PENICILLIN AND THE RECONSTRUCTION OF JAPAN

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SUMMARY

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This paper explores postwar American strategies regarding penicillin in Japan. Perceived as both an American gift and a symbol of reconstruction, penicillin played a singular role in Washington’s postwar policies towards Europe and Japan. Washington encouraged US pharmaceutical companies to penetrate Europe but sought to protect intra-European trade. In Japan, however, importing penicillin from the US or establishing private American factories was forbidden. Jackson W. Foster implemented a smaller-scale, military-directed version of the US’s wartime penicillin project. In this paper, it is argued that the MacArthur administration aimed to boost Japanese penicillin production and transfer American industrial culture to Japan. This was initially a major success. However, the Japanese pharmaceutical industry failed to break down barriers to market entry established by first movers and, consequently, was uncompetitive throughout the twentieth century. This paper regards the American penicillin project in Japan as a factor in the weakness of the postwar Japanese pharmaceutical industry.

Penicillin and the reconstruction of Europe and Japan
By the end of the Second World War, it appeared clear to Washington policymakers that the recovery of Europe and Japan was essential to the interests of the US. In order to support their rearmament programmes, Nazi Germany and Japan established a series of bilateral

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agreements that gave them access to raw materials and allowed them to maximise their industrial production systems. Autarkic policies were considered the basis of totalitarianism and nationalism. Roosevelt emphasised that freedom could not survive in the US in a world dominated by the Axis powers, as the government would have to control the economy. The view of policymakers in Washington was that postwar Europe and Japan should be organised on the basis of a system of free, multilateral agreements, thus placing them beyond the influence of Soviet totalitarianism. Washington policymakers believed that a free, integrated European market would benefit both Europe and the US, and that European political systems and economies should be harmonised with those of the US. Thus, the US pressed Europe to introduce economic liberalisation measures. As Alan Milward’s reconstruction shows, the European Recovery Program – the so-called Marshall Plan – was the major instrument of such strategic economic and geopolitical design. In Japan, in contrast, the MacArthur administration attempted to perform a great social and economic experiment consisting of reconstructing a whole society in harmony with the American way of life.

Penicillin played a singular role in postwar American strategies due to its multifaceted nature. It was a wonder drug capable of saving millions of lives, one that American troops had brought to postwar Europe and Japan, and could therefore be portrayed as a powerful symbol of the age of peace and prosperity the US was bringing. However, penicillin was also an industrial product, the manufacturing of which led to major changes in the pharmaceutical industry. Together with the growth of healthcare systems, wartime research and production projects on antibiotics and other synthetic drugs, such as sulfa and anti-malarial drugs, generated what historians refer to as ‘a therapeutic revolution’. Between 1932 and 1969, sales of prescription drugs jumped from thirty-two per cent to eighty-three
per cent of all consumer expenditure on medical drugs.\textsuperscript{6} The production of such drugs required large investments, the construction of new facilities and the acquisition of marketing services to reach doctors and hospitals. Thanks to the revolution originated by penicillin, companies such as Merck, Pfizer and Glaxo were transformed from medium-sized firms to global companies\textsuperscript{7}.

This paper examines the particular role that penicillin played in the reconstruction of Japan. The MacArthur administration implemented a military-directed, large-scale penicillin production project aimed at boosting the manufacturing of antibiotics in Japan. This paper argues that the project also aimed to transfer American industrial culture to Japan’s pharmaceutical industry, and evaluates its short and long-term consequences in that regard.

Historians have focused on the American penicillin research project\textsuperscript{8}. Robert Bud has provided a crucial insight into the making of penicillin worldwide in the postwar years\textsuperscript{9}, as well as into the role the drug played in the UK and in postwar controversies between Britain and the US\textsuperscript{10}. Maki Umemura has described the development of the postwar pharmaceutical industry but has not investigated penicillin’s role in the reconstruction of Japan\textsuperscript{11}. In fact, the only reconstruction of the American large-scale penicillin production project in Japan has been provided by Yukimasa Yagisawa, one of the researchers actually involved therein\textsuperscript{12}.

The next section of the paper features a brief reconstruction of the large-scale penicillin project in the US, to show the similarities and differences between it and the large-scale production project carried out in the US during the Second World War. The third section focuses on the Japanese penicillin project, highlighting how it differed from the contemporary European penicillin projects. The paper’s final section consists of a general discussion of the role of penicillin in the US’s postwar strategies in Japan, Austria and Germany, the ex-Axis countries occupied by the Americans.
The American penicillin project

Large-scale penicillin production posed many problems, the most significant being that, due to its aerobic nature, penicillin required the medium on which it was fermented to have a large surface\textsuperscript{13}. Pfizer researchers introduced the vertical stirred tank fermenter and submerged fermentation techniques, which made penicillin production faster and cheaper. Nevertheless, in addition to requiring substantial investments and the expertise of biochemists, engineers and mycologists, establishing large-scale penicillin production was a long and difficult process, which involved numerous problems that often had to be solved on a day-to-day basis.

