

of particles and their ultimate annihilation in a detector of some sort. Theoretically, one would like to be able to predict the probability of the occurrence of such a sequence. In quantum field theory of the conventional type, the sources are particles to be associated with the quantum states of some field. In sorcery, these source particles are replaced by source functions, real-valued ordinary functions of space-time, whose general characteristics can, to some extent, be fixed by the symmetries, Lorentz covariance and other factors assumed to hold for the theory. The object of the game is to determine the probability of a vacuum-vacuum transition in the presence of these sources. For weak sources a perturbation theory is available and, by a very ingenious series of arguments involving the causal requirement that particles cannot be absorbed before they are emitted, Schwinger derives the terms in the series which involve the causal Green's functions familiar from field theory. The significant feature of this expansion is that at no stage is any appeal made to a field-theory Lagrangian or to quantized fields. On the other hand the source functions are primitive phenomenological entities, at least on the level of presentation of the present book. We are not invited to take apart the sources, as one would try to do in a normal field theory. Perhaps in a subsequent volume Schwinger will tell us how to use source theory to compute, say, the Schwinger magnetic moment of the electron. At the level of phenomenology of this book this, as far as I can determine, is put in by hand as a phenomenological parameter.

The book is written in a cheerfully polemic tone. (There are occasional dialogues with an interlocutor called "Harold"—once addressed, *à la* Galileo, as Sagredo—who gets mowed down each time he puts his hand up to ask a question.) It is addressed to what I might refer to as Consciousness III graduate students who are both sufficiently smart so as to be able to read it, but whose minds have not been warped "past the elastic limit" by previous exposure to operator field theory or S-matrix theory. Perhaps such students exist at Harvard, but, as for myself, I did not find the book easy going. Schwinger is such a virtuoso at calculational techniques that to him, no doubt, the extension of sorcery from spin one to spin three fields is a simple exercise. I found it a calculational Mount Everest and, perhaps, it, and some of the other more abstract examples, might have been relegated to appendices. On the other hand I found his presentation of spin-half scattering processes by means of helicity techniques absolutely beautiful and instantly stole some of his derivations for my

course in advanced quantum mechanics. These techniques apparently have nothing, to do with the underlying source philosophy, and anyone whose mind is already too warped to forget what he has learned from field theory can start, for example from page 286, where he will find a familiar-looking expression and then proceed to see how Schwinger works with it. In doing so he will find himself led backwards into the book and soon he will be swimming happily among the sources.

As elementary-particle theory has become more and more polluted by the emissions of advanced mathematical technology, books about it have become stuffier, more obscure and less and less fun to read. Schwinger's book, while not easy reading, is—because of the unconventional personal tone epitomised in his motto "If you can't join 'em, beat 'em" and because of the elegance and power of his calculational methodology—fun to read. Whether source theory will lead to profound new discoveries of the type that Schwinger, and others, have made using conventional field theory remains, I think, to be seen. Perhaps Schwinger has some surprises up his sleeve for the next volume that will settle the matter.

Jeremy Bernstein

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### The Collected Works of Count Rumford, Vols. 3, 4, 5

S. C. Brown, ed.

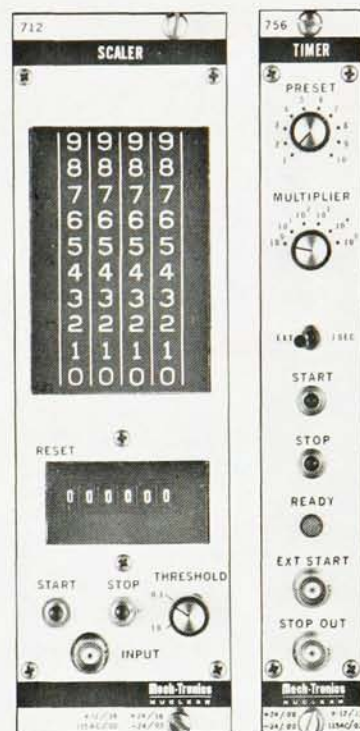
504 pp., 503 pp. and 512 pp.  
Harvard U. P., Cambridge Mass.,  
1969, 1969, 1970. \$10.00 each.

These volumes continue the presentation of Count Rumford's work that was begun in volumes 1 and 2. Rumford's masterful understanding of the science and technology that interested him is clearly demonstrated by these collected works.

