Green Mountain Proving Ground: Gateway to Tomorrow

G Harry Stine
G. Harry Stine is the president of the National Association of Rocketry. After receiving his degree in physics from Colorado College in 1952, he spent over five years at White Sands Missile Range, where he worked in various phases of rocketry. Later he was employed by the Martin Company at Denver as a design engineer. He was one of the first rocket enthusiasts in the nation to voice alarm at the rocket potential revealed by the Soviet artificial satellite; as a result, this action caused him to lose his position with Martin. Since that time, he has devoted his energies to the field of model rocketry. He is president and chief engineer of Model Missiles, Inc., in Denver, Colorado. Stine is a member of the American Rocket Society, a fellow of the British Interplanetary Society, a member of the American Association for the Advancement of Science, the Authors' Guild, and the Association of Lunar and Planetary Observers. As a "part-time" writer, Stine has published books, factual articles, and hundreds of science-fiction stories.

"Recovery Crew, stand by! Pad number one ready to launch!" The public address system announces the thirty-first test of the day. There is a flurry of activity in range control and tracking stations. The fire control officer inserts his key. There is a momentary hush. Then, on its tail of smoke and flame, the mighty rocket leaps skyward—all the gleaming white "14 inches" of it.

Most Americans are now familiar with the well-publicized U. S. missile and rocket test areas, the Atlantic Missile Range, the Pacific Missile Range, and the White Sands Missile Range. Rockets, missiles, Space and satellite vehicles launched from these places are probing Space and extending mankind's frontiers beyond the atmosphere. But too few people have heard of Green Mountain Proving Ground, which is just as much a gateway to tomorrow as those "hallowed" spots listed above.

Green Mountain isn't big—only 560 acres—and, in contrast to the three major missile test centers, it is located within ten miles of a major city, Denver, Colorado. It has launching pads, flight safety, optical instrumentation, communication nets, and all the other essentials of a rocket testing area. Other missile testing centers often close down over weekends, but that is the time Green Mountain gets into gear.

This diminutive rocket proving ground is used to test diminutive missiles. The largest vehicle launched there to date was 36 inches long and weighed 1 pound. The average missile fired there weighs less than 2 ounces, is about 12 inches long, and reaches an altitude of 500 to 1000 feet.

Since its founding in November 1957, over 10,000 model rockets have been flown there. And the safety record is perfect! There has not been a single accident.

This amazing safety record stands in stark contrast to the increasing number of rocket
accidents reported among amateur rocketeers over the nation. The record is even more amazing in view of the fact that Green Mountain Proving Ground is operated by teenagers. There is adult supervision, of course, but that isn’t the whole reason for the excellent safety record.

Green Mountain Proving Ground is operated under the auspices of the Mile-High Section of the National Association of Rocketry, a nonprofit organization backed by such well-known rocket experts as Willy Ley, Col. Charles M. Parkin, and Erik Bergaust. At the time of the founding of the NAR, it was realized that two things were needed among teen-age rocketeers. Safe, tested components, and a means of reaching teen-agers to disseminate information. The emergence of model rocket components in the form of small, high-thrust rocket engines and model rocket kits satisfied the first requirement. The NAR was organized to satisfy the second one.

The founders of the NAR in turn recognized the need for two elements in the informational area of the problem, two items which were totally lacking in most other amateur rocket organizations. The first of these was a set of standards or rules for the teen-age rocketeer to follow in making and launching his rockets. In essence, these standards would set limits within which the youthful designers could work. The second item was a safety code of tested rules, adopted in part from “big missile” work; this safety code would guide teen-agers within the limits of the launching and handling standards.

The safety code came first because of the need for getting this information into the hands of youngsters to stem the tide of rocket accidents.

A comprehensive set of standards was adopted later. Since model rocket components were now commercially available, these standards also included competition rules which allowed youngsters to measure their own progress and achievement against those of others within a standardized framework.

These things were not original concepts. They were borrowed outright from model airplane enthusiasts, who under the safety rules and competition regulations of the Academy of Model Aeronautics, have progressed at an amazing rate with a reputable safety record of their own.

The reasons for the safety record of Green Mountain Proving Ground lie in the Safety Code and the standards of the NAR. Green Mountain has worked from the beginning—even before the rules were written, because the rules were tested there.
Although the NAR is a young organization, there is so much to tell about it that a whole magazine could be devoted to it. In fact, NAR publishes its own monthly newsletter The Model Rocketeer, which is sent to all members and contains news items, contest announcements, a question-and-answer section, and other items of interest. NAR also publishes "NAR Technical Reports"; examples of the contents are illustrated by some of the titles of the NAR Tech Reports: "Basic Rocket Trajectory Calculations," "Building a Range Firing Panel and Communications System," and "Project Eyeball, An Optical Tracking System."

