Chapter V

Simple, Rugged, and Reliable:

Radio Policies and Practices Take Shape

If radio waves only went out to the boundary of a forest and stopped there, we could toss out equipment as ordered, but radio waves don't do that. Even in California a radio wave behaves just as it does elsewhere.

- Jack Horton[1]

The administration of a successful Forest Service communication program required much more than establishing radio as a new communications concept. Success depended on how radio was accepted by the personnel in charge in the field. Even though the Washington Office could order this new tool for use throughout the Forest Service, Laboratory staff never forgot that many headstrong Forest Supervisors could resist its incursion. The technical, logistical, and administrative decisions made at all levels, from the Washington Office to the Radio Laboratory, had to be tempered with the understanding that workability was one thing, and acceptance and implementation were something else.[2]

To maintain the momentum of the radio program, the Washington Office allowed Region 6 to assume administrative control during the 1930's. The Portland Office was in the best position to do this because of its past experience. (Certainly, the Washington Office was far removed from the forests.) As a result, Region 6 was able to "suggest" programs to Washington, often getting them approved and circulated as Forest Service policy, a method perhaps more palatable than having radio policy dictated to the Regions directly by the Washington Office.

This rubberstamp policy was reflected in early correspondence between Roy Headley and Ernest N. Kavanaugh, Assistant Regional Forester for Range Management, Region 6, after Headley requested in the fall of 1932 that this Region submit suggestions to the Chief Forester for extending radio use in the administration and protection of all the National Forests.

Kavanaugh outlined several short, specific guidelines. They gave Region 6 the responsibility for the purchase, inspection, and approval of all radio equipment, and authority to arrange for sets and parts to be stocked by manufacturers. The Radio Laboratory in Vancouver was to provide technical assistance to the Regions so that it would be aware of their needs. The Regions would then purchase radios on a "pay-as-you-go" basis and pay the salaries of technical personnel hired to install and maintain them. Headley approved Kavanaugh's outline on November 15 and distributed almost an exact copy of the suggestions to the Regional Foresters, instituting the first Servicewide radio policy based on the "suggestions" of Region 6.[3]

Portland Retains Control of Program

The decision to retain control of the radio program in Portalnd was unusual for the Forest Service and proved to be somewhat of a handicap for the Radio Laboratory. Each Region, working within overall policies and guidelines established by the Washington Office, had always been allowed considerable autonomy in managing the National Forests within its boundaries. The *Forest Service Manual* or "Green Book" disseminating Washington policy to the field, did not spell out in detail the exact procedures by which Forest Service goals were to be achieved, so that Regional Foresters, Supervisors, and District Rangers had a certain amount of discretion based on their analyses of priorities and local attitudes. If a field officer could justify and support an exception to the rules, his decision was usually given due consideration and accepted at the higher administrative levels of the Forest Service.[4]

By leaving Portland theoretically in charge of Servicewide radio development, Washington created the possibility for interregional conflict over such centralization of communication policy; each Region could be expected to consider Radio Laboratory guidance binding only insofar as it pertained to an individual Region's needs. If a Region determined that its needs were unique or contrary to a decision made in Portland, it was free to deviate from Portland's recommendations or even to choose commercial equipment over the products designed and produced at the Laboratory. Regional autonomy further complicated the work of the Radio Laboratory because the Washington Office did not give anyone the authority or duty to arbitrate inevitable deviations by any of the Regions. Real, as opposed to implied, direction was lacking.

Earl Loveridge, for example, told the Regions that "...all apparatus such as radio sets, transmitters, receivers and test equipment should be purchased through the Radio Unit..." in order to insure some semblance of centralized radio development, provide for the coordination of activities, and take advantage of quantity purchase discounts. But there

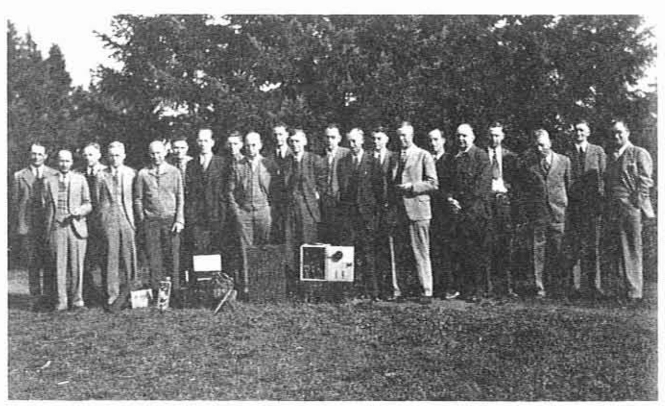

Figure 45. Men from the Regions who attended a radio course held at the Radio Laboratory, Vancouver, Wash., March 1934. (NA:95G-287881)

was no directive in this correspondence that *required* the Regions to purchase *only* Forest Service-designed equipment.

This situation naturally left officials like Jack Horton in a quandary when rebuffed by Regional Foresters in other Regions whose authority equalled that of the Region 6 Regional Forester, who was nominally in charge of national radio practices. Horton, removing himself from consideration, asked Roy Headley to appoint a "radio dictator" who could keep each National Forest from devising its own independent communications plans. This committee or person, Horton suggested, should have a clear picture of the total needs of the Forest Service and the

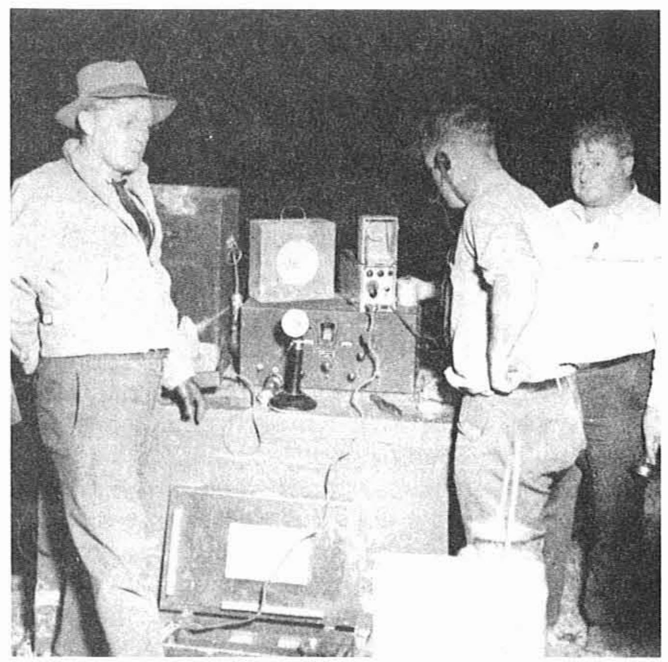

Figure 46. The Forest Service's small type PF set with speaker is on top of a Hammarlund Comet Pro commercial receiver in this photo. The receiver was used in conjunction with the Forest Service type M radiophone transmitter, which is visible behind Forest Supervisor William V. Mendenhall at left. This night photo was taken at the radio center on the Barley Flats fire, Angeles National Forest, southern California, in 1936. (NA:95G-341689)

authority to develop a firm Servicewide policy based on those needs.

