analysis. His collaborators were few but well chosen: Ahlfors, Deny, Helson, and Malliavin. Probably it was his impressive collaboration and deep friendship with Lars Ahlfors that landed him the position of permanent member at the Institute for Advanced Study in Princeton, New Jersey, in 1954. In Princeton, he took over the office previously occupied by Albert Einstein. It is unfortunate that Beurling was not able to continue on American soil the extremely productive period he enjoyed in Uppsala in the 1940s, with students such as Göran Borg, Lennart Carleson, Yngve Domar, Carl-Gustav Esseen, and Bo Kjellberg. Had he been able to wield more influence in Princeton, the period of abstraction in mathematical analysis, which was such a dominant theme in the 1950s and 1960s, might have been balanced by a deep and elegant approach that focused not on form but on content.

Bengt Beckman has produced a fascinating book that acquaints us with some of the stars of 20th-century Scandinavian mathematics. In addition, we gain some insights into basic cryptology.

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From Newspeak to Cyberspeak. A History of Soviet Cybernetics

by Slava Gerovitch

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REVIEWED BY PAUL JOSEPHSON

Most readers know of the impact of ideological interference in the practice of Soviet scientists. In the case of biology, the peasant agronomist Trofim Lysenko rose to the top of the scientific establishment with Stalin's personal endorsement. He advanced Lamarckian notions of the influence of acquired characteristics that supplanted genetics. After a 1948 national conference that proclaimed Lysenkoism the only true Soviet biology, dozens of geneticists lost their jobs and were exiled from the laboratories to sheep-breeding farms at the end of the empire; and genetics was purged from university curricula. In physics, too, several scientists joined ideologues in an attack on quantum mechanics and relativity theory. The attack nearly had disastrous results for physicists, many of whom were forced to abandon research. In both of these cases, questions of epistemology, class struggle, and other issues of importance in the official Soviet philosophy of science, dialectical materialism, played a role, as did Cold War pressures to promote a new, Soviet science that was different from, and better than that in the West, particularly in the United States.

In a superb contribution to the history and philosophy of science, Slava Gerovitch considers the place of cybernetics in Soviet philosophical disputes, and the development of what he calls "cyberspeak" in the postwar USSR. Gerovitch, a research associate at the Dibner Institute, has studied the history of Soviet computing and cybernetics for some time, and beyond *From Newspeak to Cyberspeak*, is now focusing on human–machine interaction in the Soviet space program. *Cyberspeak* he defines as a universal language of man–machine metaphors described in such terms as information and feedback and control, e.g., the organism as an entropy-reducing machine, the computer as a brain, the brain as a computer. Gerovitch joins several other scholars in rejecting the notion that cybernetics was severely damaged by ideological interference in the form of such official pronouncements that cybernetics was a "reactionary pseudo-science." That interference was relatively short-lived, and scientists learned how to manage it.

Yet the fact that attacks were short-lived and ignorant should not lessen our appreciation of the way in which they reflected the dangers of doing science in the USSR generally. Those who carried on the anti-cybernetics campaign employed accepted ways of discourse and dispute to rescue their careers and grind their axes. These activities surely are seen in the West, but not with the fury and lasting costs to people and fields of research. Perhaps, as Gerovitch implies, because cybernetics was needed for radar and rocketry, the Cold War saved it from further attacks—in the way that research on the atomic and hydrogen bombs saved relativity theory and quantum mechanics from ideological interference.

Gerovitch provides a detailed discussion of what made attacks on cybernetics possible in the first place in a discourse that took place between the language of cybernetics and the language of Soviet ideology. He asserts that the ideological language was much more flexible than many historians have gathered. Soviet scholars learned to play by the rules of the establishment—the government bureaucracy and Party apparatus—in their rhetorical styles, modes of thought, and arguments to defend cybernetics. Like their opponents, who saw in cybernetics idealism, "kow-towing" to the West, among other dangers, they turned to quotation-mongering and label sticking (what others have called the "quote and club" method) to put them on the defensive. Gerovitch shows that the postwar ideological campaigns lacked coordination and coherence; they were rarely orchestrated from the top down.

