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U.S. Eyes Over Russia

Satellites Focus on Soviet Secrets

Second of three articles

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The U.S. government has never released photographs taken by its best spy-in-the-sky satellites, although some officials of the Carter administration hope to convince the Central Intelligence Agency to do this during the coming debate on the strategic arms limitation treaty (SALT II).

By all accounts, those photographs

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are remarkable—"really beautiful, beyond all comparison," in the words of Amrom Katz, a pioneer in the field of space photography. Katz, a former government official, is not convinced that good pictures are enough to catch the Soviets if they try to cheat on SALT II, but he does not challenge the clarity or utility of those photographs.

A classic boast involves a golf ball on a green—American satellite cameras could pick it up, the experts say. The example may not be too significant, since the Soviet Union does not have a golf course, and golf balls are not strategic weapons. But the metaphor makes an accurate point about the satellite cameras' abilities.

The first article in this series discussed U.S. methods for monitoring the testing of Soviet intercontinental rockets. Testing, of course, is not the only subject that interests the United States. American intelligence analysts—thousands of them—are trying to learn whatever they can about the production of Soviet rockets, submarines, aircraft and other weapons and about their deployment, storage and use.

It is in these areas that photo reconnaissance becomes crucial. Squadrons of satellites—Big Birds, KH11s and others—orbit the earth, their paths making tight cross-hatch patterns over the Soviet Union every day.

The precision and clarity of photos from space depend on the focal length of the camera and the grain or number of lines per millimeter of the film used. A recent, unpublished paper by Bruce G. Blair and Gary D. Brewer of Yale estimates that present cameras can distinguish an item on the ground if one of its dimensions exceeds three or four inches.

This is probably the outside limit for cameras in space, given the distortions created by the earth's atmosphere, though specialists say there is still room for some further refinements.

The United States relies on two basic kinds of photo satellites, one which takes pictures of broad areas on earth—"search and find" satellites—and a second which can take closeups of, say, a single missile launcher, known as "close-look." According to Blair and Brewer, some satellites can do both.

According to an analysis published six years ago, search-and-find satellites then included systems that allowed for on-board development of photographic film. Electron scanners can then "read" the processed picture and transmit it to earth. This technology may already have evolved to the point that the United States can receive instantaneous pictures the equivalent of television transmissions from satellites over the Soviet Union.

Close-look satellites swoop as low as 80 miles over a target, photograph it and jettison the film, which can then be caught in mid air by aircraft or swept off the surface of the sea by helicopter.

Satellite orbits are intricately planned, so that the same satellite crosses the same spot over the Soviet Union at the same time every day. This minimizes the chance that changing shadows might confuse photo analysts. Reconnaissance satellites apparently transmit electronic images to relay satellites in space, which in turn send the images to earth stations as they pass over them.

But the technology has gone far beyond simple photography. U.S. satellites also carry "multispectral scanners" which read light emissions outside the visible range.

Images recorded by multispectral scanners, which extend into the infrared range, can be separated into electronic messages and transmitted to earth. With the help of computers, analysts can construct "false color" pictures of scenes on the ground, an approach that does not rely on the natural color of objects but rather helps identify what they are made of.

In an example cited by Blair and Brewer, an ordinary picture of a missile silo cover painted green and covered by green leaves or needles of a tree would probably not be noticeable to the eye or in an ordinary photo. But a false-color picture of the same scene could make the paint appear blue while the foliage looks bright red.

Computer processing also allows for sophisticated image enhancement techniques, described in a new pamphlet on verification to be published this month by the Union of Concerned Scientists:

"Computers disassemble a picture into millions of electronic Morse code pulses, then use mathematical formulas to manipulate the color, contrast and intensity of every tiny spot. Each image can be reassembled in various ways to emphasize special features and highlight specific objects that were buried in the original view.

"Electronic 'subtraction' of earlier pictures from later ones makes unchanged buildings or landscapes in a scene disappear while new objects (like missile silos under construction) stand out."

In the foreseeable future the United States expects to be able to deploy radar scanners in space, a potential breakthrough that could compensate for the most basic shortcoming of all existing kinds of photo reconnaissance—their dependence on daylight and clear skies.

The Apollo 17 moon mission carried side-looking, synthetic aperture radar that could record remarkably good images of the moon from a distance of 60 miles. Larger radars that could be sent into space on the new space shuttle presumably could do much better.

With all the available tools American analysts study what they can see on Soviet territory. (Thousands of people are said to be engaged in this work.) They locate and monitor factories that produce armaments, watching not only for finished products coming out of these plants, but also calculating the amounts and kinds of raw materials that go into them.

The analysts scrutinize Soviet test sites, missile launching silos, submarine construction and sea trials, rail lines that transport military equipment, airfields and the like. They try to explain the function of every suspicious-looking installation they can identify, measuring the manpower stationed at each or trying to define the visible activities around the installation.

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