Alarmed lest one or two aggressive Regions outdistance the others, Horton cautioned Headley about insurmountable problems "...if we give one unit the cream and let the other starve."[6]

Washington, however, did not waver from its inclination to allow wide freedom for each Region and avoid strong direction in radio communications policy. Through most of the period between 1932 and 1948, the Chief Forester's Office continued to acknowledge the technical leadership of Portland, saying, "We make no pretense as to being authorities in radio matters...",[7] while denying the Laboratory real authority over the Regions.

In an attempt to provide some centralized leadership, promote the use of radio throughout the National Forests, and lend substance to Portland's implied control of the program, the Radio Laboratory held radio schools for Regional- and forest-level personnel. This approach brought together those responsible for purchasing and budgeting. It also gave Simson, Lawson, and Squibb an opportunity to educate those who might be suspicious of the value of radio. Using a simplified course in electronics fundamentals, the sets were presented to personnel as logical, straightforward devices with a practical application in suppressing forest fires. Setting up a field demonstration of a typical communications operation, they effectively demonstrated the operation, provided hands-on experience, and reduced resistance to this new technology.

Undoubtedly, this formal approach proved more beneficial in promoting the cause of the Laboratory than earlier forms of indoctrination. In one instance, while finishing up an installation on the St. Joe National Forest, Lawson was giving a demonstration to Charles Scribner when a call came over the speaker. Lost in the

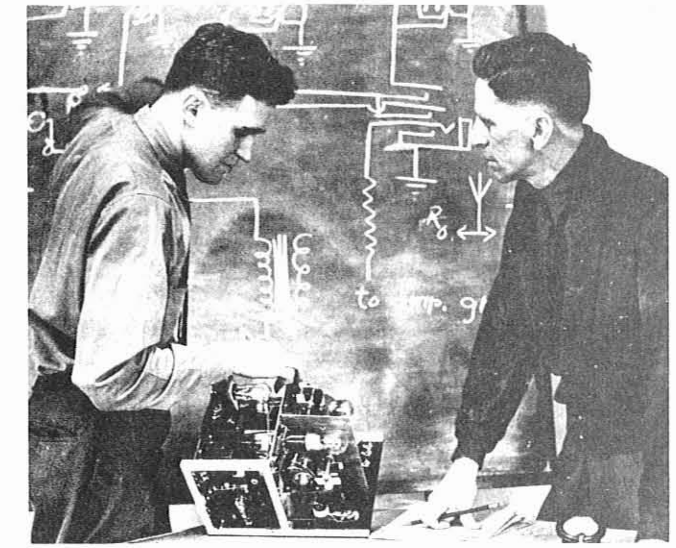

Figure 47. Radio familiarization course held at the Radio Laboratory, Vancouver, Wash., March 1934. Above, Harold Lawson pointing out to R. W. Shields, an inspector for the old Eastern Region (R-7), the relationship of components to the schematic drawing on the blackboard. Below, W. Foy Squibb identifying radio sections for Fritz J. Poch, technical assistant, San Isabel National Forest, Colo., Region 2, center and Leonard D. Blodgett, timber sales specialist, Olympic National Forest, Wash., Region 6, during the 1934 radio course. (NA:95G-287885, 287886)

details of correct procedure, Scribner had set aside his unlighted pipe to pick up the microphone. Before responding, he absentmindedly struck a match, stuck it under his nose, and uttered a hyphenated expletive that was received without difficulty back at headquarters.[8]

Patent Infringement Question

The question of patent infringement was one of the first administrative tangles encountered by the Radio Laboratory staff in their pursuit of lightweight portables. In the early 1930's, many circuit designs were protected from commercial production by manufacturers holding the patents. While they were unable to curtail the use of these circuits, they often received a royalty fee from the secondary manufacturer. Uneasy over their responsibility, as well as the potential liability of the Radio Laboratory and increased costs, Simson raised the possibility of patent infringement. He asked Jack Horton to obtain the opinion of the U.S. Department of Agriculture legal staff before completing bid specifications on the P and SP sets.[9]

Horton passed this request on to the Chief's office and received a short, blunt reply from Earl Loveridge. According to Loveridge, who had sought the opinion of the well-informed radio expert, Dr. J. Howard Dellinger at the National Bureau of Standards, who had earlier encouraged Dwight Beatty, "...the radio patent situation is so hopelessly involved that it is almost impossible to determine who the owners of 'good' patents on radio equipment are."[10] Dr. Dellinger had also pointed out that other Government agencies "...disregarded the patent situation in drawing up specifications for radio equipment and have specified the type of equipment desired in exact and detailed terms."[11] On this advice, Loveridge recommended that the Radio Laboratory proceed with bid specifications.

When the first run of radiophones was completed one year later, Spokane Radio Co. (SRC), the contractor, questioned the possibility of infringing on patents held by the Radio Corporation of America (RCA) and Lee DeForest, and voiced its worry that it might be held liable for royalty payments at a later date. Jack Horton decided to research the subject further in the U.S. Codes. In his letter to Frank Prince of SRC, Horton cited page and reference on the obligations of non-patent licensees and unlicensed manufacturers. He concluded that SRC was required by the Government to use patented circuits and could not, therefore, be held liable for infringement. If a licensed manufacturer chose to seek redress against a contractor for the Government, it would have to first sue the Government before the Court of Claims after the sets were constructed.[12]

But the issue of nonobligation by non-licensed manufacturers was not easy to quell. As more and more Forest Service radios were constructed, manufacturing contractors became more and more uneasy about involvement in court suits. Perplexed by what he thought a closed issue, Jack Horton once again wrote Washington. He said that the Forest Service faced no more than an increased cost of about 7 percent for royalties or a suit in the Court of Claims. Admitting that the circuits in question were patented, and that both RCA and DeForest were receiving "tribute" from other manufacturers, Horton questioned their claim to credit or compensation. "Personally," he told the Forest Service Chief, "I doubt the validity of these patents and believe both these outfits have a rather uncertain hold on them."[13]

As a suggested strategy, Horton asked the Washington Office to continue to include a contractual release from patent infringement for contractors of Forest Service sets. He believed this would quiet their concern over lawsuits from RCA--"a big concern with plenty [of] money and legal talent"--and close the issue of the Forest Service paying royalty fees that small, local companies would require if the Government did not intercede between them and the larger corporations.

