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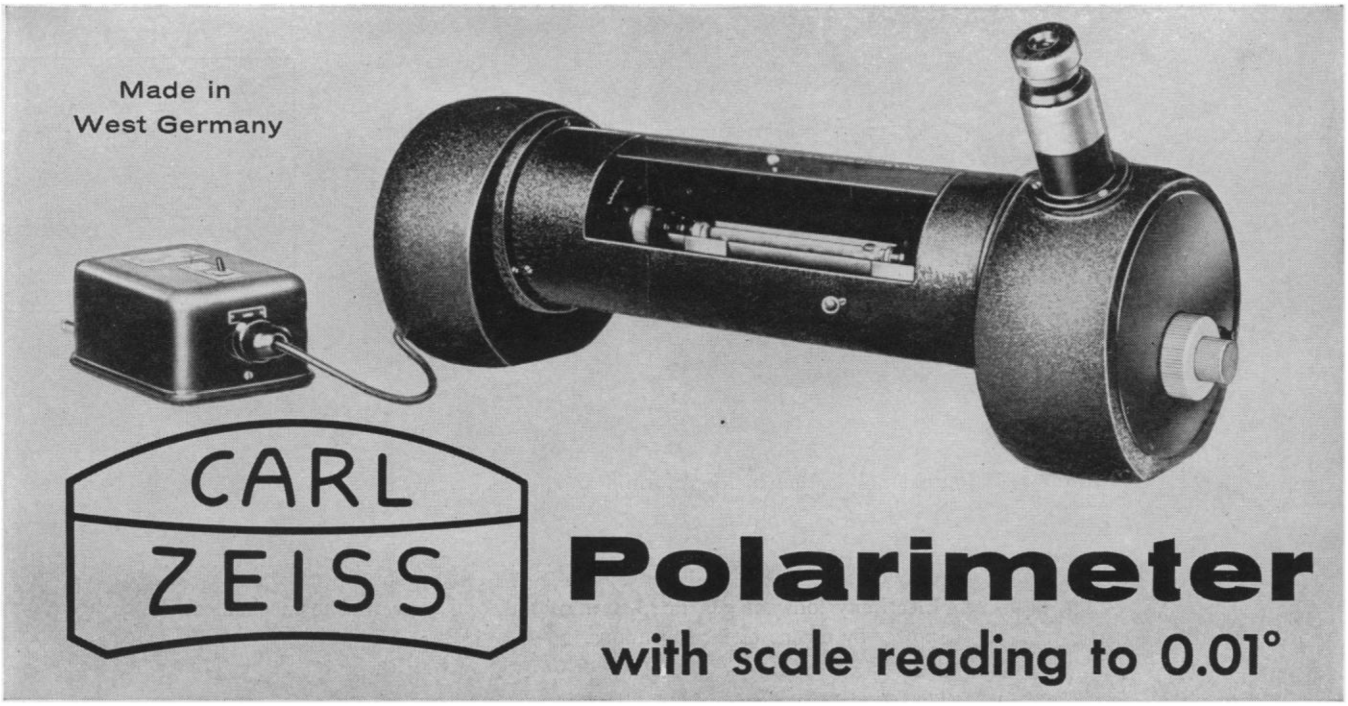

Assures ease in manipulation and higher accuracy in making measurements because:

- Inclined observation telescope permits readings from sitting position.
- Through observation telescope, the scales as well as the half-shade field of view can be observed.
- Direct vernier readings can be made to 0.01° and estimated to 0.005°.
- Moveable carrier, holding two polarimeter tubes, facilitates procedure of examinations.
- Coaxially-mounted coarse and fine adjustment knobs and switch controlled by right hand resting on table-top.
- Interchangeable built-in sodium or mercury spectral bulbs furnish strictly monochromatic light controlled by precision interference filters.
- Newly-designed, precision polarimeter tubes ensure the absence of strain, further assurance of true measuring results.