Volume 3, *Devices and Techniques*, is devoted primarily to the practical application of heat, but it also includes pioneering scientific considerations on the importance of steam as a heat-transfer medium. Problems he considered include improved means of heating meeting halls, houses and public buildings and supplying heat for industrial processes, all by methods utilizing the increased heat-transfer efficiency through the use of steam. There is a long detailed paper giving original designs for kitchen stoves, fireplaces, ovens and cooking utensils for large-scale food preparation. This was a major concern of Rumford's during his

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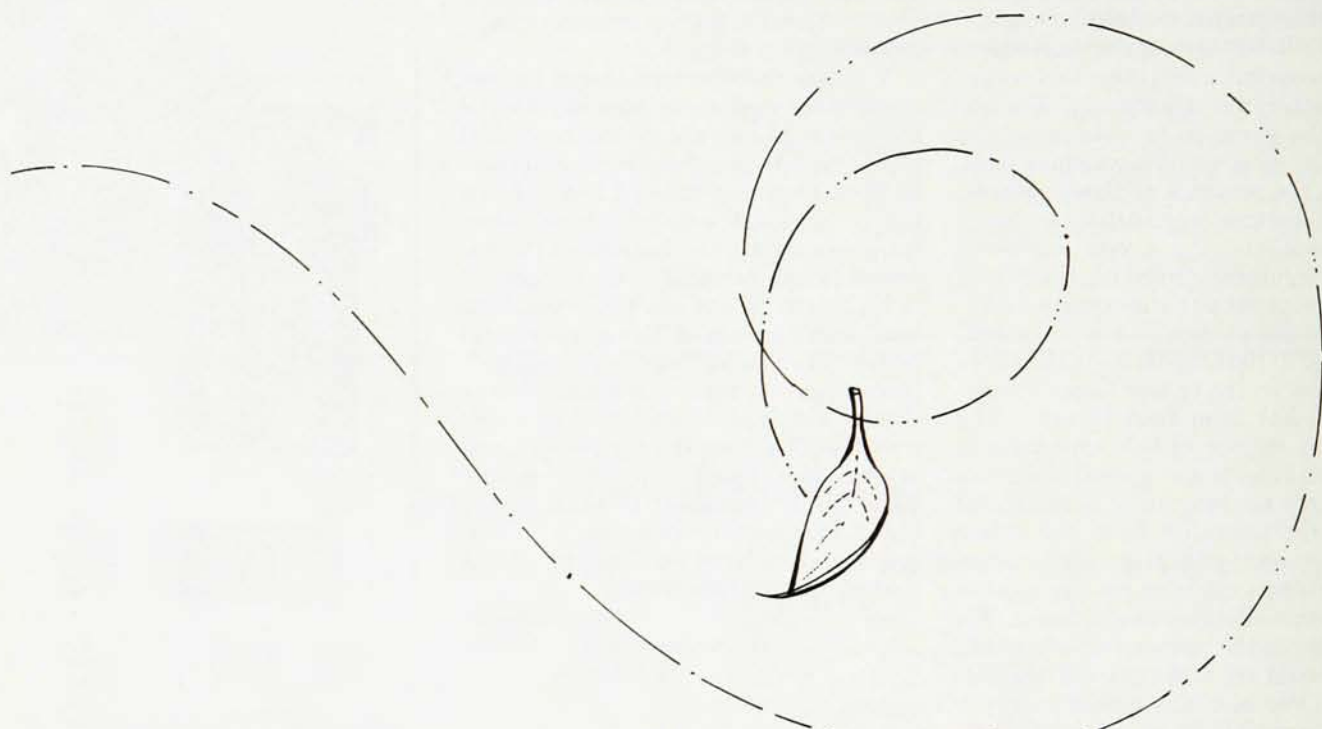
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14 years in Munich, where, as an officer of the State of Bavaria, he was constantly faced with the problem of providing for the needy in more efficient hospitals and social-welfare programs.

This volume also presents interesting experimental results on the physical properties of silk, on the moisture absorbed by various cloth and furs and general consideration on more efficient use of fabrics, all showing Rumford's broad interest in the properties of materials. One of the papers carefully explains the advantages of broader wheel rims for carriages, which in his day were the major source of transportation throughout Europe. An interesting paper at the end of the book gives a design for a frigate prepared by Rumford for the British Admiralty. This shows the imagination, concern for quantitative engineering details and the thoroughness that are evident in all Rumford's work.