Horton, however, was reasonably certain from his "review of court decisions" that if RCA or DeForest should challenge the Forest Service in the Court of Claims, they would get no more than the usual 7 percent for their trouble. In that event, the Government would be out no more than if they had made the smaller companies liable for patent infringement and paid the 7 percent on the front end. In spite of this possibility, Horton did not take RCA or DeForest seriously. "I believe that RCA or DeForest would be very reluctant to ask for a show down in Federal court ...,"[14] he told the Chief. With a gambler's resolve, acquired perhaps from his experience in the Forest Service, Jack Horton was willing to call the bluff.

The response from the Washington Office arrived in Portland nearly a month later. Its tenor was decidedly legalistic and included a copy of a decision provided by the U.S. Comptroller General in a similar case.[15] After covering historical and legal precedents, Edward A. Sherman, acting in the capacity of Chief Forester, gave Horton authority to proceed as he had requested. "In this case, since you state that the alleged patent rights are probably not valid and since to ask the contractor to carry the entire risk would increase the price about 7 percent, it is believed advisable for the United States to assume the risk rather than pay the increased price."[16] The Forest Service was putting its money on Jack Horton.

Ten years later, after some 5,000 sets had been put into use by the Forest Service, David S. Nordwall, Alternate Director of Operation in the Washington Office, made an inspection trip to the Radio Laboratory. His final report reviewed the earlier Forest Service patent controversy and recalled that RCA, in particular, had challenged the use of the Armstrong oscillator circuit in Forest Service radios. Because RCA had declined to seek recourse in the Court of Claims, "for obvious reasons," Nordwall concluded that "since no further complaints have been received during the past 10 years, it is believed safe to assume that this is a closed issue."[17]

On the other side of the patent controversy, because of the confusion over ownership, the Radio Laboratory submitted several ideas for patent consideration. A representative of General Electric Co. (GE) had informed them this procedure was necessary to protect the Forest Service should an enterprising individual or company make separate application, obtain a patent through default, and require royalty payments from the Forest Service at a later date.[18] "In other words, if we simply develop the apparatus without securing a patent in the Government, anyone could patent it and thus be able to charge all subsequent users a royalty,"[19] Jack Horton succinctly pointed out.

With this in mind, the Laboratory staff searched for mechanical and electrical innovations necessary to the mission of the Radio

Laboratory. The first was submitted for patent in mid-1931 and described as a "power-feed antenna" invented by Harold Lawson. Before submission, however, the Bureau of Agricultural Engineering, U.S. Department of Agriculture, again consulted Dr. Dellinger and also Elmer L. Hall of the NBS Radio Section, finding "... that antennas very similar to the one in question are in use at the present time by amateurs."[20] A few months later the Laboratory also submitted material to the Chief Forester for patent application on the type P and SP sets. But this time, the cover letter pointed out, the patentability of either device was doubtful. "We claim nothing new in circuits," cautioned the Radio Laboratory, "but the arrangement and combination of parts and circuits ... in the design of portable and semiportable apparatus."[21]

Complexities of Designing Portables

The patent applications for these radiophones never went beyond the U.S. Department of Agriculture. On the one hand, as the issue of patent infringement and royalties slowly subsided, it was no longer necessary; on the other hand, Lawson and Squibb had difficulty claiming complete originality for their work. Willing to protect the Government's interests in developing portable, lightweight equipment, both men, however, were aware of their debt to amateur radio and the practice of utilizing existing circuits as needed. The task, however, was not simply one of duplicating the work of others. It required the adaptation of "... known radio principles and circuits to the very specialized and exacting requirements of forest protection communication."[22] Most amateurs of the day could construct a battery-operated portable whose weight would test the endurance of any man. The trick was to make the same set weigh half as much, but still do the same job.

To succeed, Lawson, Squibb, and those who later joined the staff had to be aware of the advantages and tradeoffs of many different circuits, each with its own peculiar and unique advantages. Some circuits might provide greater sensitivity or fewer external controls, require less power, or have more volume or fewer expensive parts. It was not simply a matter of clipping a few components or attempting to compromise quality in the interest of lighter weight. Each concept had to be tested on the bench, incorporated into the rest of the circuit, and tested again.

Then, too, there were the relative merits of alternative design: Would capacitive or inductive coupling provide greater benefits? Could a newly designed single tube be made to work in place of the current two? Were certain parts common to reception and transmission, and, if so, could they be effectively switched back and forth if that component were used in both circuits?

Climatic effects were also a concern in the design of lightweight sets. Knowing that the success of their product depended on consistent operation in both the humid forests of Washington State and the arid deserts of the Southwest, as well as at altitudes ranging from sea level to the Continental Divide, the Laboratory conducted environmental tests, albeit primitive, on each radio type.[23]

Under Gael Simson's constant urging to keep the sets "simple enough for a mule to operate,"[24] each detail in the design was evaluated. When decisions on enclosures were necessary, the Laboratory determined experimentally how many rivets and gussets would be required to make a chassis withstand the shock and weight of a packhorse tumbling over the side of a mountain. To measure the effects of this type of abuse, Lawson climbed to the roof with a set, held it at arm's length, and, in what his coworkers called an "unfair" test, watched as the unit crashed to the pavement below.[25] Even though the set worked after replacing a tube, Lawson had special tube sockets designed that allowed the tubes to rest on a foam compound and be held in place with spring clips attached to the chassis. Lawson remembered his own near brush with death while fighting a forest fire and strove to keep operational procedures clear and concise. The outcome of his detailed consideration to the person trying to send an urgent message resulted in the Laboratory adopting Beatty's watchwords--simple, rugged, and reliable--as design goals.

