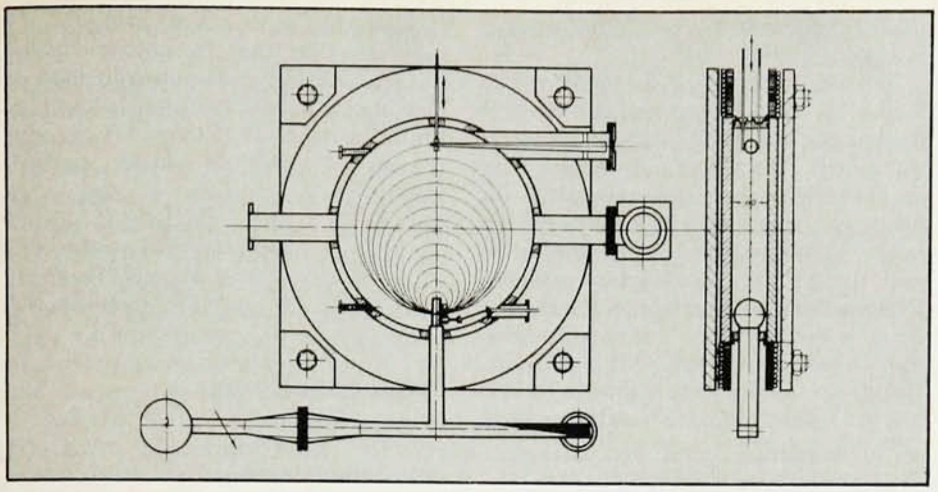

The first microtron built at the Physics Laboratory of the Academy of Sciences, USSR seen in plan, (left) and side elevation (right). A microtron is a cyclic particle accelerator in which the time of successive revolutions of the particles increases by exactly one or more cycles of the radiofrequency voltage. The diagram appears in *The Microtron*, by S. P. Kapitza and V. N. Melekhin.

to 1976. However, since sometime prior to that date, considerable progress has been made in the development of continuous wave (cw) race-track microtrons and related machines (at the Universities of Illinois (Urbana), Mainz and Stanford). These devices now promise to make a considerable impact on the field of nuclear physics at energies up to 800 MeV. Such machines are only mentioned as a possibility in the final chapter. In the circumstances a new edition would have been appropriate.

The microtron was proposed in 1944 by V. I. Veksler in the historic paper in which he described the phenomenon of phase stability. The classical microtron is a fixed-frequency, constant-magnetic field accelerator in which the orbits are cotangential. Early microtrons relied on field emission from the accelerating cavity, which restricted them to low average currents (about 10 nanoamps) and low magnetic fields. A real breakthrough came in 1959 when V. N. Melekhin proposed a novel method of injection that enabled higher magnetic fields to be used. His innovations have culminated in microtrons with energies up to 44 MeV (University of Wisconsin, 1973) and average currents up to 100 microamp (Moscow, 1963).

S. P. Kapitza and V. N. Melekhin are the persons primarily responsible for the development of microtrons during this latter period, and as such they are amply qualified to write this monograph. The translator, I. N. Sviatoslavsky, and editor, Ednor M. Rowe, are both associated with the University of Wisconsin project.

The text provides both a unique history of the microtron and the instructions necessary to build and operate such a machine. The first chapter covers some of the history, general principles of operation, particle injection and the design of particular microtrons. These subjects are then expanded in considerable detail in subsequent chapters. Sufficient information is supplied here to enable any competent group to design and build its own microtron. The authors devote a final chapter to the cw microtron. As already mentioned, this section would benefit considerably by being brought up to date.

One or two annoying features of the book must be mentioned. First there is no index and the order of the references in the text is totally arbitrary, which makes it difficult to use as a reference book. Secondly, only pulse currents are mentioned throughout, with only a few details of duty factors. This would be particularly irksome for most accelerator users, who are mainly interested in average currents. The book is cheaply but adequately printed although many typographical errors have not been corrected.

In spite of its shortcomings, *The Microtron* fills a gap in the historical literature and provides an excellent instruction manual that should be read by all students of accelerator physics. Scientists in developing countries who want a cheap electron accelerator, would benefit considerably from the information provided.

