Approved for Release: 2014/09/10 C01407029 (b)(3)(c)

~~SECRET//X1~~

Previous Next Contents

*Science and Tradecraft*

# Origins and Applications of Nuclear Intelligence (U)

*Henry S. Lowenhaupt*

Looking back, it is amazing how close the US government's continuous search for technical information on the Soviet nuclear program was to the cutting edge of technology. By that I mean that in designing the technical collection tools and analyzing the results of collection operations, the latest ideas in both science and technology were used. Moreover, the sophisticated tools and techniques brought to bear on nuclear intelligence problems often provided breakthrough solutions to civilian problems as well. (U)

Of course we all knew we were in a gut match with the Soviet Union. Their focus on national security was beyond anything previously known for a big country. We were aware that "obtaining the bomb" was a top priority for Joseph Stalin: the construction and research activities of the First Chief Directorate of the Council of Ministers (their atomic project) had a priority exceeded only by actual troop movements. (U)

(b)(1)

## Nuclear Collection in World War II (U)

The first attempt to use cutting edge technology in nuclear intelligence came near the end of World War II. It involved the development of a new approach to estimating the production rate of mines using aerial photography when the mines were sequestered in enemy territory. Mining engineers steeped in the technical literature on the Joachimstahl uranium mines in Czechoslovakia analyzed aerial photographs of the enterprise taken a year apart. The postwar surprise was how accurate their estimates were: the Germans had not had access to multi-tonnage amounts of uranium after all. This was the start of the use of professional technical experts for understanding aerial imagery of complex technical, especially nuclear, targets. (U)


Approved for Release: 2014/09/10 C01407029

Approved for Release: 2014/09/10 C01407029 (b)(3)(c)

(b)(1)

The Chicago scientists soon developed a means for measuring the radiation of highly radioactive xenon with its 5-day half-life. To use this tool successfully, however, we would need to deploy the instrumentation in safe locations within a hundred miles or so of suspect nuclear sites. Accomplishing this as our troops fought their way across Germany, needless to say, was not a very realistic possibility. (U)

In contrast, radio-krypton with its 10.4-year half-life could be collected at much greater distances from potential targets. At the time, however, there was no known way to analyze it in any sort of quantitative and duplicable manner. Dr. Willard Libby, then at the University of Chicago, took on the task. He found a way to analyze krypton-85 as a gas in a kind of Geiger tube, using an array of Geiger tubes surrounding the specimen to detect and subtract the cosmic ray background. This gave us a useful tool. (U)

Building on his national security work, Dr. Libby, full of ideas as usual, continued his experiments using carbon dioxide gas. His purpose became to learn how to measure the naturally occurring carbon-14 in carbon dioxide. He succeeded. Carbon-14 measurement is now a standard means of dating prehistoric remains and has revolutionized the prehistory of Europe and the Middle East. Dr. Libby received the Nobel Prize for Chemistry in 1960 for his work on carbon-14 dating. (U)

**Detection of Nuclear Detonations (U)**

Soon after the war was over, it became clear that the USSR was doing everything possible to develop a nuclear weapon, including committing espionage against the United States and ransacking East Germany for scientists and technicians with skills applicable to nuclear research. Moscow established an enormous uranium mining effort in East Germany labeled Wismut A. G. (Bismuth Incorporated). Likewise, it commenced large uranium mining operations in Czechoslovakia, Bulgaria, Estonia, and Soviet Central Asia. Given the tight security practiced by the USSR, finding some means of determining when the first Soviet nuclear test would occur became of crucial importance. (U)

In 1947, Washington brought together an interagency scientific task force whose objective was to determine how to detect foreign nuclear weapon detonations using exceptionally long-range technical techniques. Col. Frank Valente—a former professor of physics at Columbia University and the Army's scientific expert during the construction of Oak Ridge National Laboratory in Tennessee and the Hanford Reactor Site in Washington state—represented the Manhattan Engineering District (the US Atomic Project), and, later, CIA. Dr. Lester Machta, a young genius in the weather forecasting field, assisted the Air Force team. Several outstanding people represented the nuclear laboratories, including "Spof" English, an eminent radiochemist with the Atomic Energy Commission (AEC).



Approved for Release: 2014/09/10 C01407029

Approved for Release: 2014/09/10 C01407029 (b)(3)(c)

(U)

(b)(1)

The task force's priority recommendation was to develop high volume filters that could be deployed on (b)(1) designated aircraft. Aircraft equiped to collect large volumes of aircraft and analyze its radioactivity was to follow, as soon as it could be devised. (U)

(b)(1)

**Tracking Airborne Radioactivity (U)**

Tracking multiple fission products back to their point of origin to determine when and where the first Soviet nuclear detonation had occurred gave us only a general location in Central Asia—an area the size of my hand on a National Geographic map of the Soviet Union. Clearly, we had serious problems to overcome. (U)

(b)(1)



Approved for Release: 2014/09/10 C01407029

Approved for Release: 2014/09/10 C01407029 (b)(3)(c)

(b)(3)

The use of the technical knowledge developed to track nuclear plumes, combined with the advent of high-speed computers and an increase in the number of weather recording stations, changed weather forecasting for civilian as well as military purposes. The result was the extension of forecasts from a 2-day window in 1950 to weather predictions of a week or more today. (U)

(b)(1)

**Seismic Technology (U)**

(b)(1)


Approved for Release: 2014/09/10 C01407029

Approved for Release: 2014/09/10 C01407029(b)(3)(c)