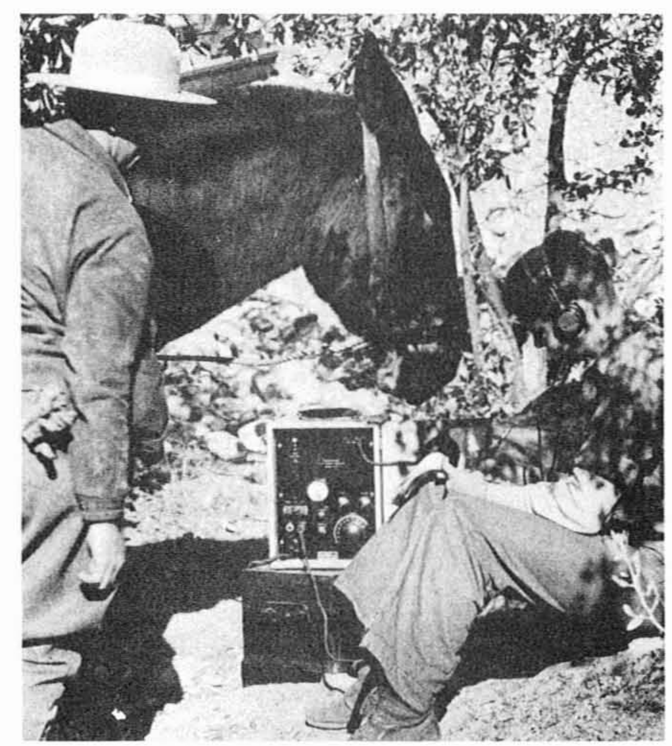

Figure 48. Type SP radio set "simple enough for a mule to operate." (NA:95G-285343)

The success of their efforts is amply illustrated by a number of Forest Service anecdotes. Among common occurrences were the recovery of a radio from the bottom of a canyon after a packhorse lost its footing, resurrecting a set that had fallen from a moving vehicle, and surviving abuse during a grueling fire season. Some paid the lightweight sets high compliments by relying on them as they would an axe, Pulaski tool, or shovel. When needed, they worked.

A railroad crash provided the ultimate proof of the simplicity, ruggedness, and dependability of the sets. A Ranger and his railroad speeder car on fire patrol came face to face with a Chicago, Milwaukee, St. Paul & Pacific locomotive on a blind curve. With only enough time to dive off the car, he watched as it was demolished by the train roaring an arm's length from his body. When the dust settled, he searched for anything salvageable and collected the pieces of equipment for which he was accountable. In a bedsheet, he threw a mangled PF Kitbox and radiophone. At headquarters, the box and radio were photographed, the set examined, batteries replaced, and the unit tested. It came through with flying colors. It was returned to service with minor cosmetic repairs.[26]

The staff found attention to minute differences in weight just as important, as Colin Fletcher, considered the major spokesperson for modern-day backpackers, does today. He tells has proteges that if they watch the ounces, the pounds will take care of themselves. The

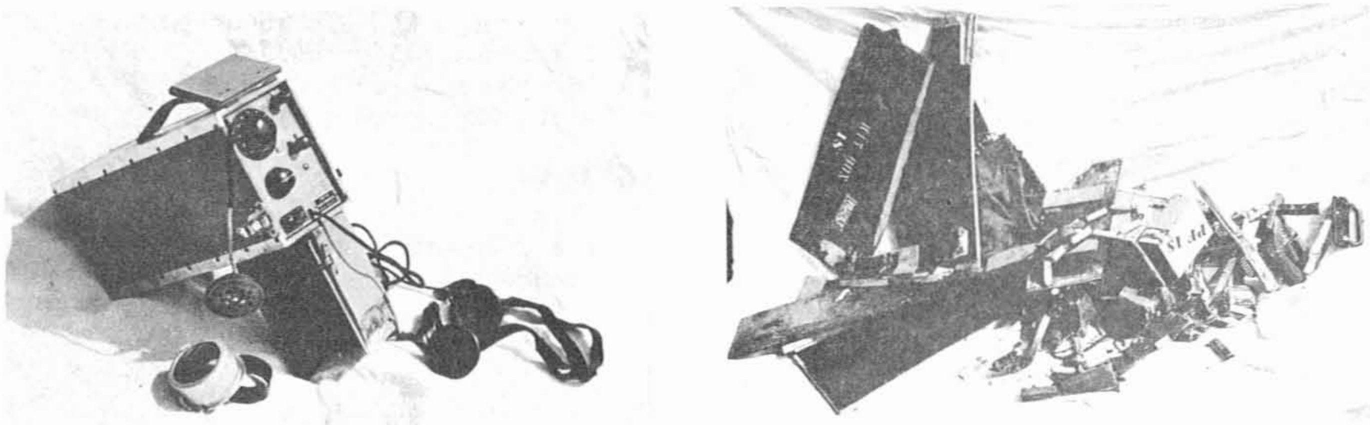

Figure 49. Type PF radiophone, left, and kitbox, right, after collision with a railroad locomotive. When the batteries were replaced, the set worked perfectly. Following minor repairs at the Radio Laboratory, it was returned to field service. (Forest Service photos, History Section)

Radio Laboratory wanted to design a smokechaser's set that could be carried by one man with firefighting tools and other paraphernalia up mountainsides, across valleys and rockslides, over downfalls and through dense timber, and still arrive at a fire with a useful communications tool.

To go a few pounds above the unknown, optimal weight might make a man ditch his burden in the interest of speed or comfort, yet in the mountains the radio signals had to be able to traverse rugged ground. If the weight of the batteries was decreased in the interest of portability, the output power would be decreased. If the staff increased the output power, they would pay a penalty in greater battery weight. Somewhere in between was an acceptable compromise that would allow the person in the forest to comfortably pack in his burden and successfully send out his message.

Figure 50. Portability of the type P radio is demonstrated by Harold Lawson of the Radio Laboratory. Note antenna loading coil and battery under container. (Forest Service photo, History Section)

Costs Had to Be Kept Low

As design efforts progressed at the Laboratory and the number of sets in the National Forests increased, the staff began to learn that factors other than reliability, simplicity, and ruggedness were important. Unit price and maintenance costs were significant determinants of attitudes to radio. Field men had limited budgets and could not afford an effective communication system if it meant cutting back on other essential projects. Even though one $50 radio might avert a million-dollar fire, the decision to cross out some items from the budget and substitute "Radios" was an agonizing decision for those with limited resources to spend on roads, bridges, trails, telephone lines, lookout towers, buildings, labor, and a host of other needs.

