Capturing the changes in the knowledge base underlying drug discovery and development in the 20th century and the adjustment of Bayer, Hoechst, Schering AG and E. Merck to the advent of modern biotechnology

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The so-called biotechnology revolution has changed the institutional and knowledge environment of the pharmaceutical industry. The industry incumbents have faced the challenge of adjusting to the new conditions for innovation in drug discovery and development. Drawing on the theoretical framework of the organizational capabilities of the firm, this contribution aims at capturing the changes in the knowledge environment and exploring the adjustment of 4 German corporations (2 companies rooted in the coal tar dyestuff industry and 2 traditional pharmaceutical companies) to the advent of modern biotechnology.1 Despite the firm-specific capabilities in organic chemical synthesis, the representatives of the coal tar dyestuff industry seem to have been better able to adjust to the external discontinuity in their knowledge environment. The existence of research and development activities, the science-based research tradition together with interactions to access the extramural knowledge base of the firms seem to have been crucial in the perception and adoption of the new technological possibilities of biotechnology after the 1970s, rather than prior competence in biotechnology or the employees with the skills to develop the capabilities to exploit it.

Introduction

In simple words the pharmaceutical industry shapes the business of discovering, developing, producing and commercializing drugs, i.e. products with therapeutic properties. Basically new drugs can be developed either with the application of organic chemical synthesis or from the separation of compounds produced by natural

1 Biotechnology refers to the processing of materials with biological agents to provide goods and services (BULL et al., 1982). The revolutionary discoveries in the 1970s of artificially controlled recombinant DNA enabled the direct manipulation of genetic material of biological agents involved in the processing of goods and services. The techniques of rDNA are the basis of modern biotechnology, which has created enormous expectations for industrial applications. The body of literature on innovation studies often uses the term “biotechnology revolution” to refer to this technological development. However, biotechnology has a long historical record (BUD, 1993).
microorganisms. During the 19th and 20th centuries scientific advances have contributed to the development of these technologies (Gamberdella, 1995). In the first decades of the 19th century, and until the 2nd World War, the scientific principles of organic chemistry guided drug discovery without providing understanding about the biological processes of diseases. In contrast, after a period of successful application at the beginning of the 20th century, biotechnology for drug production was more or less a niche technology in pharmaceuticals until the 1950s. With the discoveries of recombinant DNA (rDNA) and monoclonal antibodies in the 1970s biotechnology became a key tool for drug discovery and development and production. The era of modern biotechnology began. Accordingly, drug producers have been forced to develop new capabilities for the application of the new scientific advances (Santos, 2003; Galambos & Sturchio, 2003).

Contributions to innovation studies and explorations of industry dynamics and processes of creative destruction have chosen the advent of modern biotechnology in the 1970s to study, among other issues, the reactions of incumbents in the pharmaceutical industry to the shift in their knowledge environment. In general terms, these contributions do not consider explicitly the historical conditioning of technological change, a process where culture and history matter. An exception is Henderson (1994) which explores the development of the competencies of pharmaceutical companies involved in drug discovery in the last quarter of the 20th century.

This contribution is an empirical exploration of the major changes in the knowledge base underlying drug discovery and development and the ability of German drug producers to exploit the technological opportunities of biotechnology after the advent of modern biotechnology in the 1970s. The analysis explores the historical conditioning of the adjustment of firms to this technological discontinuity considering that the German corporations active in drug discovery and production come traditionally from two different sectors: the traditional pharmacy and the coal-tar dyestuff industry. Until the 1950’s both sub-sectors of the pharmaceutical industry were different in their organizational capabilities, their product lines and most importantly their attitudes towards the application of biotechnology.

The paper is organised as follows: the next section introduces the development of the German pharmaceutical industry and the major changes in the underlying knowledge base. Next, the theoretical and methodological framework to explore the adjustment of firms to technological discontinuities is sketched. The subsequent section

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