(b)(1)

Again, civilians have benefited from work stimulated by national security needs. Currently, the USGS also hosts an international civilian seismic detection coalition whose primary purpose is to locate and measure nuclear blasts, earthquakes, and volcanic explosions anywhere in the world. This information can also be used to forecast the paths of tidal waves caused by earthquakes. The USGS data is available to help planners organize emergency relief efforts following seismic or volcanic events, especially in isolated places without easy access and communications. (U)

**Acoustic and EMP Measurement (U)**

(b)(1)

Once the dangers of EMP were recognized, the US military had to "harden" all of its electronic equipment, a task that took adecade. The techniques that were developed were passed into the civilian economy in various forms. As a result, civilian TVs and radios are now more resistant to damage from pulses from electric transmission lines and lightning flashes. (U)

**Nuclear Detection Satellites (U)**

(b)(1)

**Measuring Plutonium Production (U)**



Approved for Release: 2014/09/10 C01407029

Approved for Release: 2014/09/10 C01407029 (b)(3)(c)

(b)(1)

Experience with krypton-85 had a surprising and important civilian spin-off related to global warming. Working with the National Weather Service (NOAA) and with international cooperation, Machta applied these techniques to measuring the carbon dioxide content of the total atmosphere. This gas is the major contributor to the "greenhouse effect" and may be linked to the current general warming of the earth. At the moment, how much it contributes to the global warming, and what to do about it, are topics of heated international debate. (U)

**Environmental Collection (U)**

(b)(1)



Approved for Release: 2014/09/10 C01407029

Approved for Release: 2014/09/10 C01407029

(b)(1)

This intelligence effort has helped to make the operation of civilian nuclear power plants safer. Since the late 1950s, some 30 nuclear power plants have operated in the United States without any *serious* medical problems—and that includes the partial core meltdown at the Three Mile Island reactor in Pennsylvania in 1979. (U)

(b)(1)

The creation of these tools for nuclear intelligence purposes influenced the development of ever-more-sensitive forensic techniques for a host of civilian uses. Police departments and the FBI use them quite effectively. They are now regularly employed, for example, to detect art forgeries. A few years ago, the famous Shroud of Turin was determined to be from the14th century, rather than the 1st century—microprobes showed that the paint was of a type used in the 14th century, and radiocarbon dating on a speck of the cloth confirmed the age. (U)



Approved for Release: 2014/09/10 C01407029

Approved for Release: 2014/09/10 C01407029 (b)(3)(c)

**The U-2 Reconnaissance Aircraft (U)**

Lockheed Aircraft Company's design and construction, under CIA contract, of the U-2 reconnaissance aircraft in the early 1950s made possible high-quality imagery of nuclear facilities in the USSR that had been kept hidden for over a decade. In addition to monitoring nuclear activities, the U-2 photographed ballistic- and anti-ballistic-missile R&D facilities. It exposed military plants producing aircraft, armor, and naval vessels in the USSR, China, and the Near East. Its use during the Cuban Missile Crisis was crucial to slowing down the Soviet advance throughout the world. (U)

The U-2 produced quite unexpected civilian and military spin-offs. Foremost was the boost given to development of the first real space suit. The U-2 pilots had to be able to endure conditions at over 70 thousand feet during missions of up to 20 hours in length. The lessons-learned are used by NASA today in space flights and moon walks. (U)

The reconnaissance aircraft required a capability for high-resolution photography from great heights. New cameras and lenses had to be devised, along with finer-grain and faster-acting film. Upgraded versions of the photographic equipment fly today in our civilian and military satellites. The R&D for color imagery from space required a major increase in the acuity of color film. These advances are now incorporated into the film you buy for your camera at the store. (U)

The designers of the B-2 stealth bomber and F-117 stealth fighter were amazed to discover that many of the anti-radar solutions they wished to design into their aircraft had already been worked out for the U-2 and, later, the SR-71 (Blackbird)—hardly civilian applications, but nevertheless showing that CIA's technical intelligence was first again. (U)

**Infrared Imagery (U)**

(b)(1)





Approved for Release: 2014/09/10 C01407029

Approved for Release: 2014/09/10 C01407029 (b)(3)(c)

The application of IR imaging to civilian and military weather forecasting is a major spin-off from intelligence programs. All our current weather satellites use a combination of infrared and visible-light imaging. The infrared capability highlights clouds in the upper atmosphere and snowfields on the ground, while clouds in the lower atmosphere are recorded using visible light. Ground-based radar and weather stations provide important supplemental data. In another application, the National Institute for Standards and Technology promotes the use of IR imagery to determine if houses and larger installations have unwanted heat leaks. (U)

**Reflection (U)**

The Nuclear Intelligence Community is to be commended for sponsoring these highly technical and ultimately successful projects. For me, it has been fun and an honor to be associated with them and the wider nuclear community for more than half a century. (U)

**Footnotes:**

[1] Gen. Vannikov had been chosen to lead their atomic program because of his outstanding job overseeing the production of Soviet military equipment during World War II. (U)

**Dr. Henry S. Lowenhaupt** has been a distinguished senior scientist with CIA for more than 50 years. In addition to his CIA duties, he was a Deputy for Collection on the Joint Atomic Energy Committee from 1948 until his retirement in 1990. He was honored as a Trail Blazer at the Agency's 50th Anniversary celebrations. (U)

(b)(3)(c)

Previous Next Contents

SECRET//X1



Approved for Release: 2014/09/10 C01407029