The cost also helped swing many skeptical Rangers over to deciding that this new technology was not worth their investigation; along with many others, some were loath to accept a new idea. Accustomed to packing beans, flour, ammunition, and perhaps a bottle of whiskey for an extended trip into the forests, a Ranger could be out of contact for weeks while on his duties. To tell him to carry an expensive radio in his duffel for daily contact with headquarters was not a good way to make a radio convert out of a grizzled veteran accustomed to solitude.

The unit price of each radio was also important in planning future Laboratory projects. Perhaps beginning with Beatty's early experimental work, the staff recognized that even in the 1930's, rapid technological progress in parts and theory meant that one design was

Figure 51. The solitude and beauty of a Ranger's extended trip into the back country is reflected in this scene at Trappers Lake, White River National Forest, Colo., Region 2, ca. 1918. This is now part of the Flat Tops Wilderness. (NA:95G-43141A)

barely through field tests before it was necessary to return to the drawing board or workbench to keep up to date. The design procedure at the Radio Laboratory allowing for this planned obsolescence was straightforward: First, begin with all known circuits and existing components. Second, construct and test a modern, compact, reliable, and practical set that is not expensive. Third, on completion, gather up everything learned and revealed throughout the industry in the meantime and start improving on past performance. If an initial design effort had been overly expensive, it would have been difficult to justify rapidly replacing existing units only because of improved technology. "In the interest of economy," Gael Simson pointed out, "nothing is spent on beautifying the sets as it is felt that rapid obsolescence makes such attention unjustifiable."[27]

To someone unfamiliar with radio, this planned obsolescence could appear to be fiscally unsound. But the pace of technology was swift and relentless. "Almost daily," the *Radio Handbook* pointed out about 1938, "new tubes, parts and technique are being developed."[28] In a profession where the evolution from vacuum tube, to transistor, to integrated circuits took place within the span of a single career, the Laboratory staff could not succeed in their mission by standing still. They had to search continually for new tubes that might take less current, antenna changes that would enhance performance, batteries that improved duty cycles, and circuits capable of stabilizing performance of lightweight equipment.

This quest was aided by an infant but highly innovative, fast-growing, and competitive electronics industry that sought constantly to devise sophisticated circuitry and develop technically improved equipment and components. Spurred by competition, they produced products at a bewildering pace, and the men at the Laboratory had a near-ideal, almost unprecedented opportunity to provide the men in the field with equipment that was always up-to-date.

As a pioneer in lightweight, low-power, radio development, the Radio Laboratory was often tempted to add too many features to Forest Service radios. The decisions, not unique to electronics, require careful judgment by the design engineer, who must often choose between adding features to solve a problem or trying to solve it by other means. Additional investigation of the literature or discussions with other specialists, for example, might reveal that a problem could be eliminated by substituting component values, altering physical layout, or even abandoning "nice-to-have" features. A second closely related, perhaps more important factor, stems from the human tendency to equate design with creativity. This can blur the distinction between pragmatic, or practical, design and overdesign. When producing an item that does not yet exist, the professional design engineer is tempted to create an object reflecting mastery of the subject as well as ability to assimilate new developments.

Radio Amateurs Ran the Laboratory

The Forest Service did avoid the problem of overdesign. Beatty, of course, literally came out of the woods to demonstrate the viability of a concept. With no more than an elementary background in electronics, he acquired and used only that knowledge necessary to demonstrate the concept. When he had to employ assistants, he turned to radio amateurs--who were also self-taught. Actually, Beatty would not have had much luck locating qualified graduate engineers. In 1930, nearly all holders of E.E. degrees were well trained in design of power plants and the erratics of high-voltage transmission lines, but electronic circuit theory and design was not yet a substantial part of the university curriculum.[29]

At the upper levels of Forest Service administration, this preference for self-educated engineers was based on the long and deeply held creed--only recently modified--that foresters could better determine the needs of the Forest Service than graduate engineers or other specialists. "Early in the history of radio development for forest protection communication," Gael Simson told the readers of the *Journal of Forestry* in 1938, "it became apparent that best results could be obtained by placing foresters, who also had a technical knowledge of radio, in charge of development work; rather than depending on radio engineers who were not familiar with forest protection problems."[30]

The Forest Service's tenacious belief in this general, fundamental principle was reinforced by the successful efforts of Beatty, Simson, Lawson, and Squibb during the formative years of radio development. This policy protected the emerging Forest Service communication program from radio design that was too refined, too expensive, or too fragile for use under the rugged field conditions and, that, thereby, might have caused the radio program to fail in its infancy.[31]

Once the Laboratory's design goals for a model were established and a prototype developed and thoroughly tested, a method for manufacturing the model in quantities had to be devised. Initially, Beatty and the Laboratory had sets made by private shops from a working model. As the program took shape, Regional Forester Charles J. Buck, brought up the possibility in 1931 of establishing a production line at the Radio Laboratory.[32] Undoubtedly fearful of treading on private enterprise, the Washington Office suggested with little hesitation in a return letter that the Laboratory produce small numbers during the winter to keep "key men" productive, but did not believe "... the Forest Service should go into the business of constructing radio sets on a large scale."[33]

Lacking instrumentation accurate enough to determine circuit performance and tolerances required to guide a manufacturer through production, the Laboratory continued the model-bid practice. Potential manufacturers were invited to view a working laboratory model and submit bids on a fixed quantity of identical units. Theoretically, a business with no knowledge of electronics could be awarded the contract. But this did not turn out to be the case. The successful bidders were usually located within a few hundred miles of the Portland office and had previous experience in electronics manufacturing. Such companies as SRC in Seattle, and the Radio Specialty Manufacturing Co. and Oregon Electronics in Portland, consistently bid on and obtained Forest Service contracts.

The smaller local concerns not only lent their expertise to preliminary design considerations, but they also were cooperative when units were coming off the production line for testing. They provided valuable assistance in suggesting or completing the necessary changes between the prototype and final product, or incorporating alternatives that would improve performance.[34]

No administrative problem associated with the advent of radio in the Forest Service could bring a faster knee-jerk response from the Washington Office than the subject of "administrative" radio, or point-to-point communications. Even before radio had a chance to prove its effectiveness in putting down fire, the advocates of wireless communication were imagining benefits from "invisible wires" strung throughout the National Forests.

