Book Reviews

Polymers and Patents

The Chain Straighteners. Fruitful Innovation: The Discovery of Linear and Stereoregular Synthetic Polymers. FRANK M. MCMILLAN. Macmillan, London, 1981. xx, 208 pp. £17.

In the 1950's Frank M. McMillan worked in what he calls the "golden age" of polymer research. Following Karl Ziegler's discovery of a catalyst that produces very long but unbranched polyethylene molecules, widespread research between 1953 and 1955 led to new nsights into the three-dimensional structure of polymers and to the discovery of new substances, such as polypropylene. McMillan's narrative, based primarily on interviews and correspondence with the people involved, focuses on this two-year burst of activity. A former polymer research and business development manager for Shell Development Company, McMillan is very familiar with the events he recounts.

Karl Ziegler's path to fame, fortune, and a Nobel prize began when he became director of the Max Planck Institute for Coal Research in 1943. Though not interested in coal research, Ziegler commanded a contract guaranteeing him autonomy in directing research and granting him rights to inventions that fell outside the interests of the sponsoring coal companies. After the war ended, Ziegler discovered that an organometallic compound, aluminum triethyl, linked ethylene molecules together into short unbranched chains. Previously, polymerized by high pressure, polyethylene exhibited chain branching. After Ziegler patented and publicized his discovery, several companies licensed the new catalyst. No important innovations followed immediately.

In 1953, an experiment in a reactor contaminated with nickel yielded very long- and straight-chain polyethylene. Additional experiments showed that mixtures of a transition metal and an organometallic compound produced these polymers. While Ziegler concentrated on his catalyst, researchers elsewhere took the next step by making polypropylene. No one pursued it very far, either in deference to Ziegler or in anticipation of his patents for it. Within a few months of the polyethylene discovery, Ziegler prepared polypropylene. Upon filing his patent application, he learned that Giulio Natta had filed one ten days earlier. As a consultant for Montecatini Chemical Company, which had licensed Ziegler's initial catalyst, Natta had kept track of Ziegler's research.

This incident created a rift between the two men who would share a Nobel prize in 1963. Natta's contribution, however, was cited as the determination of the relationship between the highly regular molecular structure and the physical properties of polymers made with Ziegler catalysts.

Since others had prepared polypropylene before Ziegler did, Natta's patent application launched a complex five-way interference suit that lasted 15 years.

McMillan details the activities of various companies, such as Hercules, Exxon, and Phillips Petroleum, in this new area of polymer chemistry and technology. Some of them made independent discoveries, and others depended on Ziegler licenses. Ziegler's catalyst provided the basis for new types of plastics and synthetic rubber with improved properties.

McMillan uses his case study to point out the critical factors that lead to fruitful scientific and technological activity. Since almost all the discoveries were unexpected, he argues that researchers need freedom to pursue interesting results instead of working mechanically toward predetermined goals. Ziegler's discoveries had an immediate impact because the news spread quickly via channels such as the respected polymer chemist and publicist Herman Mark. Upon hearing the news, researchers appreciated its significance. Polymer science and technology had progressed to the point where Ziegler's and Natta's contributions provided answers to pertinent questions. The expansion of polymeric products after World War II kept businessmen amenable to risking capital on new polymer ventures. Thus, flexible research management, effective communication, and proper timing led to rapid innovation.

Although these conclusions seem to be valid, McMillan draws some others that are not well supported by his case study. He notes that since Ziegler's discovery and Natta's work there have been no breakthroughs of the same magnitude. He does not accept the explanation that the major discoveries have already been made. He argues instead that the lack of significant innovation lies in the unwillingness of management, preferring to concentrate on cost-cutting process improvements, to take risks. This may be true, but it is not evident in his study.

At another point, McMillan maintains that Ziegler's lucrative contract reflects faith in non-targeted research even during the difficult circumstances of World War II. Yet he provides no evidence for this assertion. The sponsors of the institute may well have had other reasons for catering to Ziegler's demands.

This book gives an insider's view into the way in which multinational companies learn of new developments and scramble to stake out their claims in the new field. Ziegler's unusual situation aided the rapid diffusion of the technology. This created a competitive situation that led to a great deal of duplicated or wasted effort. The legal battle over polypropylene diverted energy from more productive pursuits. The case of polypropylene stands in marked contrast to other examples of innovation, such as nylon, that are solely the product of one company. Most cases probably lie somewhere between these two.

McMillan has assembled a considerable amount of information that is of interest to the historian of science and technology. This material could have been presented in a more straightforward and concise manner, however.

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The War Against Hookworm

The Germ of Laziness. Rockefeller Philanthropy and Public Health in the New South. JOHN ETTLING. Harvard University Press, Cambridge, Mass., 1981. xiv, 264 pp. $18.50.

Early in this century an estimated 40 percent of the residents of the southern United States suffered from hookworm infection, a malady that often led to iron-deficiency anemia and left its victims looking gaunt and sallow. Because of its enervating effects, journalists sometimes called it the "germ of laziness" and, especially in the North, identified it as the cause of the South's alleged backwardness. The offending parasites generally entered the human body through the