by technological advances, or is politically inspired. If the former, he suggests, such a race may not play the same role in international politics as in the past and might not be a signal of, or a cause for, heightened political tension. He regards Europe as simply indefensible at present and therefore regards as academic the question of a European ABM, raised by Jeremy J. Stone in his paper "ABM: The next MLF?" He thinks that an argument for ABM based on meeting a potential Chinese attack is almost certain to be counterproductive with the European allies, while at the same time it is European opinion that the present Soviet ABM deployment requires little U.S. response. Any serious deployment of ABM by the U.S. and the U.S.S.R. may be expected to have disruptive effects upon alliances, with the natural conclusion being drawn that an undefended Europe would be the probable battlefield for future U.S.–U.S.S.R. conflict. This point is also made by Young and by J. I. Coffey.

With the exception of some mention of China in the papers by Coffey, Martin, and David R. Inglis, *Debate the Antiballistic Missile* is devoted to the question of a ballistic missile defense against possible Soviet attack. The argument has been made that it would be fairly easy to penetrate a thin ABM deployment, even for the Chinese. The strongest answer to the threat of a Chinese nuclear attack remains the strength of the U.S. deterrent forces. The only rejoinder to this is to raise the specter of rash behavior on the part of the Chinese, although it is generally agreed that, as McNamara said in his speech of 18 September, "China has been cautious to avoid any action that might end in a nuclear clash with the United States." The best McNamara could do was to come to the marginal conclusion that a light deployment of U.S. ABM's against possible Chinese irrational behavior was prudent. The same marginal grounds for a decision to upgrade the thin deployment will exist as Chinese nuclear strength or ability to penetrate our defenses develops. Once deployment is started, there will be increasing momentum for a deployment that will appear threatening to the Soviet Union. It is therefore proper to consider at this juncture the question of a ballistic missile defense against possible Soviet attack as well.

The basic disagreements are largely tied to political judgments. There is little argument with regard to the technical questions. At the AAAS annual meeting in New York last December, Hans A. Bethe discussed the "kill" mechanisms to be employed against incoming nuclear warheads and the penetration aids that might be employed to overcome an antiballistic missile system. (His views have since been published in an article in the March 1968 issue of *Scientific American,* "Anti-ballistic-missile systems," by Richard L. Garwin and Bethe.) His conclusion that an effective area defense was beyond assurance was not contested during the two-day symposium on Ballistic Missile Defense, nor has it been since. This raises again the issue of civil defense, dismissed by Brennan as being unnecessary with an area-defense system. Both proponents and opponents of ABM agree that to the extent that ABM would safeguard deterrent forces on both sides, it might contribute to a more stable strategic situation. Again, there is general agreement on the potentially destabilizing threat of the introduction of MIRV (Multiple Independent Reentry Vehicles). It should be recognized that this destabilizing threat has evolved out of concern for offsetting ABM even before any decision to deploy was reached. In the light of this and other research-and-development efforts to negate the defense, it is difficult to see how an offense-defense race can be avoided once ABM's are deployed. Nevertheless, it is on precisely this point that the differences arise. The proponents of ABM contend that some degree of "damage limitation" could be pursued without evoking an effort by the other side to restore the previous level of "assured destruction." This contention is based on the view that it is rational to desire somewhat lower potential damage to both sides. That is indeed rational, but if rational behavior can be counted on, the route to lowered potential damage is through arms reduction. Leonard S. Rodberg's paper deals effectively with the conflict between ABM and arms control and reduction. It is in the perception of how governments and forces within governments might act that opinions diverge. Nearly everyone agrees that there is no real security in the world as now armed, with or without ABM.

Except for some mention by Betty Goetz Lall, in "Congress debates," nothing is said about the relevance of the ABM issue to national and international economics. Perhaps it is considered trite and obvious in sophisticated analysis to question the sense of priorities that contemplates spending tens of billions of dollars to pursue the dangerous will-of-the-wisp of a ballistic missile defense when far more urgent needs go unattended at home and abroad. But that such questions are being raised elsewhere is evident from the crisis of confidence in the dollar, which is partly a reflection of European judgment of the poor purposes to which American money is already being put.

At the time the thin ABM was decided upon, it was widely felt that the decision was made more to defuse a possible '68 election issue than on the basis of military considerations (see James Reston, "The anti-Republican missile," New York *Times,* 22 Sept. 1967). An informed public might have precluded such a possibility. Given the present likelihood of a new administration in 1969, it may not be too late to debate the antiballistic missile.

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Adsorption

Electrosorption. ELIEZER GILEADI, Ed. Plenum, New York, 1967. xiv + 221 pp., illus. $12.50.

This book arose out of a series of seminars delivered at the University of Pennsylvania in J. O. M. Brockris's laboratory. There are seven chapters and seven authors. In the main, however, the authors use the same general approach, which leads both to some cohesiveness and to a considerable amount of repetition. In some instances different symbols and terms are used for the same quantities in different chapters.

In the first four chapters there is a continual comparison made between adsorption from electrolytic solutions (electrosorption) and gas adsorption. There is a tendency to depreciate the present knowledge of adsorption on solid metals, which is probably not justified in the light of recent work. Throughout the book the attempt is made to deal with solid electrodes, rather than mercury. There is no real description of present-day experimental solid surfaces in solution, however, and the rather complex theories almost neglect the character of the metal surface.

