his way through the wide-ranging and complex literature on the role of metal (and other) contacts in the performance of photoconductors. It is, indeed, helpful to have so great a variety of experiments assembled in one chapter. The discussion reflects his own broad experience in this field.

The editors of *Semiconductors and Semimetals* have carried out a responsible service to the solid-state community in assembling this volume.

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Albert Rose's early work was central to the development of TV. He is a fellow at RCA Laboratories, Princeton, N.J.

Crystals and the Polarising Microscope

By N. H. Hartshore, A. Stuart
4th ed. 614 pp. American Elsevier New York, 1970. $29.50

This edition (as well as the previous editions) is intended mainly to teach students of chemistry how to use the polarizing microscope in the identification of substances. As the authors point out, very little material is needed and the analysis is often quick and clear.

The authors first build a fairly good base of classical crystallography such as mineralogy texts generally present. This seems quite complete, although they say that beginners might do well to consult their more elementary work *Practical Optical Crystallography*. This basis for crystallography is done with a minimum of mathematics. This reviewer also recommends Elizabeth A. Wood's *Crystals and Light* for background.

In brief, the method of identification consists of observing many physical properties and then determining what substances have matching physical properties. To this end, one observes crystal shape (including symmetry), color, fracture, cleavage, refractive index or indices, dispersion, optical sign, whether isotropic, uniaxial or biaxial (if biaxial, the angle between axes) and pleochroism, among other properties. The effects of temperature changes should also be noted.

The authors have added much material on supplementary equipment and how to use it. They discuss microtomes, optical compensators (quartz wedges, Berek and Ehringhaus compensators), immersion media, spindle stages, hot and cold stages, universal stages and other equipment.

The section on the mesomorphic state (liquid crystals) has been amplified and some odd effects are explained in detail. The section on "organic fibres" has been replaced by one entitled "Polymers and Biological Materials."

One naturally compares this book with the *Handbook of Chemical Microscopy* by E. M. Chamot and Clyde Mason. Chamot and Mason are stronger on straight microscopy, but Norman Holt Hartshorne and Alan Stuart are stronger on crystallography.

I differ with the authors on a few minor points. They give calcite and diamond as examples of perfect crystals. Today, carefully grown silicon crystals having certified very low dislocation counts are on the market. This is not true of calcite or diamond.

The authors say the polymorphic series in descending temperatures are α, β . . . and illustrate with silicon dioxide. In the US, α quartz is the room-temperature form which converts to β quartz at 573°C. The authors list quartz as pyroelectric, but symmetry considerations show this to be impossible. However, temperature gradients could produce a similar effect.

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Aristotle's Physics I, II

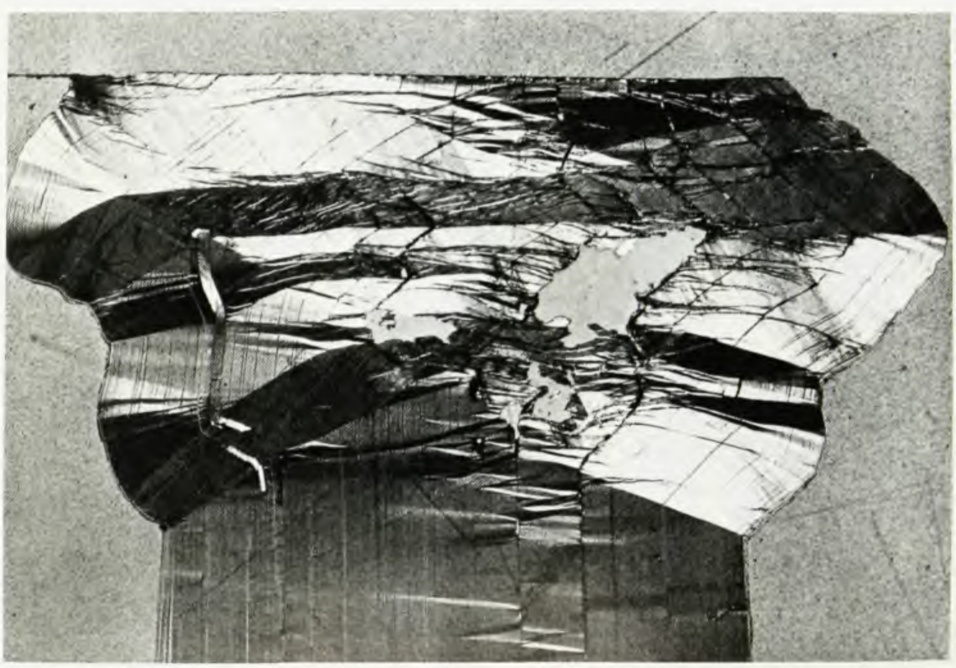
***Trans. by* W. Charlton**
151 pp. Oxford U.P., New York, 1970. Cloth $5.50; paper, $2.85

Poor Aristotle!