The fourth volume of the series, *Light and Armament*, is divided into two distinct parts. The first discusses the physics of light and illumination and is of real interest even though Rumford's contributions to these subjects were not as outstanding as to the science of heat. However, he made important advances in methods of light measurement and in optical instrumentation. Rumford developed a shadow photometer which is known by his name, and defined the first "standard" candle, which continued to serve as an international unit for light intensity until recent times. These papers on optics report quantitative studies of translucent diffusing screens and demonstrated procedures whereby glare can be eliminated without an appreciable loss in overall light intensity. Specific applications include ground-glass window panes, translucent lamp shades and other devices. There is an interesting paper on experiments with colored shadows that clearly reveals his skill as an experimenter, and a rather fanciful paper on the harmony of colors.

The second part of this book is on gunpowder, the ballistics of cannon, the velocity of projectiles from guns, and related ordnance studies. These are thorough and detailed in their quantitative evaluation. It is a curious fact that when Count Rumford was elected to the Royal Society he was chosen for his work on armament rather than for his basic researches in heat and optics.

The papers presented in *Public Institutions*, volume 5 on these collected works, demonstrate Rumford's concern with the humane application of science and technology. They show a remarkable foresight into present-day problems in these areas of public concern.

Throughout his life and especially during his residence in Munich, Rumford was closely associated with the rul-

ing class and became deeply concerned with the serious social problems confronting Bavaria. Much of his work on improvements in the efficient utilization of heat for cooking, heating buildings and in industrial processes, was designed to alleviate the conditions of the underprivileged. At that time there were veritable mobs of unemployed hungry people, and Rumford exerted a major influence in providing work, food and housing for these people and in setting up effective programs to teach them useful trades and to educate their children. An interesting item is his great effort to interest people in the use of coffee as a substitute for alcohol. How successful this was in Bavaria is not reported!

The last part in this final volume recounts Rumford's ideas in founding and endowing the Royal Institution of Great Britain. This organization, which has been one of great leadership in education and scientific research, incorporates even today many of his original concepts for such an institution.

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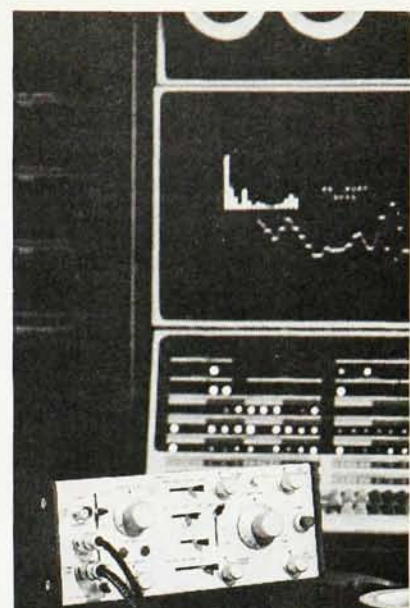
**Biological Aspects of Radiation Protection** (Conf. proc. International Symposium, Kyoto, Japan, Oct. 1969). T. Sugahara, O. Hug, eds. 273 pp. Springer-Verlag, New York, 1971. \$18.50

**IEEE Transactions on Nuclear Science** (Conf. proc. 1971 Particle Accelerator Conference Accelerator Engineering and Technology, Chicago, Ill., 1-3 March 1971). 1161 pp. IEEE, New York, June 1971, Vol. NS-18, No. 3. \$20.00 for nonmembers of IEEE; \$10.00 for members.

**Lecture Notes in Physics, Vol. 8:** Proceedings of the Second International Conference on Numerical Methods in Fluid Dynamics (Conf. proc. Berkeley, Calif., 15-19 Sept. 1970). M. Holt, ed. 462 pp. Springer-Verlag, New York, 1971. \$7.70

**Modern Optical Methods in Gas Dynamic Research** (Conf. proc. International Symposium supported by the New York State Science and Technology Foundation, Syracuse, New York, 25, 26 May 1970). D. S. Dosanjh, ed. 295 pp. Plenum, New York, 1971. \$14.50

**Fundamental Aspects of Dislocation Theory**, Vols. 1 and 2, National Bureau of Standards Special Publication 317 (Conf. proc. National Bureau of Standards, 21-25 April 1969). J. A. Simmons, R. deWit, R. Bullough, eds. 1376 pp. US Department of Commerce, National Bureau of Standards, Washington, D.C., 1970. \$8.25 □



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