NAR has also established model rocket flight operations areas at locations other than Green Mountain. Peak City Proving Ground in Colorado Springs, for example, was set up by NAR members on land donated by the John Wong, Jr., of Denver, Colorado prepares a model for flight at Green Mountain Proving Ground. Note the various configurations, including scale models of the "big ones". (Photo by Katzel) parks department of that city as a result of a city ordinance sponsored by NAR. Peak City operates along the same lines as Green Mountain, and boasts a perfect safety record, too.

In the educational field, NAR has helped schools set up rocketry divisions for their science clubs. In Littleton, Colorado, where such a program is in operation, two NAR members this year won top honors for their work in developing a micro-miniaturized rocket telemetry system (FM-AM, 8 channels, 1 ½ inches in diameter, 4 ounces, 12 inches long, 100 mw output on 27.25 mc.) complete with ground equipment.

This spring, NAR started its first contest season, to culminate in the NARAM-1 (NAR Annual Meet #1) at Green Mountain Proving Ground in July.

All this started at Green Mountain Proving Ground, and Green Mountain is still the top range in the NAR. But what has it done besides proving that model rocketry under NAR sanction can be safe? An answer to this question may be found in the young men who built Green Mountain.

Several of them will be starting college in the fall of 1959; they know and understand rocketry now, and they plan to make astronautics their career. Others are still a long way from college, but they understand research and development; they can sit down and plan a flight test program, for example, and carry it through. They have learned optics, meteorology, aerodynamics, electronics, thermodynamics, and basic scientific disciplines—not from books, but from actual experience. They have supplemented their mathematics by putting it to practical use.

There is no doubt that ultimately the careers of young men are strongly influenced by experiences during their formative years. Green Mountain Proving Ground has given its participants experience in the field of rocketry. It is quite likely that they will eventually stand high in their chosen profession; after all, they have a head start.

Let's take a look at a typical day at Green Mountain. All the range equipment is portable and is stored in Denver during the week. A half-mile of communication cable was once stolen from Green Mountain, so range par-
This page includes a small image of a model rocket, described as a 'scale model work at Green Mountain Proving Ground under NAR rules produced this flyable miniature replica of the German V-2.'

Participants don't take chances any more. Rocketeers meet at a rendezvous point in Denver at 9:00 A.M. on Saturday morning. There are usually two, and sometimes three, station wagons loaded with gear. Then the caravan takes off for Green Mountain, easily accessible by four-lane highway and paved roads, but still a good way out.

Upon arrival at the range, the communications crew starts stringing out the communications wire from a back-pack cable reel, donated by an oil survey firm. The instrumentation crew sets up, levels out, and "zeros in" the tracking telescopes. The launcher crew sets up launchers, plugs in the firing panel, and checks out the public address system.

Everyone then starts preparing his models. If a model utilizes a rocket engine other than a tested commercial type, it is removed to the isolated Hazardous Test Pad, 100 yards from other operations and equipment. It will be launched at some time during the day by a trained crew under adult supervision and by remote electrical control.

The launching pads at Green Mountain are unused, concrete foundations of ammunition magazines, 25 feet wide and 45 feet long. They stand about 4 feet above the ground and have stairways at either end. No blockhouse is needed; during hazardous tests, everyone stands behind a foundation. Nothing is ever fired which would require overhead protection. Since all NAR rockets require a system which destroys the aerodynamic stability before they come down and since all models flown are extremely light, it's better to be out in the open where you can just step to one side if one comes down your way.

Eight launchers are usually set up on the main pad. If there are more rockets to be flown during the day than can be launched from a single eight-launcher pad, a second pad is set up on another foundation. But, since it is possible to fly and track 50 models per hour at Green Mountain, two pads are rarely needed.

All firing is done by remote electrical control. All firing panels have safety circuits which include keys, guarded switches, firing lines shorted until the switch is thrown, and other interlocks.

Each model ready to be launched is placed on the ready pad atop a flight-test data sheet. This sheet lists the designer of the model, type of engine it has, and other technical details. The launching officer picks up the model and its sheet, places the model on a launcher, and notes the launcher number on the sheet. This keeps the fire control officer from getting confused later on.

Once all launchers are loaded, the call goes out over the PA system, "Trackers, man your stations! Recovery crew, stand by! Pad Number One ready to launch!"

The boys manning the telescopic tracking stations report in by telephone.
"Tracking One manned!"
"Tracking Two manned!"