In fact, Soviet cybernetics developed along many of the same lines along which cybernetics developed in the West. Such scientists as Andrei Kolmogorov and later Alexei Liapunov contributed to the foundations of cybernetics. Gerovitch discusses the work of these scientists against the background of comprehensive analysis of the contributions to the field of Norbert Wiener, Arturo Rosenblueth, and Claude Shannon.

Although cyberneticians were adept at disputation, there were significant pitfalls that awaited them until after Stalin's death. Their contributions were measured against the standards of the West, but they were required to avoid showing contamination with Western ideas. Soviet scholars had to avoid falling behind the West in computing and simultaneously following Western trends too closely. At the same time, a Cold War ideological battle against the West led to the cutting off of international contacts. Intellectuals were forced to toe the Party line. In this environment, the boundaries between academic and political disputes disappeared.

An important facet of the history of computer science and the first Soviet computing machines was the connection between cyberneticians and their powerful military and Communist Party patrons. One such example is Mikhail Lavrent'ev, who, as director of the Institute of Computer Technology, received facilities and protection from the new Moscow City Party Chief, Nikita Khrushchev. Later, as Party leader, Khrushchev enabled Lavrent'ev to found the Siberian city of science, Akademgorodok, with its own new Computer Center in the late 1950s. When it came to military purposes, computers were a technology without ideological deviations.

After the death of Stalin, in the mid-1950s Soviet computers were deified and entered the public realm, no longer to be held under wraps of military secrecy. Cyberneticians touted computers as paragons of objectivity based on quantitative knowledge, precise language, and precise concepts. They also commenced an attack against past ideological interferences of the philosophers and their allies among scientists and Party officials. Gerovitch's discussion of the battle against dogmatism and calcification of philosophical discourse under Stalin at this time is engaging. Ultimately, Gerovitch writes, cyberneticians "overturned earlier ideological criticisms of mathematical methods in various disciplines and put forward the goal of the 'cybernetization' of the entire science enterprise" in search of objectivity in the life sciences and social sciences alike. (p. 199) This conclusion reinforces the sense that an excessive scientism developed in the USSR.

In the 1960s cybernetics became a full-fledged science in the Soviet establishment. It found an institutional home in a council of the Academy of Sciences of the USSR, experienced rapid institutional growth, and saw a new publication, *Problemy kibernitiki*, which was one of the most influential such publications in the world. Its promoters claimed that cybernetics had become a universal, objective language, and as such would break interdisciplinary barriers and legitimize the use of mathematical methods in other sciences. Its power was evident in the fact that even before Lysenko was deposed, cyberneticians promoted genetic research in physics and chemistry institutes, speaking about genes as units of hereditary information. Supporters thought cybernetics might be a panacea for reforming the Soviet economy through the creation of "optimal" models for planning and management. But scientists ultimately realized that central mainframes in large-scale systems to centralize input and output calculations for such a huge economy were simply unfeasible.

Once institutionalized, Gerovitch concludes, cybernetics became part of the Soviet establishment in service of the nation's management, administration, direction, and government purposes. The goal was to control the entire national economy, technological processes, and so on, to ensure optimal governance. An alliance between cybernetics and dialectical materialism followed in the early 1960s. In the end, cyberspeak became so much a part of establishment thinking, so much the mode of dominant discourse, that its supporters grew disillusioned with efforts to apply it willy-nilly. Fissures in the cybernetics community as in Soviet society itself created new disputes. Some scientists had grown increasingly conservative and anti-Semitic, while others joined the dissident movement to protest increasing violations of human rights under Leonid Brezhnev. This suggests that scientism or not, cybernetics, like other sciences in other countries, could not avoid reflecting the social, political, and cultural norms of the nation in which it developed.

Gerovitch only touches on reasons why the USSR failed to embrace the computer revolution, some of which have roots in the debates over "thinking machines" that occurred from 1950 to 1965. He does not consider the decision to build computers based on reverse engineering after so many decades of success in building indigenous machines. In addition, because his focus is on philosophy and intellectual history, some readers will need to seek other sources to gather the impact of the broader context of Soviet history and politics on cybernetics.

Gerovitch's study is based on a thorough use of archival materials and unpublished memoirs and interviews. This book will be of interest to advanced undergraduate students, graduate students, and teachers, as well as to computer scientists, historians, and philosophers. I recommend it highly.