Imagine what it will be like for Einstein, two thousand years from now, when his physical works will be handled by scholars trained in the long-since-dead German language, or long-since-obsolete 20th-century philosophy. When this day comes, surely nothing of Einstein's physics will be comprehensible to anyone trained in the natural sciences.

Such has been the fate of Aristotle, now owned lock, stock and barrel by classicists and students of ancient philosophy. Aristotle—author of the earliest known textbook of physics, which was "must" reading for all serious students of the field for some two millenia after it was written; architect of concepts that still underlie much of current physical thought, a fact rarely appreciated today. One would expect his works to be approached with awe by modern scholars, and with at least as much scientific training and understanding as we take for granted when approaching the works of comparable figures such as Newton, Maxwell, Einstein or Bohr.

Unfortunately, all we get these days is books like the one under review, which open with the words "The first two books of Aristotle's *Physics* do not deal with problems in what we today call physics." Some idea of W. Charlton's sophistication in matters scientific can be garnered from the Appendix, entitled "Did Aristotle Believe in Prime Matter?" In fact, Aristotle's struggle with the concept of prime matter was a complex one, identical in its scientific and philosophic content to recent struggles with the concepts of matter conservation, energy conservation and (in general) conservation laws governing physical entities that never change in some important respect. Aristotle's com-



Polarizing microscope view of kink bands in natural biotite. Photo courtesy of Neal Carter, Earth and Space Sciences Department, SUNY at Stony Brook.

ments were immensely interesting, and the themes he introduced have remained embedded in physics to this day. But what Charlton gives us is a series of comments of the following semi-inane caliber:

"The idea, however, that if there is nothing which remains throughout a change, then things come to be out of or pass away into nothing, is mistaken. Between alteration on the one hand, and creation and annihilation on the other, there is a third possibility. If you have a glass jar from within which you have removed the air and everything else you can find; and you see a frog suddenly appear in it; then you might call that coming to be out of nothing. If you see a man sitting in a chair, and suddenly he has vanished irretrievably, and in his place is a pile of books which have never been seen or heard of before, you might be tempted to say that the man has passed away into nothing and, by a strange chance, the books have come into being out of nothing in the same place. But when the passing away of one thing is always and intelligibly attended by the coming to be of another, for instance when wood passes away in smoke and flames, or a saucer of water passes away and the air is refreshed, then we do not say that the first thing has passed away into nothing, but into the second, and we say that the second has come into being, not out of nothing, but out of the first. Yet we cannot say that there is something which remained throughout and underwent these transformations, unless we can find some description under which this thing can be identified throughout. It may be added that we can often find such a description if we look, not for something which constituted first one term of the change and then the other, but for something which first one term and then the other constituted. . . ."

The heart of the book is Charlton's translation which, not surprisingly, is barely comprehensible. One sample will suffice. Here is Charlton's rendition of a paragraph in Book I, Chapter 4:

"Further, if it is necessary that, if a part of a thing (and I am speaking of the parts into which, as constituents present in it, the whole can be divided) can be as large or small as you please, then so can the whole, and if it is not possible for any animal or plant to be as large or small as you please, it is not possible that any part should be either; for if it could, so could the whole. Now flesh and bone are parts of animals, and fruits are parts of plants. Clearly, then, neither flesh nor bone nor anything of that sort can proceed indefinitely far either in enlargement or in diminution."

Aristotle contemplating the bust of Homer, in a painting by Rembrandt, 1653.

A determined reader would probably discover, after several readings, that Aristotle is discussing a scaling principle that sets upper and lower limits on the possible sizes of the basic units of organic matter. (This principle is a familiar one to biophysicists.) Rendered into a version of English more familiar to everyday scientists, this passage would read:

Again, it follows that an object can be of any size whatever if its component parts—where I mean by "component parts" actual subdivisions of the whole into which it can be broken up—can be of any size. Therefore, since a plant or an animal can not be of any size whatever, it is clear that any component part of a plant or an animal can not be of arbitrary size. For if any part could be, so could the whole. Now, flesh and bone and other tissues are component parts of an animal, as is vegetable matter of a plant. Therefore, it is clearly impossible for flesh or bone or anything else to be of arbitrary size.

We shall never adequately appreciate the strengths and weaknesses of our present physical world view until we have paid proper attention to the ancient Greek foundations upon which this world view has been based. Unfortunately, books like this, sponsored by august universities, do not contribute toward such an appreciation.

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Principles of Celestial Mechanics

By P. M. Fitzpatrick
405 pp. Academic, New York, 1970. $12.75

This book, based on the author's own lectures, is intended as an undergraduate text. The first seven chapters, covering the unperturbed Kepler problem, expansions in elliptic motion, and the planetary equations in the Gauss form, are meant to provide a one-semester course, possibly at the graduate level.

The topics included and the treatment of them are directed specifically