Pharmaceutical companies were reluctant to produce penicillin by fermentation. Doing so meant acquiring expertise in fermentation and designing entire new factories that ran the risk of becoming obsolete in just a few years, as chemists thought they would shortly find a method for producing penicillin by chemical synthesis\textsuperscript{14}. That turned out to be more difficult than expected, however. Consequently, penicillin was still being produced by fermentation in the 1940s and 1950s\textsuperscript{15}.

Having failed to attract the interest of the national industry or obtain strong support from the Medical Research Council, Howard Florey turned to the Rockefeller Foundation. Thanks to a grant from the foundation, Florey and his co-worker Norman Heatley travelled to the US. The British started collaborating with the Americans. The American government reached an agreement with the country’s pharmaceutical companies and, at the same time, began negotiating an agreement with the British government concerning patents on penicillin and its production. The American project was coordinated by the Office for Scientific Research and Development (OSRD). American pharmaceutical companies co-operated in the government-sponsored programme and shared information. A number of government agencies supported pharmaceutical companies at
different levels. The OSRD’s War Production Board co-ordinated production and allocated resources and raw materials. The Northern Regional Research Laboratory and, subsequently, the Food and Drug Administration worked on refining industrial penicillin production processes (submerged fermentation technology and penicillin strains). The OSRD’s Committee of Medical Research focused on clinical and chemical research and handled civilian requests for penicillin. The Office of Production Research and Development involved various universities in research on more productive strains of penicillin and on fermentation, and facilitated the circulation of knowledge amongst the different actors. Additionally, a number of new factories were financed with public money, and a project on the chemical synthesis of penicillin was carried out simultaneously. The final agreement between the UK and the US envisaged the OSRD allocating patents to firms on the basis of their contribution to penicillin research. It is worth noting that the agreement with the British allowed the Truman administration to use it as an instrument of its global postwar policies.

The large-scale penicillin production project in Japan

In 1947, Douglas MacArthur asked Jackson W. Foster, a former pupil of Selman Waksman, to organise and oversee penicillin research and production in Japan. The American occupation authorities wanted to quickly improve Japanese civilians’ health conditions in order to avoid social unrest and to contrast the Communists’ influence. Foster implemented a sort of smaller-scale, military-directed version of the US’s penicillin project. He set up central laboratories to carry out research on fermentation and purification, as well as a pilot plant. He also organised a three-day symposium to instruct researchers and technicians from university and industrial laboratories. No patents were disclosed, but the Americans passed on all their technical expertise and scientific knowledge. The Supreme
Commander for the Allied Powers (SCAP) directed the project by issuing licences for penicillin production and allocating resources to companies and laboratories that followed its directions. To protect national production, importing penicillin from the US was strictly forbidden. That was crucial to the success of the whole project, given that such imports would have covered the country’s needs more quickly and cheaply. It is worth noting that all European state-directed penicillin programmes failed, and that one of the reasons for that was that they could not compete with American penicillin, which was cheaper and of better quality. In 1944, the French Ministry of War, in collaboration with the Pasteur Institute and France’s two major pharmaceutical companies, Rhône-Poulenc and Roussel, decided to set up a state-run penicillin factory. As Jean-Paul Gaudillière and Bernd Gausemeier have reconstructed, the project failed because of tensions between scientists from the Pasteur Institute and military personnel. Military officials thought that production should begin as soon as possible, initially using surface fermentation technology, with facilities to be converted at a later date following the acquisition of submerged fermentation technology. In contrast, the Pasteur Institute microbiologists Federico Nitti and Jacques Trefouël thought that proprietary deep fermentation technology should be obtained, even if it took several months of research. In the end, the pharmaceutical companies withdrew from the project. Rhône-Poulenc acquired know-how and technology from Merck, and Roussel from Shenley. The public factory was shut down without having produced any penicillin. State-directed penicillin production was also envisaged in Britain and Italy, but did not cover internal demand. There was a major difference between the large-scale penicillin production project that Foster implemented in Japan and the one the OSRD had carried out during the war. In *Science, the Endless Frontier*, Vannevar Bush stressed that the American penicillin project, of which he was head, was not directed by the government:
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Penicillin reached our troops in time to save countless lives because the Government co-ordinated and supported the program of research and development on the drug. The development moved from the early laboratory stage to large scale production and use in a fraction of the time it would have taken without such leadership. The search for better anti-malarials, which proceeded at a moderate tempo for many years, has been accelerated enormously by Government support during the war. Other examples may be cited in which medical progress has been similarly advanced. In achieving these results, the Government has provided over-all co-ordination and support; it has not dictated how the work should be done within any co-operating institution 28.

