Space Administration; the second part, covering ionization processes in the upper atmosphere and the quiet and disturbed ionosphere, will be offered by a lecturer not yet chosen.

For further information, write to Prof. Juan G. Roederer, Facultad de Ciencias Exactas y Naturales, Perú 272, Buenos Aires, Argentina.

A course in electronics for scientists will be offered during July 6 through 24 at Princeton University to college teachers in the physical and other sciences. Essentially a laboratory course, it will stress a working understanding of electrical measurement and electronic circuitry as well as a practical knowledge of the operation and application of servo systems, operational amplifiers, and digital timing



FLIGHT INSTRUMENTS for Space Science Research

are described in new Keithley Space Science Catalog. It contains full specifications and prices for all standard electrometer amplifiers and dc to dc converters. Our capabilities for designing custom amplifiers, associated circuitry and complete systems are fully described.

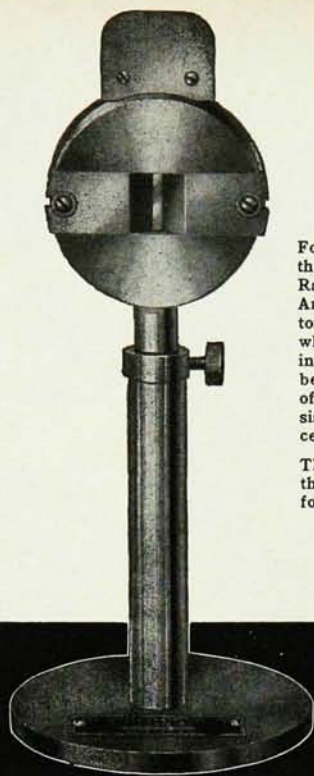
Keithley electrometer amplifiers include linear, logarithmic and automatic ranging units capable of measuring to 5×10^{-13} ampere full scale. These instruments have helped scientists in rocket and satellite probes since the first Vanguard series. Applications include measurement of ultraviolet light, ion densities, gamma rays and x-ray radiation from solar flares.

SEND FOR NEW CATALOG
ON SPACE SCIENCE
FLIGHT INSTRUMENTS



**KEITHLEY
INSTRUMENTS**

12415 Euclid Avenue • Cleveland 6, Ohio



EPLAB

Thermopiles

For many years the thermopile has been the accepted instrument for measuring Radiant Heat from Radiant Heaters at the American Gas Association Testing Laboratory in Cleveland, Ohio. Since 1930, when Vandaveer first described his work in this field,* an Eppley thermopile has been used for this purpose in hundreds of tests and the results have been consistent and accurate to within 1 per cent.

This is but one of the many applications in the field of radiant energy measurements for which Eppley Thermopiles are ideally

suited. They may be obtained with windows of different materials, and various types of black are available for receiver coatings.

All Eppley Thermopiles are supplied with a certificate of calibration, this calibration being made against a Standard Lamp from the National Bureau of Standards.

If you have a problem involving the measurement of radiant energy we invite you to write us, describing your problem in as much detail as possible. We will be glad to make recommendations and there will be no obligation.

**Vandaveer, Industrial & Engineering Chemistry, Vol. 22, page 596, June 1930.*

BULLETIN NO. 3 ON REQUEST

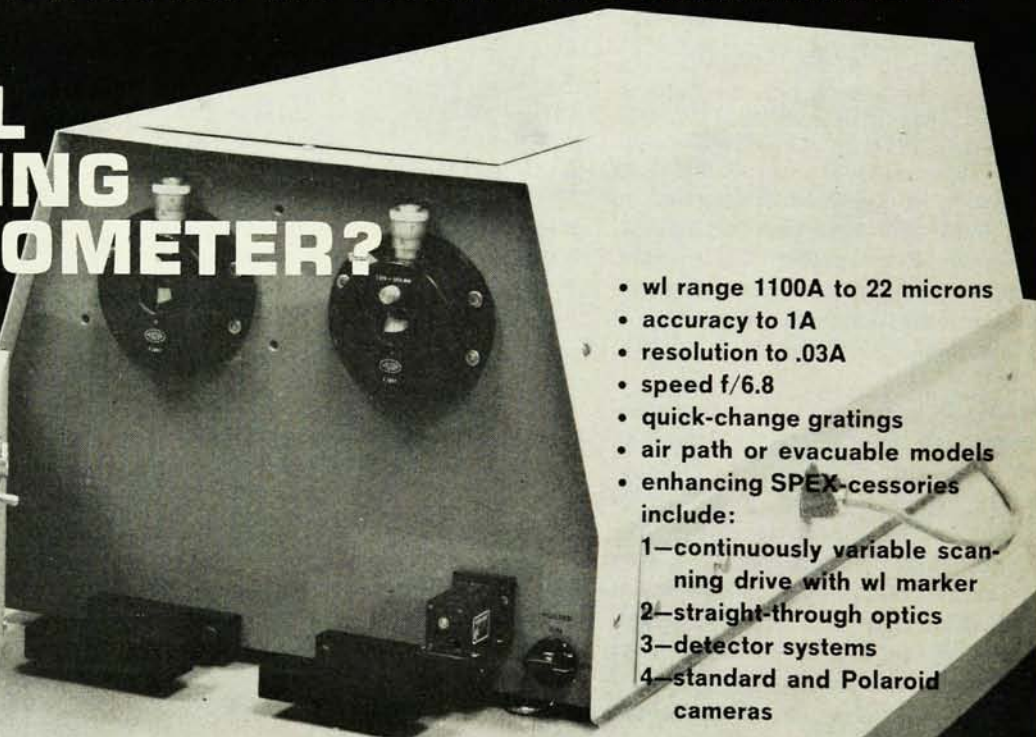
ADDRESS: 10 SHEFFIELD AVE., NEWPORT, R. I.