"For example," read a 1932 report, "on a newly acquired ranger district which was without telephonic communication, practically the entire administrative and protective communications was handled by radio."[35] But before work crews could roll up telephone wires and forget about the annual springtime chore of maintaining miles of telephone line after a winter's abuse, someone reminded the visionaries of the lease agreements between the Forest Service and A. T. & T. The arrangements gave the Forest Service up to a 50 percent reduction in toll call rates if it did not use any device in competition with telephone.[36] Unable to justify the expense incurred by loss of these telephone leases, the Chief Forester's office overruled those who favored more radio. He required personnel to emphasize the use and importance of telephone "in order to forestall needless alarm on the part of A. T. & T. that Forest Service radio is unnecessarily infringing on their utilities..."[37] Personnel were to make certain that "...newspaper correspondents are given to understand that, in general, radio will not be used in the ordinary administrative work of the Forest Service."[38] The result was a series of carefully worded statements emanating from the Radio Laboratory during the 1930's:

> We use radio to supplement the telephone system--*not to replace it.*
> - A. G. Simson (July 12, 1934)[39]

> This radio net, if it can be so called, has not replaced the telephone, nor is it intended that it should.
> - A. G. Simson and F. V. Horton (April 20, 1935)[40]

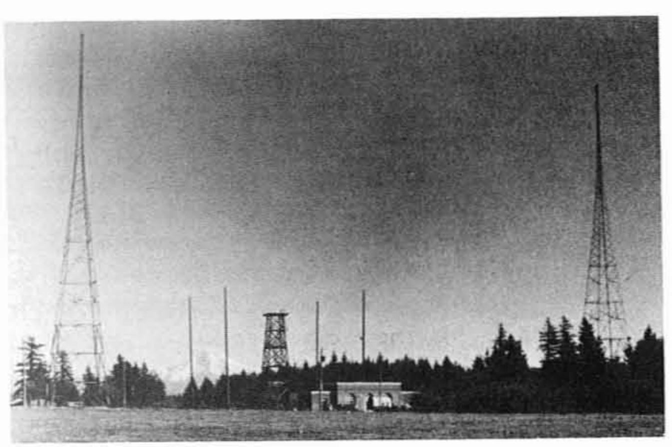

Figure 52. The Radio Laboratory and transmitter towers for control station KBAA on the outskirts of Portland, Ore., national headquarters for Forest Service radio from 1933 until 1952. Mt. Hood appears in left background. (Forest Service photo, History Section)

> Radio is used in the Forest Service primarily as a supplement to the telephone. In most instances it cannot replace the telephone. Instead radio furnishes communication where the telephone is impossible or impractical.
> - A. G. Simson (April 11, 1936)[41]

> ... each has its place in the forest communication system. Where the use is not heavy, where telephone line maintenance is difficult or expensive, and in areas of heavy static, such as where a telephone line covers territory with radical changes in elevation, the radio may furnish more satisfactory and dependable communication than the telephone. On the other hand, for 24-hour service and where it is necessary to have community outlets, as in cities and villages, the telephone is usually more useful than the radio.
> - A. G. Simson (April 1938)[42]

Figure 53. At work in the Portland Radio Laboratory are, left to right, Harold Lawson, Ralph Kunselman, and Foy Squibb. (NA:95G-302659)

Figure 54. George Barrett of the Portland Radio Laboratory communicating with Civilian Conservation Corps (CCC) camps operated by the Forest Service in northern Oregon and southern Washington, 1935. (NA:95G-302663)

> In general good telephone will furnish better communication than radio, though there are many exceptions to this generalization.
> - *Radio Handbook* (April 1938)[43]

Radio Laboratory Is Moved to Portland

Once the principle was established that lightweight, low-power, low-cost radio could be a part of the arsenal of forest protection devices, establishing permanent and improved facilities became the next priority. The rented house in Vancouver was not much of an improvement over its predecessor in Tacoma. It lacked adequate space, security, and amenities. When a defunct radio station, KEX (at 122d Avenue and Glisan Streets, on the outer limits of Portland) became available in 1933, the Forest Service took a 3-year lease on the property and then acquired the site, covering 5 acres.[44] It served as the headquarters of Forest Service communication development for the next 18 years. Located within view of Mt. Hood some 40 miles to the east, it was ideal for Laboratory development programs. It was not only large enough, but also was equipped with the dream of radio experimenters--two 220-foot steel towers. After building on to the rear, and adding four tall telephone poles and a lookout tower, the Forest Service found that most situations could be duplicated and tested at the site.

During the first few years of Forest Service radio development, a significant difference of opinion inherent to radio acted as a divisive force within the Regional communications sections of the Forest Service. This issue was the effective relationship of transmitter output power, or wattage, to the distance that a transmission must travel. The proponents of "brute-force" propagation were ever ready to argue the merits and minimize the drawbacks of shifting Forest Service transmitters to higher levels of output power. They based their stand on the debatable assumption that if an existing 5-watt transmitter is on the fringe of adequate performance, then a 10-watt version is preferable because it should significantly improve performance.

In retrospect, this situation, was probably partly attributable to the lack of positive leadership from the Washington Office. But it also resulted from the efficient design efforts and planned obsolescence policy of the Radio Laboratory. With new weight-saving models appearing each fire season, communication heads in the field who championed increased power had two effective ways of influencing final design specifications. Each year, they were invited by the Radio Laboratory to submit their suggestions for improved performance. They also often had authority from the Regional Forester to purchase what they wanted when they wanted it. If the Radio Laboratory refused to go along with pre-design suggestions or ignored opinions from the field, a Regional communications officer could resist the expansion of radio communication, at least the Laboratory's models, into "his" National Forests by delaying purchase of planned or existing Laboratory radios. In this way, he could influence the Radio Laboratory in its consideration of Regional needs.

Power Issue Difficult to Resolve

The issue of output power was difficult to resolve for several technical reasons. Perhaps the most apparent was associated with the expected performance of the batteries. During the 1930's, battery cost and longevity had a noticeable influence on radio design. A radio requiring a high current source could decrease the effective operating life of the batteries too quickly. Frequent replacement of the batteries could also make field maintenance cost prohibitive. The Laboratory, therefore, geared each set's power requirements to the intended use of the set and predictable battery performance. The rule of thumb was: "If you double the power, you must double the batteries, and hence, double the weight."[45] An existing 3-watt radiophone weighing 25 pounds, for example, would need to be replaced with a 6-watt unit weighing about 50 pounds--hardly the smokechaser's idea of portability.

