of the relationship between productivity gains and the rise in real earning in the economy as a whole and in selected industries. These findings give what is probably a more accurate picture than previous studies made with less refined statistical methods.

Let us now consider the subject of productivity gains in connection with agreements in wage rate increases. Let us assume that labor unions and management have agreed on increases in wage rates in proportion to the increase in productivity in the economy as a whole. What difference does it make whether the conventional or the refined method of measurement is used? If the conventional method is used for determining a wage rate increase, labor participates pro rata in the net gains in production attributable to the installation of new machinery, to technological and managerial improvements, and to all other factors making for an increase in production per unit of tangible capital invested and per man-hour worked. The corporation, on the other hand, *shares* in the contribution of a greater labor effort. Basically the percentage distribution of incomes between labor and capital remains the same.

If the refined measurement is used, labor would not participate in the production gains attributable to a larger investment in tangible capital per worker. Labor would gain pro rata through improvements in the efficiency of management and in the technological qualities of plant and equipment. Use of productivity ratios for an appraisal of wage rate increases is by its nature a short-run application. In the short run, very drastic changes in the relationship between labor and capital cannot be assumed. Therefore, the assumption of a constant distribution between capital and labor should not cause a very serious error in a short-range analysis. On the other hand, the use of a measurement of capital productivity resting on only crude tangible capital data does introduce a source of possibly serious error into the calculation.

The capital productivity ratio which is combined with the man-hour productivity ratio is based not on tangible capital actually used but on that available (footnote, page 14). Thus, the refined productivity measurement is a combined measure of production in relation to man-hours *actually worked* and of production in relation to tangible capital *available,* irrespective of the degree of its utilization. It would be justifiable to measure production in terms of available factors of production (manpower and machines) as an expression of the efficiency of the economic system. The combination of one factor actually utilized with another factor available introduces an error in the computation which may be less than the error committed if different countries or distant time points are compared with the use of the conventional period. The error of the refined method may, however, be larger than the error of the conventional method for short-range analyses.

Also, as a tool for long-range economic projections the use of the conventional method is justified as long as the economic analyst is fully aware that the rate of productivity growth thus measured includes the effect of changes in the tangible investment per worker in addition to all other factors which make for either increased or decreased net output. For a projection into the future it would be best if each of these factors could be appraised separately.

A mechanical extrapolation of the refined index of productivity is not much better than an extrapolation of the cruder index. The latter has the advantage that it can be taken as a point of departure for studying each of the factors which enter its determination, including changes in tangible capital per worker, the efficiency of capital, the efficiency of management, and all other factors. In any case, a projection must consider separately the trends in the ratios of capital stock to output and of man-hours to output. But no particular advantage would be gained by using the combined index for this purpose.

The refinements in productivity measurements proposed through the various studies of the National Bureau and summarized in this pamphlet have substantially contributed to our understanding of the problem and have provided us with tools for measurement that are of great value for certain problems. The conventional method of productivity measurement is, however, not yet obsolete and probably will continue to be most suitable for most practical purposes. Fabricant failed to discuss the purposes for which the various methods of measuring productivity are most suitable. This is my only criticism of an otherwise extremely useful publication.

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Medical Education. Annotated bibliography, 1946–1955. World Health Organization, Geneva, Switzerland, 1958 (order from Columbia University Press, New York). 391 pp. $6.75.

The basis for this select bibliography was a search of the world literature on medical education published between the years 1946 and 1955. Over 4000 references were collected. Virtually all of them were examined, and 2500 were selected for listing in this bibliography.

The references are classified alphabetically by author under the following headings: "History of medical education"; "Aims, trends, and general considerations"; "Special subjects" (for example, allergy, anesthesiology, bacteriology); "Pre-medical education"; "Students"; "Teachers"; "Curriculum"; "The patient in medical education"; "Academic teaching"; "Audio-visual aids"; "Research in medical education"; "The medical school in the community"; "Internship and licensure"; and "Countries and continents." An author index is included.

Brief annotations are given for all articles written in a language other than English, or, in the case of works published in English, for articles whose scope cannot be deduced from the title.

The Physics of Elementary Particles. J. D. Jackson. Princeton University Press, Princeton, N.J., 1958. ix + 135 pp. $4.50.

This concise survey of elementary particle physics had its origin in a series of lectures given at the summer seminar of the theoretical physics division of the Canadian Association of Physicists in 1957. The emphasis tends to be on recent developments; for example, the author gives considerable attention to the formulation of the theory of β-decay required by the experimental asymmetries that demonstrate nonconservation of parity.

The book is divided in three parts. The first outlines the interpretation of results on pion-nucleon scattering and on photoproduction of pions from nucleons. The second discusses K mesons and hyperons in terms of the Gell-Mann classification scheme and several models that have been proposed for the strong interactions of these "strange" particles. The third part is devoted to weak decay processes. Both the β-decay of nuclei and meson and hyperon decays are discussed, with emphasis on the nonconservation of parity. Among the topics that are omitted are nucleon-nucleon forces, antinucleons, and the production of pions in nucleon-nucleon collisions. In general, experimental methods are not described, but experimental results are quoted whenever necessary to justify or illuminate the development of theoretical ideas.

The result is a logical and consistent presentation of the areas in which understanding of elementary particles has been advanced most significantly during the last decade. As an introduction to the field of elementary particle physics the book will be of somewhat limited usefulness, since a good working knowledge of quantum mechanics, nuclear

physics, and at least classical field theory is required of the reader, and the concise presentation makes few concessions to his weaknesses. It cannot be expected to serve as an account for the general reader, for the undergraduate in physics, or even for most scientists trained in fields other than physics. For those with adequate background, however, it should prove to be a valuable discussion of a field in which good books are rare. To some extent it may serve as a sequel to Fermi's similar book, '*Elementary Particles,*' published eight years ago.