THE EPPLEY LABORATORY, INC.

SCIENTIFIC INSTRUMENTS

NEWPORT, RHODE ISLAND, U. S. A.

IS THERE A PROJECT IN YOUR LAB AWAITING A SPEX OPTICAL SCANNING SPECTROMETER?



- wl range 1100A to 22 microns
- accuracy to 1A
- resolution to .03A
- speed f/6.8
- quick-change gratings
- air path or evacuable models
- enhancing SPEX-cessories include:
 - 1—continuously variable scanning drive with wl marker
 - 2—straight-through optics
 - 3—detector systems
 - 4—standard and Polaroid cameras

Write, phone or visit us for full specifications and prices on these instruments as well as our Grazing Incidence Spectrometer-Monochromators.

SPEX

INDUSTRIES, INC. • 3880 PARK AVENUE • METUCHEN, N. J. 08841 • ☎ 201-549-7144

and counting circuits. Prof. Christie G. Enke of the Department of Chemistry will direct the course. More information can be obtained from Parker L. Coddington, 307 Nassau Hall, Princeton University, Princeton, N. J.

Research Participation

Washington State University, Oregon State University, and the University of Washington, through the Inter-University Committee of these three institutions, have announced two new programs of financial support for research which is related to nuclear science and engineering and is to be performed at the AEC's Hanford Laboratories, Richland, Wash.

The Richland Faculty Appointment Program provides support for faculty members during the summer, or at other times for periods up to one year, at the appointee's monthly academic salary level plus travel and relocation allowances. The Richland Graduate Fellowship Program is designed to assist graduate students of advanced standing in the performance of their thesis research. Graduate fellows receive a basic annual stipend of \$3000 plus tuition, fees, and travel and dependent allowances. Graduate fellowship appointments are renewable.

These two programs are to be administered through the Center for Graduate Study at Hanford, a joint undertaking of the three universities, located in Richland. Applicants are asked to write to the Director of the Center for Graduate Study, 1112 Lee Boulevard, Richland, Wash. 99352.

Departmental Programs

The Catholic University of America has organized a new Department of Space Science and Applied Physics offering courses leading to the master's and doctor's degrees in space science, fluid mechanics and heat transfer, aerospace engineering, and applied physics. The Department's aim is to educate the "engineer-scientist", and its program will balance instruction in science with training in the skills of experimentation and inventive technology. Research in the Department includes work on plasma behavior in geophysics and space

physics, basic problems of blood flow and non-Newtonian fluid mechanics, and radiation heat transfer. Fellowships and scholarships are available. Further information can be obtained from Dr. C. C. Chang, Department of Space Science and Applied Physics, The Catholic University of America, Washington, D.C. 20017.

The College of William and Mary, in Williamsburg, Va., has announced that graduate work in the Department of Physics will henceforth include a doctoral program.

The University of Vermont has established a PhD program in physics. Active research programs of the Department of Physics include physical acoustics, biological physics, surface physics, statistical mechanics, and quantum field theory. The doctoral program plans to emphasize preparation for academic positions. Further information is available from Prof. A. D. Crowell, Department of Physics, Williams Science Hall, University of Vermont, Burlington, Vt.

A new graduate program in applied science leading to the master's and PhD degrees has been introduced by the University of California with the establishment of a Department of Applied Science under the chairmanship of Edward Teller, associate director of the Lawrence Radiation Laboratory. Instruction will be carried out at Livermore and the University's campus at Davis, Calif. The program is designed to produce specialists capable of bridging the gap between basic and applied nuclear sciences.

The Department of Mathematical Physics of the University of Edinburgh has announced that it will institute a one-year diploma course (graduate level) in elementary-particle physics, starting in the fall of this year. The course will include lectures on quantum mechanics, special relativity, descriptive particle physics, scattering theory, quantum field theory, dispersion relations and analyticity properties, symmetries and electromagnetic and weak interactions, together with relevant mathematical topics. Lectures on numerical methods

in this neat package...



*a complete
dc laboratory*

The Keithley 610A Electrometer has 64 dc ranges... all you need to investigate in-circuit measurements with no loading, semi-conductor parameters, capacitor characteristics, photo-electric devices, piezo-electrics, properties of insulators and outputs of ion chambers. The 610A is line-operated and comes in bench or rack models. Brief specifications:

- 9 voltage ranges from 0.01 to 100 volts fs with 2% accuracy on all ranges
- input impedance selectable in decade steps from 1 ohm to 10^{14} ohms
- 28 current ranges from 3 amperes to 10^{-12} ampere fs
- 27 resistance ranges from 10 to 10^{14} ohms fs with provision for guarding
- constant current source from 1 milli-ampere to 10^{-12} ampere in decade steps
- gains to 1000 as a preamplifier, dc to 500 cps bandwidth, 10 volt and 1 milliamper outputs
- price \$565

Other ELECTROMETERS

Model 620,	31 ranges, bat.-operated,	\$280
Model 621,	37 ranges, line-operated,	\$390
Model 600A,	54 ranges, bat.-operated,	\$395
Model 603,	50 kc bandwidth amplifier,	\$750

Send for latest catalog



**KEITHLEY
INSTRUMENTS**

12415 Euclid Avenue • Cleveland 6, Ohio