The Bureau of Standards

At the bureau McLean worked mostly on proximity fuzes for rockets and bombs, while a similar group under Merle Tuve at Johns Hopkins

University was working on fuzes for projectiles, a more difficult design job. Engineer Jack Rabinow put it simply: Johns Hopkins was working on fuzes for things that rotated, and the bureau people were working on fuzes for things that didn't. When Henry Swift first saw McLean at the bureau, he and Rabinow were molding bakelite propellers for the proximity fuzes. "Neither Bill nor Jack knew much about this subject, but they just went right ahead and did it."[20]

Rabinow, a Russian immigrant, vividly recalls his first meeting with McLean. In 1941 Rabinow was working at the bureau as a mechanical engineer. His unusual mechanical talent was already evident in his designs. Although Rabinow was contributing, he felt he was just marking time until he was drafted. Rabinow's supervisor, Hugh Dryden, had other plans for him.[21]

A man of few words, Dryden asked him what he knew about ordnance, to which Rabinow replied, "Not very much." Dryden handed him a book on the subject and told him to read it. Rabinow read the entire volume over the weekend. When he reported back, Dryden mentioned "a few problems" and asked him to design an air pressure–actuated switch. Rabinow designed the switch and asked the machine shop to make it. The technicians knew that Rabinow was a superb technician—he cut the threads for his Leica's telephoto lens by hand—and were eager to help. They were impressed by the fast-talking engineer who could also use machine tools. "I could get the machine shop to do anything," he recalls, "because anybody who could cut threads by hand was God." They made the switch overnight and Dryden was duly impressed. When Rabinow carried off a second design job with equal aplomb, Dryden had seen enough. "Come," he said. "Where are we going?" Rabinow asked. "Never mind, just come."

Dryden took him to a room in the next building. Full of tinkerers, the room seemed a madhouse. Dryden, unperturbed, called to a young man who turned out to be Bill McLean. Dryden's introduction was typically brief. "Bill, this is Jake, he has mechanical aptitude." That was all he said, but from Dryden, this was high praise. When Rabinow asked what they did, McLean merely replied, "You'll find out." Thus Rabinow joined McLean's group specializing in bomb and rocket arming systems.[22]

Inventor Jacob Rabinow about 1950 with instant-reverse motor. Courtesy of Jacob Rabinow

William Burdette McLean, technical director of Naval Ordnance Test Station, China Lake, 1956. Courtesy of China Lake Naval Weapons Center

Each quickly learned to appreciate the other. Rabinow, a natural inventor, described McLean in turn as "the best engineer I ever knew." Rabinow found McLean capable of deep understanding, yet able to simplify complicated matters. "He was very direct and simple about his physics"—and his designs. As with Rabinow, the technicians respected McLean for his mechanical abilities.

McLean had little patience with stupidity. Rabinow recalled a meeting when "very silly things" were proposed. Surprised by McLean's silence during the meeting, he confronted him: "You know what they said in there was bullshit. Why didn't you say anything?" Replied McLean: "Oh, I'm going to do it my way anyway." And he did.

McLean's operation started with ten assistants. Between November 1942 and January 1944 he was promoted twice, and his original group of ten grew into forty people engaged primarily in the development of aviation ordnance. At the bureau, people saw what needed to be done and did it. Bureaucratic matters were largely ignored. Rabinow, for instance, worked in the group McLean headed but was unaware at the time that it had a name. (It was "Mechanical Design," and Rabinow later became its head). "Who's the boss?" Rabinow inquired of Dryden one day. "Don't ask stupid questions," Dryden replied.[23]

While they were learning how to run an R&D operation, Rabinow and McLean were evolving a style that later became identified with the Lockheed "Skunk Works," but actually such informal operation was typical of OSRD laboratories in World War II.[24] Rabinow, who has a gift for turning a phrase, over the years evolved a set of laws:

> [Law] #13 I think, says that everything you do illegally, you do efficiently. This, of course, is perfectly obvious. For one thing, you do not write at all because writing on an illegal project is suicide. For another thing, you work with whatever equipment you have on hand, and of course, you do everything on your lunch hour, which starts at 8:00 in the morning and finishes at 5:00 in the evening. Another thing, when it doesn't work well and it is illegal, you drop it very quickly and kill the project. When it is legal, you carry it on to doomsday, hoping that somebody else will carry it on, so that when it finally fails you won't be blamed. If an illegal project does succeed, you will be a hero, but if it fails you would like no one to know about it, so you bury it quickly. Illegal projects are very, very efficient from many points of view. We were allowed to do much of this.[25]

McLean and Rabinow agreed on an experimental approach to design. On one occasion the two men were working on a parachute opener for the Bat antiship missile, which saw service late in the war; it weighed more than a ton, and test versions required a big parachute for recovery. The two decided to use a black-powder device to open the parachute and guessed at the correct charge. It exploded when they tested it. They reduced the charge and it worked. Proud of their work, they marched into Dryden's office and fired it off again. People burst in wondering who had shot Dryden, who said, "Don't worry about it, it's only Bill and Jake showing off."[26]

Today Rabinow, a professional inventor with more than 230 U.S. patents, works as an adviser to a National Institute of Standards and Technology program on "energy-related inventions." All inventors, he says, come up with lots of ideas, but the smart ones know that most of them are trash. McLean had many ideas, but he quickly discarded the trash.[27]

Rabinow recalls: "On another occasion, the issue was underwater versus surface firings of ballistic missiles. Three out of the four people said you should fire from the surface, and McLean said you should fire from underwater. If you surface, the enemy will spot you; also, if you surface, the ship will roll; if you fire from underwater, the platform will be stable. The whole committee was against him. But Bill McLean didn't care. He was like that."

What McLean cared about was getting the right answers. He spent hours pondering designs and trade-offs, which could put others in the conversation at some disadvantage since McLean might start in on something he had thought through completely, while the others had just started.[28] He often seemed oblivious to the external world while pondering. Once, called to dinner, he went to the table, ate, was somewhat quiet during dinner, and went back to the couch. Suddenly, he seemed to wake up, whereupon he threw up his hands and said, "I've got it! When do we eat?"[29]

At the bureau McLean was learning more than just how to get things done. He was learning the perils of designing complicated items that then had to be manufactured. Working on fuzes provided an intensive education in the realities of production:

> I believe this early experience in the design of fuzes was the most valuable training I have ever received. . . . It is unfortunate that every designer of military equipment cannot at some time be exposed to the problems of designing fuzes and their arming mechanisms. [It] requires the most rigorous attention imaginable to a multitude of simultaneous design requirements. A fuze must be designed with a minimum of parts, with each part doing a multitude of functions. Its reliability [must] be above the 90 percent mark, and its probability of failure in an unsafe manner should be vanishingly small. Many hours of effort at the design board and in testing must be spent trying to design the various pieces in such a manner that it is humanly impossible to assemble them in an unsafe position.
>
> I learned an unforgettable lesson about the difficulty of designing military equipment when I visited the assembly line for one of our new fuzes. One part . . . included a boss on a rotor which was carefully located so as to prevent the insertion of the part in the armed position. On the production line, however, this part appeared to be superfluous and sometimes in the way. It was, therefore, being carefully removed by filing as one step in the production procedure. I have never again been tempted to believe that a product can be produced by means of drawings alone.[30]

At the bureau, McLean became involved in two projects that later affected his Sidewinder work. The first was the Bat antiship missile, a large, slow, bomber-launched glide bomb with two versions: one guided remotely by television and a second with an onboard radar seeker. The missile got McLean thinking about guidance in general and in particular about transferring the fire control system from the launching aircraft to the missile itself. The second was toss-bombing, in which a shrapnel bomb was lobbed from a fighter to explode in the midst of an enemy bomber formation. Bombers were already of concern, and the concern increased after the first atomic bombs were

dropped. Toss-bombing would bring McLean to China Lake, where he would figure out that guided missiles, not toss-bombing, were the best way to bring down bombers.

McLean had found good teachers. His formative experiences gave him a deep grasp of science and a practical attitude toward design. He found his niche at the Bureau of Standards and honed his design talents under the pressure of the war. He now moved into an environment designed to give these talents full expression.