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The Central Nervous System and Behavior. Transactions of the first conference, 23–26 February 1958. Mary A. B. Brazier, Ed. Josiah Macy, Jr. Foundation, New York, 1959. 450 pp. Illus. $5.25.

This is a remarkably fine, interesting book. It is crammed with provocative ideas on the central nervous system and behavior—the functions of man that presumably give him status in the animal world. The contributions of the Russians are the springboard—immediately apposing their scientific and political behavior and ours. The discussions are soundly rooted in the rich soil of history. There is a pictorial survey of over 100 pages, starting with the seal of the first Italian scientific academy and ending with a panorama of Moscow University, which presents the Russian intellectual heritage in science better than any other single reference in English with which I am acquainted. Recognition of the true place of Lomonosov, Sechenov, Pavlov, and even Popov (the Russian counterpart of Marconi) among the important minds that have advanced all mankind may some day replace the propaganda distortions from the Kremlin and the uninformed journalistic outcries that serve as the Western answers.

The second portion of the book brings up to date the important modern developments of post-Pavlovian physiology: brain stimulation and conditioned reflexes, electroencephalographic studies, and electrical correlates of conditioned learning. Although these three chapters are attributed to Robert W. Doty, Frank Morrell, and Robert Galambos, respectively, they are "group interchanges" in the now-familiar style of the Macy conferences. The naturalness and the clarity of the presentations reflect great credit upon the editor, Mary Brazier.

The conference is brought to an integrated wholeness by a thoughtful summation, led by Robert Livingston. He contrasts the monistic Russian physiology with our fractionalized approach and develops this significant thought (credit for which he shares with Paul MacLean): "Perhaps because of our philosophical as well as physiological isolation of visceral and somatic mechanisms, our political tradition has tended to look upon somatic and visceral needs as rather completely independent. Our physiological philosophy has a certain impact and bears a certain responsibility in relation to our Government's political actions and diplomatic relations, and especially with respect to how, as a people, we communicate our ideals to others. This becomes of particular concern at the present in relation to how the United States is viewed by the so-called uncommitted countries. Russia has . . . been much more sensitive . . . to the importance of visceral well-being and to the relationships which they conceive to exist between the physiological and social integration of man."

To paraphrase the thought in a more concrete example: the ideals of free enterprise sound better on a full than on an empty belly, but the fullest belly will not offset the insult of being considered inferior. The psyche and the soma are indivisible, and both must be satisfied.

If, indeed, science has a role as a bridge of understanding between the two great systems of politics confronting each other with gestures that augur ill for mankind, the area of investigations of the central nervous system appears to be particularly fruitful. It would be useful indeed if all American scientists read with care the proceedings of this conference. As a reviewer I have urged the translation into English of many a Russian book; this is one which we could profitably translate into Russian if it were possible to place a copy in each scientific institute of the Soviet Union.

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Electric Conduction in Semiconductors and Metals. W. Ehrenberg. Oxford University Press, New York, 1958. x + 389 pp. Illus. $10.10.

The three most active periods in the development of theories of conduction of electricity in solids are reflected in Ehrenberg's book. In the early years of the century, Drude, Lorentz, and others based their calculations on a model in which the outer or valence electrons of the atoms in a metal become detached to form an electron gas, which was treated classically. Shortly after the discovery of quantum theory in 1926, Sommerfeld, Houston, Bloch, and others showed that many of the difficulties of the earlier theories could be removed by application of quantum statistics and by taking into account the wave nature of the electron. During the next several years the foundations of the modern theory of solids were laid down and a number of excellent texts and treatises appeared. Basic to most of this work was the Bloch or one-particle approximation, in which correlations between positions of the electrons are neglected. In general, with a few notable exceptions, agreement between theory and experiment was qualitative rather than quantitative.

The past decade has been another active period, particularly in the field of semiconductors. Extensive theoretical developments, based largely on Wilson's (1931) energy band model, and well-controlled experiments with exceptionally pure single-crystals, have brought about a close coordination of theory and experiment. Recent work on the many-body problem has helped remove some of the limitations of the one-particle theories.

In the first four chapters, Ehrenberg discusses the theory of conduction in ionized gases, which is in many ways analogous to that in semiconductors, and presents in more detail than seems necessary the classical Drude-Lorentz type theory, with some modifications for quantum statistics and two-carrier models. Chapters 5 through 9 outline the wave-mechanical treatment. The one-particle approximation is used throughout, without apology or explanation. The last four chapters (10 through 13) cover some of the postwar experimental and theoretical work on semiconductors and transistor electronics. It is unfortunate that a book on such an active field should have been so long in preparation. It is evident that most of the text must have been written in 1955 or earlier; the latest date in the bibliography is 1955.

While the book has some valuable features, it is on the whole unsatisfactory. Theoretical derivations often are given in great mathematical detail, but uncritically and without first giving the reader an understanding of what is to be accomplished and what physical assumptions are involved. The book would be difficult for a beginner in the field and, moreover, not very rewarding if the aim is to get a real understanding of what has been accomplished and what outstanding problems remain. It is probably most useful as a reference volume or for supplementary reading on particular topics. The book is beautifully printed, in keeping with other Oxford University Press volumes.

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