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Outliers in Statistical Data

V. Barnett, T. Lewis
365 pp. Wiley, New York, 1978. $39.95

Any scientist interested in the information contained in data becomes involved in the decision of whether or not it is reasonable to reject unrepresentative or outlying observations in a data set. Although such eighteenth-century workers as Daniel Bernoulli, Friedrich Bessel, Adrien Legendre and Benjamin Peirce first recognized this problem, the great burst of activity in outlier techniques that we are witnessing began in the early 1960's. Experiments yielding large amounts of data where the data analyst may not known much about the experiments or the theory underlying the data production are increasing. Vic Barnett and Toby Lewis have written the first text, one that addresses the problem in this setting. Barnett is the author of *Elements of Sampling Theory* (Crane, Russak, New York, 1975) and *Comparative Statistical Inference* (Wiley, London, 1973). He is an editor of *Applied Statistics*, a journal of the Royal Statistical Society, London. Lewis is known for work on stochastic processes. They have collected more than 400 references and 47 pages of tables providing a rather complete survey of the current state of the art. And art it is! Practically speaking, for each choice of technique that "captures" an outlier, the mathematical statistician can devise a way around that choice. Nevertheless, Barnett and Lewis have successfully organized the existing material under these broad topics: sources and nature of outliers; methods of handling them, and outlier-generating models.

Unrecognized outliers can reflect measurement errors or the inherent variability of the data source or the imperfect collection of samples (execution errors). To recognize that an item is an outlier implies the existence of an underlying model for generating all the data. An outlier is an "extreme value" in the sense that it is discordant, that is, statistically unreasonable based on an assumed stochastic model. The data analyst can choose one of four options to deal with outliers. One possibility is to accommodate them by utilizing such robust methods as trimming or Winsorizing for location estimates or the median deviation for estimates of dispersion. A second way is to incorporate "maverick" data by replacing the initial model with a revised one where no observation is discordant. A third approach permits the offending items to identify some unsuspected factors of the population leading to the formulation of an alternative model that will account for the outliers. Finally, there is outright rejection of the extreme values.

Outlier-generating models is a topic more interesting to the mathematical statistician than to the physicist. Ironically, this topic is both the strength and weakness of the book. By putting the collection of outlier methods on a model theoretic basis, the authors contribute to understanding the reasons for the selection of a method. Some of the most useful models are the slippage, mixture and exchangeable types. Slippage models, the most common type in the literature, were first reported around 1950. In its general form the slippage alternative states that all except a small number of observations come from the assumed data-generating model with given mean and variance. The aberrant observations arise independently from a modification of the initial distribution where either the mean or variance is shifted in value. However, the discussions are neither easy to follow nor do they provide much guidance in choosing the best technique for a particular situation. This is not exclusively the problem of Barnett and Lewis. It is, unfortunately, the state of current knowledge of outlier theory. For example, what constitutes a suitable performance criterion for a test of discordancy is an open issue.

The organization of the book into a "tests of discordancy-accommodation" dichotomy inevitably leads to some redundancy. But this is not serious. Nor are the several typographical mistakes, for example, on page 49 where a section has been omitted; on page 76 (a spelling error) and the garbled phrasing on page 90. Perhaps the weakest section is the chapter on multivariate data. For completeness the authors have included this material. But again the problem is that so little is known! If my attitude toward the book is somewhat ambivalent, it should not mask the fact that Barnett and Lewis have made a significant contribution. One hopes that the book will be useful to the data analyst/statistician in furthering the development of outlier methodology.

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Polymer Surfaces

D. T. Clark, W. J. Feast
441 pp. Wiley, New York, 1978. $49.50

Polymer surface behavior has recently been achieving recognition as a field that is both scientifically and technologically important. Direct or nearly direct physical methods of studying polymer surfaces have been attracting considerable attention. A symposium was held in England recently at the University of Durham on this subject, and this volume is the outcome of that meeting. Clark and his co-workers have an active research program at Durham, and they have put together an excellent volume of papers from the Durham symposium.

Physical measurements for surface characterization are covered, such as the important ESCA technique (by Clark) and infrared spectroscopy (by H. A. Willis and V. J. I. Zichy). J. D. Hoffman and G. T. Davis have attempted to resolve the problem of "regular folds" versus an "amorphous layer" for the surface of polymer single crystals. Their solution is to hypothesize a layer of "polymer molecules that are physically adsorbed on a fairly regular folded surface . . . with loops or traverses between points of attachment . . . [which] may be detachable under appropriate circumstances." Their argument is worth examination.

There are five chapters on friction, adhesion and wear of polymers, and four on electric charge effects. The balance of the book (there are 19 chapters) includes a number of chemical and applied topics, such as photopolymerization, the use of plasmas in surface modification, photo-oxidation, and other modes of surface deterioration.

The editors have not restricted themselves to the narrowest definition of polymer surfaces, and they concede that the depths involved (1 micron or more) will not be uniformly approved. But in fact, the sub-surface region of a polymer does deviate from that of the bulk in ways that very strongly influence behavior in adhesion as well as other phenomena. To exclude this sub-surface region from consideration would be to leave that region, as it were, a never-never land, inaccessible to investigation. And it would greatly diminish the value of work with