The Radio Laboratory saw a second technical point as crucial to the issue of output power. It arose from the widely varying patterns made by radio waves in the atmosphere. Such factors as antenna dimensions and location, topography, weather and climatic conditions, receiver quality, and ionospheric and sunspot activity are of critical importance in determining the effective range of a radio signal. Early experiences in the Forest Service often reflected these peculiarities. Quite frequently, while testing the relative performance of two different units, the signal of a transmitter with only one-tenth the output power of another was received at some distance at a strength equal to that of the much more powerful set.

An example of this phenomena was the some 200-mile air distance between the Radio Laboratory in Vancouver and Lake Chelan. Using a 1 1/2-watt SP set at Lake Chelan, Washington, Ranger Roy Weeman was able to establish regular two-way communication schedules with the 50-watt station at the Laboratory. This link was valuable to the Laboratory in evaluation tests, even though the staff might question the propriety of Weeman taking part in some discussions not intended for him. In one embarrassing instance, Simson wanted to demonstrate the effective range of low power to a Chinese businessman and his son. He located a portable radio several miles from town, and after establishing contact with Lawson and the younger visitor, turned the controls over to the businessman, who started to talk with his son in their native language. Weeman, who missed the first part of the contact, broke in during a pause to ask, "What the hell are you guys doing down there? You sound like a bunch of '*#?&! Chinamen!"[46]

These anomalies of propagation also worked in the opposite manner. At times, nothing could get through. This usually happened when the transmitter was located at or near its designed fringe area. Recognizing that any transmitter, especially in the portable class,

effectively has an undefined boundary for satisfactory performance and a fairly wide region beyond this where performance is questionable, the Radio Laboratory cautioned operators that "a set designed for a 10-mile range very probably will not operate satisfactorily over a 100-mile range."[47] To the proponents of "brute-force" propagation, the staff of the Laboratory would also point out that effective range was determined less by output power than by effective communication planning.[48] Rather than try to use a portable at some fringe distance or under conditions for which it was not intended, they advised supervisors to plan accordingly and suggested that operators alter locations if they found a transmitter or receiver not operating properly within its advertised range. Most radio publications distributed by the Radio Laboratory emphasized this point, and most radio operators familiar with their territories soon learned the optimum locations for effective communications with Ranger stations and lookout towers.[49]

In addition to these technical arguments for staying with low power, Gael Simson also knew that unlimited output power might have a serious and detrimental effect upon the long range communication plans of the Forest Service. As the IRAC representative for the U.S. Department of Agriculture,[50] Simson could see clearly that the number of assignable frequencies was limited and that pressure to relinquish some frequencies would increase as radio expanded into other Government agencies and the military services.

Simson pointed out as late as 1936 that the Forest Service had but 11 "fire" radio channels and that it was necessary to assign the same frequencies to National Forests in the West no more than a few hundred miles apart.[51] Even at minimum power levels, the potential for crowding and serious conflict was significant.

Laboratory Insisted on Low Power

Harold Lawson, who fully supported the technical arguments against the use of increased power and was in total agreement with Simson's conclusions on frequency crowding, often became the target for the frustrations of the proponents of brute-force transmission. They often called the Laboratory "Horton's Hobby Shop," and the attitudes of Simson and Lawson "stubbornness."[52] Communication meetings almost invariably digressed into the merits of particular power limitations.

Jack Horton and Harold Lawson never wavered from their position. From the beginning, Horton insisted "... that low-power was essential."[53] To those who would listen, Lawson recounted his experience with the first National Forest radio network where he learned a lesson on the bad effects of unlimited power. Following installation of a type M set at the St. Joe National Forest headquarters in St. Maries, Idaho, he had distributed an SP set to each of the Forest's five Ranger Districts. While tuning up for a test at the last location, one of the California forests, which had purchased high-power, commercial gear for experimentation, came on the channel and effectively blocked out communications on the St. Joe. Drawing on this situation, Lawson depicted an Idaho smokechaser in the same position attempting to notify headquarters that a fire was out of control. If the smokechaser had to cool his heels while a lookout in California called in his next month's grocery list, the radio would have been rendered ineffective for the very person for whom it was intended.[54]

This argument, of course, was challenged in many ways by those who perceived the administrative structure of the Regions not as a totem pole with the field man at the top, but as a complex of varied services, all with unique requirements and all in need of adequate and equivalent radio communication capabilities (see chapter 15). If this structure required levels of output power threatening the most important link in the fire-control chain, then other agreements, understandings, regulations, and communication plans would need to be devised. Before these differences of opinion could be resolved, however, technology provided a temporary distraction.

Reference Notes

1. F. V. "Jack" Horton to Roy Headley, 26 January 1934, Gaylord A. Knight Collection.

2. Herbert Kaufman has outlined the administrative structure of the Forest Service in the traditional triangular manner and suggested that from the viewpoint of the Forest Ranger this triangle was inverted. The result was that the men in the field believed Washington policy came about because of input from the local level. See Herbert Kaufman, *The Forest Ranger: A Study in Administrative Behavior* (Baltimore: Johns Hopkins Press, 1960), pp. 67, 68.

3. E. N. Kavanaugh to Roy Headley, 20 October 1932, Gaylord A. Knight Collection and Roy Headley to Regional Foresters, 15 November 1932, Gaylord A. Knight Collection.

4. Kaufman, *The Forest Ranger*, pp. 75-80.

5. E. W. Loveridge to Regional Forester, 6 December 1935, Gaylord A. Knight Collection.

6. "Jack" Horton to Roy Headley, 26 January 1934, Gaylord A. Knight Collection.

7. Earl Loveridge to "Jack" Horton, 22 October 1935. In this instance Horton had apparently questioned this practice in an earlier memorandum and Loveridge was responding with an explanation. In turn, Horton wrote Loveridge an apology and asked that they "... continue to work on the basis we have in the past, of being perfectly frank and thick-hided." "Jack" Horton to Earl Loveridge, 22 October 1935, Gaylord A. Knight Collection.

