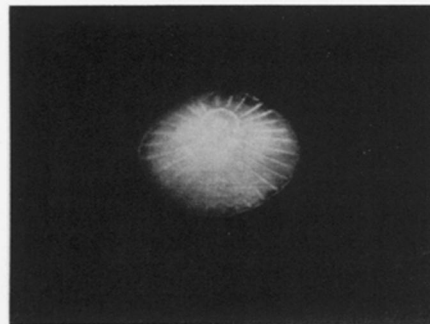
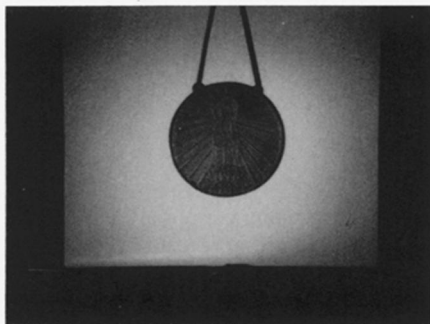


INSCRUTABLE INSCRUTABLE

By DIETRICK E. THOMSEN

Now we see only puzzling reflections in a mirror, but then we shall see face to face.
(1 Cor. 13:12)



Photos: Garmo

Makyo were frequently donated to temples, where they seem to contribute to spiritual perception. This one casts an ethereal image of Buddha (right).

To some people a mirror is simply a convenience to use when combing one's hair or engaging in some similar necessity. To others, however, down through the ages, mirrors have revealed a good deal more. It may be, as in St. Paul's remark quoted above, a fleeting glimpse of an otherwise invisible spiritual reality. It may be the engaging skewed fantasy world of Lewis Carroll's *Through the Looking Glass*. Or it may be, as in the Buddhist teaching prevalent in Japan, that a mirror is expected to reveal the inner qualities of the person looking into it (as it does in many western folktales, too).

This expectation gives mirrors religious significance in Japan, particularly the *makyo*, or magic mirrors, which cast very puzzling reflections indeed. The *makyo* are mirrors of polished bronze with a design cast into their backs. The designs are usually religious, a figure of Buddha or a quotation from Buddhist scriptures. If the

makyo are made to reflect light onto a *shoji* screen or other kind of a screen, the image on their backs appears in the projection.

What makes them do that? If the question ever occurred to the monks who inhabited the temples in which many *makyo*

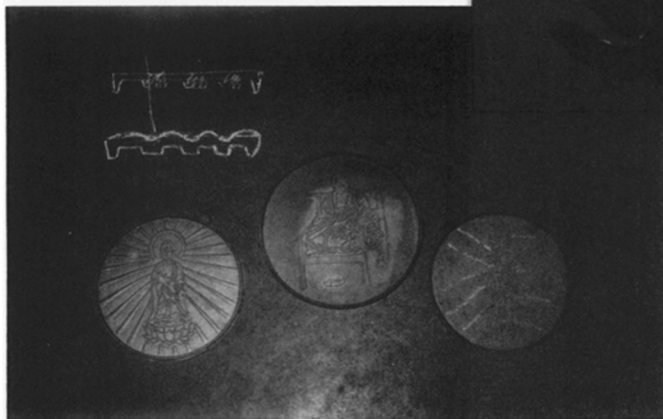


When a makyo reflects light, the design inscribed on its back shows up in the reflection (above). Typical designs include figures of Buddha and famous quotations (left).

were hung (they were a favorite thing to give to a temple), pursuit of the question was most likely rejected as unBuddhist or unmonastic. The question did, however, occur to the European scientists who came to teach in Japan in the middle of the 19th century as part of the Meiji emperor's program to bring Japan back into contact with the rest of the world after centuries of isolation under the Tokugawa shogunate. And the question occurred to the Japanese disciples of those scientists as well. Some progress in understanding the mystery has been made, but the details are still elusive.

The *makyo* were invented in China during the Han dynasty. Japanese craftsmen produced them for centuries, but in recent times the technique was abandoned until it was revived by a family in Kyoto named Yamamoto. Japanese television has made a documentary film showing how Horyu Yamamoto makes a magic mirror. Hideya Gamo of the University of California at Irvine showed the film at the recent meeting in New Orleans of the Optical Society of America. The film contrasts the hurly burly of modern Japan, freeways, fast trains, crowds of people bustling around in cacophonous cities, with the meditative quiet of the gardens in Kyoto and the solemn concentration of Yamamoto's workshop.

The making of a *makyo* begins with pouring the molten metal (85 percent copper, 10 percent tin, 5 percent lead) into a mold that carries the design to appear on the mirror's back. The film follows Yamamoto through the rough shaping of the



MIRRORS WIBBLES

Japanese and Chinese 'magic' mirrors throw mystifying images

face to finer and finer polishing. Consistent with the holistic Japanese attitude toward life, the making of the mirror is a ceremony with religious overtones as well as a piece of artisanship. The workers put on ceremonial clothing for the final stages of polishing.

Western scientists became interested in *makyo* in the middle of the nineteenth century. The first scientific paper about them was by the Englishman Robert W. Atkinson in *ASIA* magazine in 1877. In the late 19th century the mirrors got on the lecture circuit in the United States, and a presentation at Ohio State University so fascinated the students that they named their literary magazine *MAKYO*.

More recently the Chinese have succeeded in reproducing the Han dynasty technique, and Chinese scientists Ruan

Chong-Wu and Mao Zeng-Dian have subjected them to optical and metallurgical analysis by holography and X-ray structure analysis. The Chinese regard them as light-penetration mirrors, that is, that their effect depends on what happens to the light that penetrates them. But Gamo, in a paper presented at the Optical Society meeting, contends that "the essential elements in the image-formation process are slight changes in curvature on the reflecting surface that are dependent on the patterns marked on the back, as was discussed by Sir William Bragg in the *Universe of Light* (1933)."

Whatever scientists may eventually decide about the details of the mechanism, the mirrors continue to hang in the temples catching sunlight and throwing sacred images here and there. □

Continued from page 29

tional burners and its CO is at or below levels typical of existing burners. Finally, the new burner is believed to have great eye appeal.

All this doesn't come cheap. Hurley says one could expect to see the burners only on the "Cadillacs" of ranges. However, Caloric Corp., a range manufacturer cooperating on design of the IR-jet burner, is interested in seeing this concept developed. "It's a saleable burner," says Marlow Kroninger, director of product reliability for Caloric in Topton, Pa. Caloric plans to provide ranges — each containing two conventional and two IR-jet burners—for field testing this summer. Provided they pass "the oatmeal test" — surviving regular use and spills with easy clean up—he says Caloric could begin marketing ranges in the medium and high ends of its product line within three years.

Finally, now that GRI believes it has solved the problem of range-top emissions, it has commissioned DeWerth and colleagues to begin working to lower NO_x in range ovens and broiler burners. Roughly half the gas used by a kitchen range is burned in ovens and broilers, so this makes a natural complement to the other projects. DeWerth also expects this project "is going to be a lot easier" — particularly since the eye appeal of these NO_x-related modifications will be relatively unimportant. □

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