distinguished scientists advance a radical, comprehensive, and, for a time, influential critique of capitalist science. To the extent that they aimed to change as well as understand the world, their efforts—unlike those of the Royal Society or the British Association—were ultimately unsuccessful. Their goals, their means, and the outcome of their efforts were essentially different from those of politically moderate or conservative actors. Little is gained, and a good deal of analytic clarity lost, in viewing these various individuals and institutions as participants in a single cause. To group under the same heading all those who shared a concern that science "be used for the benefit of society," irrespective of how that benefit was defined, or who promoted "greater integration of science and government," whatever its ends, is to lose the capacity to make important distinctions. McGucken has produced a well-researched, comprehensive, and useful account of British scientific institutions between the Depression and the end of World War II. But he has not convinced this reviewer, at least, of the need to abandon the conventional definition of the social relations of science movement.

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Researches in the Kaiserreich

Paul Ehrlich. Scientist for Life. ERNST BÄUMLER. Holmes and Meier, New York, 1984. xvi, 288 pp. + plates. $39.50. Translated from the German edition (Frankfurt-am-Main, 1984) by Grant Edwards.

Among the most celebrated factors contributing to the rise of Imperial Germany to the first rank of industrial and military powers in the last decades of the 19th century was the active promotion by the German state, through a variety of financial and institutional arrangements, of a close cooperation between industrialists and university-based research scientists. This policy of fertilizing practice with theoretical knowledge bore immediate fruit in the chemical and electrotechnical industries. But these new science-based industries were also a frequent source of stimulus to major scientific advances and even the creation of entirely new fields of research. The career of Paul Ehrlich (1854–1915) was linked with the development of one of these new fields, immunology. In drawing upon the invaluable archival materials of the Hoechst Pharmaceutical Corporation, Bäumler's timely scientific biography provides tantalizing suggestions concerning the relations between science, industry, and the state in the Kaiserreich.

Bäumler effectively explores the connection between Ehrlich and the chemical industry to illuminate every stage of his career and the development of his science. Once describing himself as a scientist with "blinders" on, Ehrlich single-mindedly pursued several lines of research based on the exploitation of the chemistry of aniline dyes. As a medical student working on his dissertation, Ehrlich concentrated on mastering the new structural chemistry developed by Kekulé and being exploited in the dyestuffs industry. This led to the development of staining techniques for identifying cell structures and classifying the various types of leukocytes. Ehrlich quickly moved on from morphological studies to develop vital staining techniques for investigating the physiological action and distribution of substances in living cells. The basis for this new direction was his detailed knowledge of the structure of dyes. Thus, in developing the notion that the physiological effect of toxins depends upon their fixation to a cellular structure, that toxins and antibodies exhibit specific affinities for one another determined by atomic groupings enabling them to fit together like lock and key, Ehrlich exploited conceptions from dye chemistry, where, for instance, appendages to the benzene ring were known as "side chains." In explaining the creation of antibodies Ehrlich assumed that atom complexes capable of performing subordinate nutrient functions attach themselves to structures in the protoplasm as side chains. The side chains in turn have predetermined affinities for particular toxins, which they attract and bind. Overcompensation and production of side chains result in the shedding of these appendages as antibodies. Ehrlich's "side chain" theory not only was the basis for further development of his ideas in immunology, including the theory that cancer is due to changes in normal cells caused by chronic chemical or physical irritation, it also served as the basis for his groundbreaking work in chemotherapy, which culminated in the development of Salvarsan for the treatment of syphilis. Equally significant, the theory of side chains guided Ehrlich in developing precise quantitative methods for determining the antibody content of sera and standards for dosage measurement, particularly of antidiphtheria toxin, for which he was awarded the Nobel Prize in 1908.

Though Bäumler's study is a valuable contribution, it is regrettable that he devotes only superficial treatment to the scientific institutions headed by Ehrlich—the Institute for Serum Testing in Berlin and the Georg Speyer Haus in Frankfurt. In spite of the rich archival sources at his disposal Bäumler has missed important opportunities to explore, for example, the "for profit" research done at the Speyer Haus and the extent to which Ehrlich's own research interests were shaped by this environment. His fleeting treatment of Friedrich Althoff ("Ehrlich's old friend and patron"), the most powerful member of the Ministry of Culture, who shaped the careers of men like Ehrlich, Koch, and Behring while actively promoting the construction of research institutes jointly funded by private industrial firms and the government, leaves us longing for a more thorough study of the relationship between such pharmaceutical giants as the Hoechst Corporation and the state.

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Magnetic Oscillations

Magnetic Oscillations in Metals. D. SHOENBERG. Cambridge University Press, New York, 1984. xxiv, 570 pp., illus. $97.50. Cambridge Monographs on Physics.

Our present understanding of the electronic properties of solids has largely resulted from the interplay between measurements that give direct information about the electronic band structure of materials and the theoretical calculation of these electronic band states. An important and essential element in this process is the experimental determination of the energy bands at the Fermi energy. Shoenberg's book is a comprehensive review of the many experimental and theoretical considerations involved in the acquisition and interpretation of data that map out these band states. The book also reviews recent advances that permit the detailed determination of fundamental electronic parameters that characterize individual electron states at the Fermi energy.

The first important experiments in this field were performed by de Haas and van Alphen, who, in 1930, discovered that at low enough temperatures a bismuth sample exhibited oscillatory behavior as a function of an applied magnetic field.