

packagers. The market results were similar to those in the case of penicillin. Tariff Commission data indicate that the realized price of streptomycin fell from \$2,866 per pound in 1946 to \$160 in 1950. Competitive market conditions did not prevent Merck from further research on streptomycin. In 1948 dihydrostreptomycin was marketed as an improved version of streptomycin, and the product patent was issued to Merck in 1950. Six firms were licensed, three of which were bulk sellers. The price of dihydrostreptomycin has closely followed that of streptomycin.

The marketing of the broad spectrum antibiotics in the late 1940's and early 1950's ended the competitive characteristic of the postwar antibiotic market. In late 1948 Lederle Laboratories, a division of American Cyanamid, introduced the first broad spectrum antibiotic, chlortetracycline, closely followed by Parke Davis with chloramphenicol. As both firms were fully integrated into direct selling the bulk market was bypassed. With the issuance of the product patents competition could be legally excluded. Evidence through 1960 indicated that neither company made bulk sales to packagers and all requests for domestic licenses were refused. The prices of these drugs were reduced from their introductory level of \$15 per bottle of 16-250-milligram tablets, reaching a floor in 1951 at \$5.10 and remaining constant until the opening of the Kefauver investigation in 1960.

In 1950 the Chas. Pfizer Company introduced the third broad spectrum drug oxytetracycline. While waiting for FDA clearance a sales force was organized, thereby avoiding sales in the bulk market. With the issuance of the product patent all requests for licenses were rejected. The marketing of oxytetracycline caused Lederle to reduce the price of its entry, with Parke Davis meeting the price cut. The last major broad spectrum drug was tetracycline, introduced in 1953 by Lederle, but also produced by Pfizer and Bristol Laboratories and sold by Squibb and Upjohn as a result of patent interference claims. The introduction of tetracycline did not disturb the broad spectrum price level nor were domestic licenses granted to other producers or sellers.

Thus an examination of the early narrow spectrum market indicates a competitive market structure at both the manufacturing and packaging levels. Competitive behavior can be observed in price as well as in product innovation. The availability of patents and forward vertical integration provided a means by which the broad spectrum innovators could escape the rigors of competition.

The examination of the antibiotic segment of the industry points up quite clearly the major flaw in the measurement of technological progress employed earlier. If the market is subject to some degree or form of monopoly control where firms can reach agreement not to compete on the basis of price, and prices can be maintained at relatively high levels, there is a tendency not to disturb these agreements through product innovations. This has the effect of decreasing the base and overstating the proportion of innovations which constitute technological progress. Having achieved control over price and profits the major stimulant to further research is removed. There is evidence from antibiotics that once market control is established further research in the therapeutic area ceases. First, it seems doubtful that tetracycline, introduced in 1953, is the ultimate broad spectrum drug. The strong patent positions of the manufacturers and Pfizer's aggressive defense of its patent on tetracycline undoubtedly reduce the potential profitability of this segment of the market for firms contemplating entry through research. The broad claims allowed in antibiotic patents would be a major factor in discouraging entry directed research. The potential entrant to be free of patent infringement suits would be forced to discover antibiotic producing micro-organism unclaimed by the established manufacturers. Surmounting this problem there remains the threat of infringement suits designed to harass. And unless the innovating firm is of equal size with its competitor the evidence indicates that a policy of harassment will be successful in forcing him from the market. Here one can cite the fact that Pfizer drove 33 smaller competitors from the tetracycline market between 1960 and 1965 by this method.

Second, there is evidence that Lederle, after the discovery and innovation of chlortetracycline abandoned research in this area until faced with serious competition from Pfizer in late 1952. In 1948 Lederle carried out experiments with chlortetracycline that produced a substance with antibiotic properties. In the patent dispute with Pfizer, Lederle claims that this substance was in fact tetracycline. But in 1948, Lederle dominated the broad spectrum market with chlortetracycline and evidently did not feel compelled to complete its experiment. But in 1952, with Pfizer's discovery of tetracycline Lederle "... resumed the 1948