In the OSRD-co-ordinated project, pharmaceutical companies played a prominent role in research and development. As Bush emphasised, the government supported and co-ordinated the project but did not direct it. In contrast, it was Foster who directed the SCAP’s project. The American occupation authorities aimed to enable Japan to autonomously produce penicillin on a large scale as quickly as possible. Waiting for the implementation of submerged fermentation techniques was simply not an option. Thus, the MacArthur administration implemented surface production initially and submerged fermentation production afterwards. Foster supervised research and production. Postwar Japanese discourse on reconstruction portrayed him as a benefactor of the country. In 1980, Yukimasa Yagisawa described Foster and his work in Japan in enthusiastic terms:

Next, Foster inspected almost all the penicillin factories located in different districts. His advice was very practical. The batch sheets, requested for presentation to the Welfare Ministry every month, were also very useful for companies. During his five-month stay in Japan, small-scale fermenters started operation in the factories of Banyu and Tokyo Rayon. Foster left Japan on March 25, but his plans and activities were maintained by us 29.

Foster’s inspection reports on the Japanese laboratories and factories are kept by the National Archives and Records Administration at
College Park. They make for interesting reading, as they reveal both Foster’s point of view concerning the project and the SCAP’s aims. The SCAP’s large-scale penicillin production project was part of a wider plan to implement American managerial and working culture in Japan\(^30\). In one of his reports, Foster claimed that: ‘like almost all Japanese companies, the management of this company does not comprehend the meaning of organised concerted action’\(^31\). Interestingly, he also complained about the Japanese technicians’ lack of initiative:

> Judged by American Standards the Japanese technical people are decidedly inferior in training, skill and fundamental scientific knowledge and moreover display an amazing lack of initiative and resourcefulness in coping with everyday production problems which would be solved in almost off-hand fashion by an American scientist under the same condition. Basically it seems to be a lack of ability to improvise. It should be stated, however, that where first class advanced technical people would be employed in an American factory, the Japanese employ young and inexperienced technical people who simply lack the ability to project the problem and meet its demands\(^32\).

Foster’s criticism of the lack of initiative shown by Japanese technicians in solving everyday production problems will come as no surprise to historians, as the very nature of the SCAP-directed project undermined creativity. Japanese laboratories aiming to develop proprietary technology were discouraged from doing so, whereas companies and laboratories that implemented technology and know-how provided by the American scientists and engineers met with encouragement. In another of his reports, Foster wrote:

> This company is in the early laboratory stages and production is negligible. It appears to have a first-class bacteriologist and chemist who have done some good systematic research. Indication of any experimental work on the submerged process was not even contemplated for the near future. The scientific people unfortunately were spending their time trying to develop new processes instead of simply working and applying to their conditions the American methods, proven of value after as much research.
Recommendations were made for a progress by which the company should be guided, and as well numerous practical improvements in their set-up and operations were offered. Present indications are that this company independently will not make a substantial contribution to the producing program.

These documents may seem to be contradictory, in that technicians were criticised for being incapable of showing initiative, while scientists were criticised for trying to understand biochemical processes and looking for new solutions instead of applying the American methods. However, the documents reveal that Foster understood that a quick technology and know-how transfer process where penicillin was concerned would mean Japanese industrial culture being harmonised with that of the US as soon as possible.

Concluding remarks
In the short term, the SCAP’s penicillin project achieved its goals. The production and quality of Japanese penicillin improved dramatically. Monthly production rapidly increased while prices fell. Compared to the contemporary French state-run project that never produced penicillin, the SCAP’s project was a major triumph. For the MacArthur administration, it was a symbol of the success of American efforts to bring peace and prosperity to Japan. Maki Umemura has argued that the American large-scale penicillin production project was the main reason for the relative strength of the postwar Japanese antibiotics sector. In the 1950s, Japanese university laboratories synthesised new antibiotics. In the postwar years, antibiotics became Japan’s main pharmaceutical export, and drugs licensed from Japanese to American firms accounted for twenty per cent of the US antibiotics market in the 1980s.