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Traditional Japanese Mathematics Problems of the 18th and 19th Centuries

by Hidetoshi Fukagawa and John F. Rigby

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Japanese Temple Geometry Problems San Gaku

by Hidetoshi Fukagawa and Dan Pedoe

WINNIPEG, THE CHARLES BABBAGE RESEARCH CENTRE, 1989. 206 PP. US$40.00 ISBN 0-919611-21-4

REVIEWED BY CLARK KIMBERLING

The best thing about these books is their content, which is based on problem proposals carved and drawn on Japanese wooden tablets dating from a span of isolation from the West. During that time Japanese mathematicians developed their own "traditional mathematics," which, in the 1850s, began giving way to Western methods. There were also changes in the script in which mathematics was written, and as a result, few people now living know how to interpret the historic tablets. One of these is Hidetoshi Fukagawa, the Japanese author of the two books. The 1989 book opens with these words:

> A selection from the hundreds of problems in Euclidean geometry displayed on devotional mathematical tablets (SANGAKU) which were hung under the roofs of shrines or temples in Japan during two centuries of schism from the west, with solutions and answers.

Implicit in this description is the definition of *sangaku* (often written *San gaku* and *Sangaku*). The phrase "with solutions and answers" applies to the books, not the *sangaku*. Dan Pedoe, co-author of the 1989 book, explains in the Preface:

> There were few colleges or universities in Japan during the period of separation from the west, but there were many private schools, and obviously many skilled geometers who wished to thank the god or gods for the discovery of a particularly lovely theorem, and also, it may be guessed, who were not averse to displaying their discoveries to other geometers . . . with the implicit challenge: "See if you can prove this!"

The 2002 book continues the collection with additional problems and solutions. For both books, many of the solutions use modern methods. With admirably little overlap in content, the *two* books give historical descriptions, photographs, figures, calligraphy, solutions, and references, all well focused on *sangaku*. For a broader context, one may cite Chapter 22 of Yoshio Mikani's *The Development of Mathematics in China and Japan*, second edition, Chelsea, 1974 (originally published in German, 1913).

Mikani places *sangaku* in the perspective of Seki Kowa, who has been called the Japanese Newton and father of Japanese mathematics. Although Seki's lifetime (1642–1708) preceded *sangaku*, his influence in algebraic and analytic methods set the stage for *sangaku*. Mikani writes, "The highest development of the Japanese mathematics must of course be looked upon as the invention of . . . 'circular theory' "—and it is precisely the enchantment of circle-problems that pervades *sangaku*. Indeed, a majority of the problems in the 1989 and 2002 books involve circles.

One of the foremost mathematicians represented in *sangaku* was Ajima Chokuen (1732–1798). (The family name is Ajima. The given name Chokuen is used in the 1989 book, but the more formal given name Naonobu is used in the 2002 book.) The two books contain a number of spinoffs from Ajima's famous problem about three pairwise tangent circles inscribed in a triangle. A view of Ajima's place in the books provides insights into the organization and mathematical tone of the two books and also gives insights into the work of one of the leading representatives of Japanese "traditional mathematics" (as it is called in the 2002 book).

On pages 28–30 of the 1989 book, Example 2.3 and Problems 2.3.1 to 2.3.7 are presented under the heading "Three Circles and Triangles," followed by Examples 2.4(1) and 2.4(2) and Problems 2.4.1 to 2.4.7 under "Four Circles and Triangles." The presentation is in two-column format with figures in the right column. Each problem proposal is labeled "Example" or "Problem." Here are three items from the 1989 book:

> **Example 2.3:** The three circles, $O_1(r_1)$, $O_2(r_2)$, and $O_3(r_3)$ have external contact with each other. The triangle ABC is formed by the common tangents to the circles. Find the radius of the incircle of triangle ABC in terms of r_1, r_2, and r_3.

> **Example 2.4(1):** $I(r)$ is the incircle of triangle ABC, and the circles $O_1(r_1)$, $O_2(r_2)$, and $O_3(r_3)$ respectively touch AB and AC, BA and BC, and CA and CB, and all touch $I(r)$ externally. Show that
>
> $$r = \sqrt{r_1 r_2} + \sqrt{r_2 r_3} + \sqrt{r_3 r_1}.$$

> **Problem 2.4.1:** ABC is a triangle, $I(r)$ its incircle. The circle $O_1(r_1)$ touches AB and AC produced and