8. Harold K. Lawson, interview with the author in King City, Ore., May 1978.

9. A. Gael Simson to "Jack" Horton, 30 November 1931, Gaylord A. Knight Collection.

10. E. Loveridge to the Regional Forester, Portland, Ore., 9 December 1931, Gaylord A. Knight Collection.

11. Loveridge to Regional Forester.

12. F. V. Horton to Frank Prince, 7 February 1933, Gaylord A. Knight Collection.

13. F. V. Horton to the Forester, 12 January 1934, Gaylord A. Knight Collection.

14. Horton to the Forester.

15. J. R. McCarl, Comptroller General, to the Secretary of Commerce, 21 December 1933, Gaylord A. Knight Collection.

16. E. A. Sherman to the Regional Forester, Portland, Ore., 31 January 1934, Gaylord A. Knight Collection.

17. D. S. Nordwall, "Memorandum for the Record--Radio Laboratory Inspection," 24 March 1947, p. 2, Gaylord A. Knight Collection.

18. C. J. Buck to the Forester, 6 April 1932, Gaylord A. Knight Collection.

19. F. V. Horton to A. G. Simson, 1 December 1931, Gaylord A. Knight Collection.

20. W. M. Hurst, U.S. Department of Agriculture, Bureau of Agricultural Engineering, to I. G. Menikheim, U.S. Department of Agriculture, Office of the Solicitor, 4 June 1932, Gaylord A. Knight Collection.

21. C. J. Buck to the Forester, 6 April 1932, Gaylord A. Knight Collection.

22. A. G. Simson, "Radio as a National Forest Protection Tool," *Journal of Forestry*, 36, no. 4 (April 1938): 366. A reprint copy is in the Gaylord A. Knight Collection.

23. The environmental chamber at the Radio Laboratory consisted of a used oven which doubled as a humidity chamber with the addition of a few wet sponges. Lawson, interview with author.

24. Belleville, interview with the author in Saratoga, Calif., January 1978.

25. Lawson, interview with author, and W. Foy Squibb, interview with the author in Missoula, Mont., May 1978.

26. Lawson, interview with author, and description on Forest Service photo in Still Picture Division, National Archives, Washington, D.C., Record Group 95G, negative No. 322283.

27. Simson, "Radio as a Forest Tool," p. 368.

28. U.S. Department of Agriculture, Forest Service, *Radio Handbook*, (Washington, D.C.: U.S. Department of Agriculture, Forest Service, Division of Operation, ca. 1938), p. 7. Mimeographed.

29. Gaylord Knight, communications engineer in Region 8, had attempted to strengthen his self-acquired electronics background by enrolling in a college of engineering. After canvassing several southern universities, including Georgia Tech, he gave up after traveling to the University of Texas where he was told that he already knew more than they could teach him. Harold Lawson had a similar experience at Oregon State. Enrolled in an electrical engineering program, he switched to forestry on the advice of his advisor, although he continued to find a few courses to support his interest in radio. Gaylord Knight, interview with the author in Atlanta, Ga., November 1977, February 1978, and April 1979, and Lawson, interview with author.

30. Simson, "Radio as a Forest Tool," p. 367.

31. On two occasions the Laboratory hired a qualified graduate electrical engineer. Both times the Laboratory had problems assimilating the men into the development projects. Schooled

in theory, both engineers later sought employment with companies which utilized this background and went on to successful careers outside the Forest Service.

32. C. J. Buck to the Forester, 1 December 1931, Gaylord A. Knight Collection.

33. Earl Loveridge to the Regional Forester.

34. Lawson, interview with author; Belleville, interview with author; and Claypool, interview with the author in San Antonio, Tex., July 1978.

35. U.S. Department of Agriculture, Forest Service, Region 6, "Forest Service Radio," 13 November 1932, unpublished, Gaylord A. Knight Collection.

36. U.S. Department of Agriculture, Forest Service, Region 6, "Forest Service Communications Conference," Summary of meeting, Portland, Ore., 20 February to 2 March 1935; Roy Headley to Regional Foresters, 25 April 1935; A. G. Simson, "Report of Radio Committee--Spokane Fire Equipment Conference," 19 February 1936; and Carl Ewing to Forest Officers, Umatilla National Forest, Ore., 7 December 1938, all in Gaylord A. Knight Collection.

37. Simson, "Report of Radio Committee."

38. E. W. Loveridge, Acting Chief, to Regional Foresters, All Regions, 3 September 1936, Gaylord A. Knight Collection.

39. A. G. Simson to Lewis Winner, Hammarlund-Roberts, Inc., 12 July 1934, Gaylord A. Knight Collection.

40. A. G. Simson and F. V. Horton, "Radio on the National Forests," typed draft of article submitted to *American Forestry* for publication per cover letter, F. H. Brundage to the Forester, 20 April 1935, Gaylord A. Knight Collection.

41. A. G. Simson, "The Role of Radio in National Forest Communication," 11 April 1936, Gaylord A. Knight Collection.

42. Simson, "Radio as a Forest Tool," p. 366.

43. Forest Service, *Radio Handbook*, p. 9.

44. Nordwall, "Radio Laboratory Inspection." The purchase was made from the National Broadcasting Company and the Oregonian Publishing Company, joint owners, for $2,500. The address of the Laboratory was 340 N.E. 122nd Avenue, Portland, Ore. (now 97230).

45. Belleville, interview with author, and Lawson, interview with author.

46. Lawson, interview with author.

47. U.S. Department of Agriculture, Forest Service, Region 6, "Forest Service Radio," 15 November 1932, typed copy, p. 5, Gaylord A. Knight Collection.

48. Forest Service, Region 6, "Forest Service Radio," p. 3.

49. A. G. Simson, *Manual for Operating Radio Set Number P-__*, (Portland, Ore., U.S. Department of Agriculture, Forest Service, 1932); A. G. Simson, *Manual for Operating Radio Set Number SP-__*, (Portland, Ore., U.S. Department of Agriculture, Forest Service, 1932); and *Forest Service Radio Handbook*, p. 7, to name a few.

50. Earl Loveridge was the designated representative, but he had selected Simson for attendance at all IRAC meetings. See Gael Simson, Memorandum, 27 January 1939, Gaylord A. Knight Collection.

51. Simson, "The Role of Radio."

52. Both of these terms were used by William Apgar (Region 1, retired) in an interview with the author. See William Apgar, interview with the author in Sun City, Ariz., January 1978.

53. Horton to Headley.

54. Lawson, interview with author.