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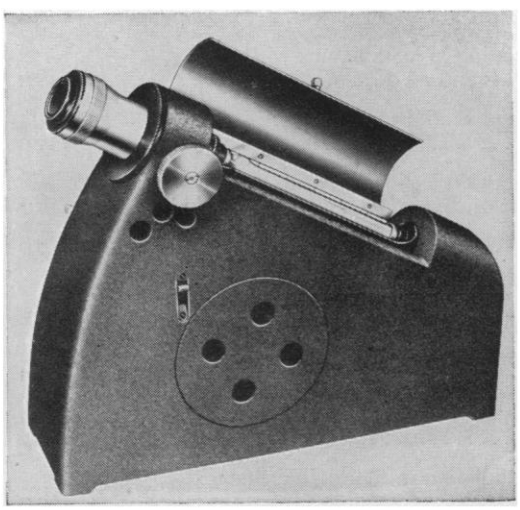

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POLARIMETER

with scale reading to 0.05°

- Inclined observation telescope permits readings from sitting position.
- Glass scale, verniers and Laurent half-shade plate (triple field of view) are observed in the same telescope.
- Illumination by either a double filament 40-watt bulb or sodium spectral bulb.
- Newly designed, precision polarimeter tubes ensure absence of strain, resulting in true measurements.
- Direct vernier readings can be made to 0.05° and estimated to 0.025°.

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The place of the Particle Accelerator in Basic Research...

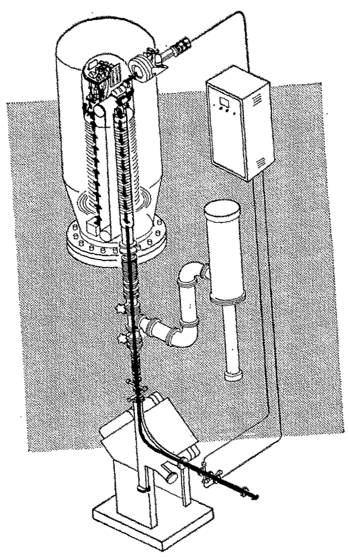
Atomic Displacement by High-energy Particles-VI

Research on the interaction of high-energy particles with atoms in the solid phase has received new impetus with the availability of controlled beams of electrons, positive ions, and monoenergetic neutrons from Van de Graaff accelerators. Investigations in this important field of solid-state physics and chemistry have been the subject of several recent surveys and books. [1, 2, 3]

Determination of Displacement Threshold

Of great interest has been the determination of the threshold for displacement in semi-conductors, by measurements that can be made with electrons of several hundred Kev. Increasing the energy above the threshold value causes the atom to recoil with sufficiently high kinetic energy to cause further displacements in collisions with neighbouring atoms. Electrons cannot transfer large amounts of energy to these recoil atoms because of the large mass difference, but changes can be effected by heavy particles if they have sufficient kinetic energy. Although high-energy protons and deutrons have been used for solid-state studies, these particles do not provide the best results because they lose energy to the lattice electrons and, at low energies, have a limited range.

Neutrons can be produced with a Van de Graaff accelerator by bombardment of targets such as Li^7 and H^3 with protons or deutrons. The resulting neutron beam is monoenergetic, with a high flux, making it ideal for displacement studies. It does not suffer from the broad energy spectrum of pile-produced neutrons and has relatively low gamma background.



2-Mev positive-ion Van de Graaff with analyzing system.

Thermal Spike

In general the monoenergetic neutrons produced by particle accelerators have energies above the displacement threshold. Their interaction with the atomic nuclei can be described by classical hard-sphere collisions and the subsequent recoil atom energy is sufficient to produce electronic excitation of neighbouring atoms. This phenomenon, originally described in 1923[3], is generally known as a thermal or displacement spike. It is one of the most difficult and yet most interesting phenomena in solid-state radiation reactions.

Seitz, in describing the theory of the high-temperature spike[2], has made an estimate of the volume affected and of the temperature and pressure produced in this region by transfer of incident energy to a lattice atom. Using assumptions deduced from rather meager experimental evidence, it can be shown that the affected volume has a radius approximately ten times the atomic radius. In this volume, the temperature is above the melting points of most solids and the pressure due to the high local temperature is of the order of 10^7 dynes per cm.[2] Although these conditions last for only about 10^{-11} seconds, which is brief in comparison with most chemical reactions, they could be useful for certain selected systems.

One of the exciting possibilities of such local thermal spikes is the use of the extremely high temperatures and pressures for chemical solid-state reactions. Little has been done in this field because of the difficulty of analyzing the results. With the availability of low-energy monoenergetic neutrons from a Van de Graaff, without the complication of Coulomb encounters with the lattice atoms, there appears hope that this promising field will attract more attention.

References.
1. Radiation Effects in Solids, D. J. Dienes, G. H. Vineyard, Interscience Publishers Inc., New York, 1957
2. Solid State Physics, F. Seitz, D. Turnbull, Editors, Vol. 2, Academic Press Inc., New York, 1956
3. J. A. Brinkman, Journal of Applied Physics, 25, 961, 1954
4. F. Desauer, Z. Physik, 38, 12, 1923.

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