The range control point is usually next to the firing panel at Pad #1. The range safety and control officer, an adult, takes his station and removes the firing panel key from his pocket. "Trackers ready?"
"Tracking One ready!"
"Tracking Two ready!"

"Trackers ready!" reports the fire control officer. First missile is from Launcher One, a gleaming white model of the Jupiter IRBM.
A scale-model of the US Navy ASP rocket swishes aloft from Pad #1 at Green Mountain Proving Ground. All launching is done on a countdown by remote electrical control. Note the range flag on the right and the anemometer tower on the left. (Photo by Katzell)

The safety officer scans the area. No one is in a place where he could be injured. No cars are coming up the access road. There are no aircraft in the vicinity. Everything is ready, and everyone is waiting. The safety officer inserts his key into the arming panel and turns it. "Range is clear! Panel is armed!"

All conversation over the communications net is heard in the launching area over the PA system. The fire control officer throws the launcher selector switch. The countdown begins.

At zero-time, the little model leaps off the launcher and rockets skyward. All eyes follow it. Trackers swing their instruments to stay on it—a difficult job with the 14-inch model boosting at 8 G's. At peak altitude, the recovery system activates, and trackers lock their scopes. The missile drops to Earth.

The recovery crew goes into action, chasing down the model to bring it in to be prepared for another flight; under NAR rules, all models must be capable of more than a single flight.

The tracking stations report in, calling off the azimuth and elevation of the model at peak altitude as seen from their stations. Two stations are always used, with more as backup if required. They are on carefully measured baselines, surveyed by the boys. The angular information is recorded on the flight data sheet, along with weather data, such as wind direction, wind velocity, cloud coverage, temperature, humidity, and barometric pressure. The sheet is then passed to the data reduction crew who stand by with slide rules, trigonometric tables, and other calculators, ready to reduce the tracking data to altitude information.

Meanwhile, other models soar up into the sky. Staged models are flown, as well as models with clustered, solid propellant motors. Many experimental flights are carefully documented with motion picture cameras; the film is later scrutinized frame-by-frame to examine performance.

Although the boys have gotten their staged models up well over a mile, such an altitude is an unusual one in spite of the generally high reliability of the models. Since the safety criteria developed for Green Mountain places

control. Note the range flag on the right and the anemometer tower on the left. (Photo by Katzell)
an altitude limit of 6000 feet on models launched there, the NAR members have emphasized achievements other than altitude.

One of the most interesting activities is a payload competition. The NAR has developed a standard payload, consisting of a cylinder of lead ¾” in diameter and about ¾” long, weighing one ounce. The object of the competitive effort is to carry this payload to as high an altitude as possible with an engine of a given thrust and duration. The payload must be totally contained in the model, must be removable from the model, and must not separate from the model in flight. Careful design pays off in this event, which very closely duplicates the requirements of real rocketry.

By limiting maximum altitudes through motor limitations, a great deal of interest is generated in scale model work. Where else could one find the following missiles being launched from the same pad on the same day: V-2, Little John, Jupiter, Jupiter-C, Thor-Able, Asp, Pogo-Hi, Arcas, Redstone, Sergeant, and Sidewinder? Careful research goes into these scale models, some of which have each rivet and weld line of the real thing.

Many original designs show up each Saturday, too. Before allowing models of unproved design to be fired, the safety officer must be convinced by design data that they are safe and stable in flight. Some strange birds have appeared at Green Mountain.

Give a boy any hobby-type rocket engine that works, plus some basic design information, and he’ll have no end of designs. However, he soon learns which ones work—and, more importantly, at Green Mountain he learns why.

Green Mountain Proving Ground is probably as important to the nation as the “big missile” ranges. The same holds true of Peak City Proving Ground and the other NAR flight ranges. Today’s missiles are being tested by today’s engineers at Canaveral, Vandenberg, and White Sands. But at Green Mountain, tomorrow’s missiles and Space vehicles are being born in the minds of tomorrow’s Spacemen. It’s being done in a manner which brings to life the NAR motto: “Safety, Knowledge, Enjoyment.”

The first man to walk on Mars is possibly flying his model rocket on some NAR proving ground today. Green Mountain was the first. It is truly a gateway to tomorrow.

Editor’s Note: Many readers will want to start their own rocket clubs. If you are interested in further information on this subject, the National Association of Rocketry is waiting to help. The NAR is also ready and willing to assist science teachers who are eager to incorporate rocketry into their curricula. If you want to communicate with the NAR, Write to Rocket Club, P. O. Box 94, Nashville, Tennessee. We will forward your communication to NAR.