Nevertheless, the Japanese pharmaceutical industry remained weak in comparison to other sectors of the country’s industry, such as electronics or automobiles, as Japan’s pharmaceutical companies were
unable to break down the barriers to market entry established by first movers, namely economies of scale and scope which allowed them to quickly drop prices whenever a newcomer tried to enter the market\textsuperscript{38}. Umemura has argued that the main factors in the failure of the Japanese pharmaceutical industry were weak incentives for companies to invest in R&D, the Japanese medical culture and the government’s protectionist policies. The secondary factors she has identified are differences in therapeutic demand conditions between Japan and its potential export markets, different drug standards, the industrial structure of Japanese pharmaceutical firms, barriers to entrepreneurship among university academics and Japanese entrepreneurs’ lack of initiative in terms of expanding overseas\textsuperscript{39}. An analysis of the SCAP’s penicillin production project may help explain the weakness of the postwar Japanese pharmaceutical industry. The Americans aimed to transfer their industrial culture to the Japanese at every level (managers, researchers and technicians). The result of any knowledge transfer process is, of course, the product of the aims of the transferring party and the receiving party. The roots of some of the factors listed by Umemura lie in the SCAP’s project. Postwar protectionist policies were a continuation of the SCAP’s protectionist policy. Foster was critical of scientists undertaking risky, innovative projects instead of adopting well-known solutions. He also complained about other factors in the industry’s weakness, such as technicians’ lack of initiative and a too hierarchical managerial structure. However, the SCAP’s penicillin project was never likely to solve those problems, as the transfer of knowledge and know-how took place at the orders of the occupying authorities rather than being a conscious acquisition by the Japanese. A comparison with the transfer of knowledge and industrial know-how related to penicillin in the other ex-Axis countries occupied by the Americans and the Allies may be instructive. In Austria, Biochemie Gesellschaft became one of the largest producers of penicillin in the postwar years thanks to help from the French occupying authorities, which provided the Austrians
with penicillin strains\textsuperscript{40}. However, it was Austrian microbiologists and industrial managers who directed the project. Austria, of course, is a much smaller country than Japan. In Germany, the Allies allowed private companies to organise production. Schering AG had performed research on penicillin during the war, but discontinued it. After the war, Hoechst was the company that, having acquired technology from Merck & Co. Inc., produced penicillin\textsuperscript{41}. Both Biochemie and Hoechst were successful companies in the postwar period. Thus, the main difference between the way in which the occupying authorities acted in Austria, Germany and Japan lies in the fact that the SCAP-directed project also aimed to accelerate the harmonisation of the Japanese industrial culture with that of the US. As Gary Herrigel has pointed out, the consequences of the American occupation of Germany and Japan were similar in a way where the steel industry was concerned. In both cases the Americans aimed to break up a concentration of political and economic powers and to create societies based on counterbalanced powers, a strong middle class, trade unions, market competition and efficient industrial oligopoly. Those policies resulted in the creation of hybrid firms, industrial structures and market strategies which turned out to be more efficient than both their pre-war counterparts and the models the Americans aimed to implement. Nevertheless, the case of the steel industry differs from that of penicillin in that, in the former, the Allies did not insist on the Japanese and Germans adopting a specific technology or industrial practice\textsuperscript{42}. In the case of penicillin, in contrast, the Allies acted differently in each country. As indicated, in Austria and Germany their policy was no different from those they applied in other industrial sectors, whereas in Japan they implemented a large-scale, military-directed penicillin production programme. The German and Japanese pre-war pharmaceutical industries were radically different in size, technological sophistication and industrial organisation, the former being a first mover in the market and the latter a latecomer thereto. Those pre-existing differences and the contrasting
measures of the occupying authorities led the two countries’ pharmaceutical industries to develop in different ways.

BIBLIOGRAPHY AND NOTES

General Bibliography


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6. TEMIN P., ref. note 5.

9. BUD R., ref. note 7; see also HOBBY G., ref. note 8.


13. HOBBY G., see note 8, p. 96.
14. HOBBY G., see note 8; NEUSHUL P., see note 8.
15. It was not until 1959 that Sheehan synthesised penicillin. Fermentation remained the most efficient method of production, however. See NEUSHUL P., see note 8, p. 384; see also SWANN, ref. note 8.
16. NEUSHUL P., see note 8, p. 388; RASMUSSEN N., see note 8.
17. SWANN J.P., see note 8, pp. 167-8.
18. SWANN J.P., see note 8.
19. BUD R., see note 7, pp. 179-80.
20. On Jackson W. Foster (1914–1966), see YAGISAWA Y., ref. note 12; and BUD R., ref. note 12.
21. UMEMURA M., see note 11.
22. YAGISAWA Y., see note 12.
23. YAGISAWA Y., see note 12; BUD R., see note 7; and UMEMURA M., see note 11. On the American policy in Japan, see SCHALLER M., ref. note 4; and COHEN R., see note 4.
24. The acronym SCAP denoted both Douglas MacArthur and the American occupation administration. In this paper, it is used to refer only to the latter.
29. See YAGISAWA, see note 12.


34. YAGISAWA Y., see note 12.

35. See UMEMURA M., ref. note 11, p. 33.

36. See YAGISAWA Y., ref. note 12.

37. See UMEMURA, ref. note 11, p. 33.


39. See UMEMURA M., ref. note 11.

40. BUD R., see note 7, pp. 91-2; KOENIG J., Die Penicillin-V Story: eine Erfindung aus Tirol als Segen für die Welt. Innsbruck, Haymon Verlag, 1984.


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