The fifth chapter gives a very good treatment of the potential of zero charge, especially as applicable to mercury. The data on solids are both variable and questionable, particularly in view of the little attention that has been

paid by most electrochemists to the cleanliness of their surfaces, and, I believe, any correlation between theory and experimental results is either forced or accidental.

The final two chapters deal almost completely with the solution and double layer. There is a large amount of mathematics, and with a sufficient number of assumptions and simplifications the usual agreement between fact and theory is found.

All the chapters have excellent bibliographies and are mainly reviews. In some instances it is difficult to separate review material from original material without consulting the pertinent references. The main usefulness of the book will be as an overall picture of the solution and double-layer side of electrosorption as viewed by Bockris and his group in Pennsylvania. The book will be helpful for its references and as a guide to present knowledge of electrosorption. It is unfortunate that the price is high.

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Immunology

Germinal Centers in Immune Responses. Proceedings of a symposium, Bern, Switzerland, June 1966. H. COTTIER, N. ODARTCHENKO, R. SCHINDLER, and C. C. CONGDON, Eds. Springer-Verlag, New York, 1967. xvi + 499 pp., illus. $19.50.

As is noted in the introduction to this symposium, the study of germinal centers of lymphoid tissues has yielded a great deal of information in the last five to ten years, after a period during which much was said about these structures but little was known with reasonable certainty. During the era of speculation various functions were attributed to germinal centers, but all were disproven by further experiment. The participation of these centers in immunological responses has now been supported by numerous studies in various laboratories, however, and it is quite apparent that it can no longer be denied.

The bringing together of a distinguished group of investigators from several parts of the world for this first conference on the germinal centers in immune response was a timely and necessary undertaking. The publication that has resulted from the conference brings to investigators of immunological phenomena and of lymphoid function a wealth of contributions on various aspects of germinal-center function.

The book is divided into 18 sections, which deal with aspects of germinal-center function and structure ranging from the phylogenetic and ontogenetic development of the centers all the way to their role in neoplastic disease.

It is already apparent, from the initial contributions on the development of germinal centers, that the exposure of animals to environment, with its myriad of antigens, is important to the development of germinal centers and that—although no definite proof of this is offered in any of the contributions in this volume—these centers are therefore quite closely related to the development of immune responses. The excellent paper by Yoffey and Olson on the formation of germinal centers in lymph nodes goes a long way to clarify many ideas on germinal-center histology and histogenesis. Also of note is the group of contributions in which the ultrastructure of germinal-center cells is described. The active localization of antigen in and around germinal centers makes it appear that they are an important part of immune response. Whether this localization is more important in a primary response or in a secondary response is a question that is still under active investigation. The paper by Young and Friedman should be singled out for the very interesting technique it reports for demonstrating the presence of antibody in germinal centers. Young and Friedman's work is nicely supported by that of Pernis and of Burtin and Buffe. In fact, the entire section on antibody formation in germinal centers leaves one with little doubt that this is indeed a true and not an imagined phenomenon. Of course, there is still the open question of what happens to the cells that are formed in germinal centers and whether they migrate from the center or remain there; White points out well the importance of this problem. The turnover studies reported deal in detail with this question. Interesting data are presented on the kinetics of lymphoid cells within germinal centers and on the migration and death of the cells in immunized and in nonimmunized animals. Germinal-center cells appear to move freely in and out of centers, and antibody-forming cells which are contained in the centers may at later stages migrate out into cortical areas of lymph nodes of red pulp of the spleen. The book also deals at some length with the importance of germinal centers in another type of immune response, that related to delayed hypersensitivity. The examination of germ-free animals has revealed very few germinal centers, again pointing to the likelihood that germinal centers are involved in the development of responses to external antigenic stimuli.

In addition to the studies directly related to germinal-center structure and function, the book includes some papers that have to do with lymphoid structure and function in general. This combination is good, since the lymphoid tissue consists of several compartments intimately related to one another.

In summary, this is a well-organized, well-edited symposium which will be of great value in providing some answers but also in raising a large number of questions. One hopes these will be answered in future symposia of this kind.

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Limnology

The Biological Basis of Freshwater Fish Production. A symposium sponsored by the Sectional Committee on Productivity of Freshwater Communities of the International Biological Programme, Reading, England, Sept. 1966. SHELBY D. GERKING, Ed. Wiley, New York, 1967. xiv + 495 pp., illus. $15.

The limnologist deals with an alien world, the world of water, and perhaps the only methodological advantage he enjoys is that from the very beginning he has had access to a series of ready-made microcosms of graded size and complexity. Even though laboratory aquaria are not small fish ponds, fish ponds small impoundments, or impoundments small lakes (for each has its own peculiar characteristics), some general rules govern them all, and what the scientist finds out about one type of microcosm can be applied, with appropriate reservations, to the others. In addition, the common problems faced in working with water have encouraged the limnologist, the fish culturist, and the fisheries biologist to seek one another's help in both theoretical and practical matters. Any systematic study of freshwater fisheries is therefore likely to contain information of significance