



FIG. 1. (Left) Rotary snow plow in action—Big Pines Road. FIG. 2. (Center) Another view of the rotary snow plow in action—Big Pines Road. FIG. 3. (Right) Bulldozer on Mt. Wilson, March, 1944.

# Snow Removal

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## THE PROBLEM

**A**SSOCIATING thoughts of snow and those of a warm climate is not uncommon and, offhand, one might conclude that the removal of snow from the highways of this area could be accomplished by allowing the same invariable natural laws to operate as, in our imagination, dispose of the proverbial "snowball" and the "paraffine dog." Such a conclusion, however, fails to take into account many of the elements of the problem and consequently it may be of interest to consider a few of them. In giving this consideration, it may be well to bear in mind that extensive variation occurs in other parts of the country and that this particular analysis relates only to southern California. Many of the ideas expressed are the result of practical solutions of an interesting problem.

A number of miles of important highways in this area traverse districts where elevations of from three to seven thousand feet are common. From November to March, these districts are subject to snowfalls of from a few inches to seven or eight feet. If no attempt at cleaning is made, important establishments, such as weather bureau stations, scientific observatories, and other inhabited establishments, are isolated for several months and main arteries, such as the Ridge Route and Angeles Forest Highway, are closed. Invariably, also, visitors in the forest area are snowed in and prevented from returning to important duties in the nearby cities. In addition, it should be noted that utilization to the fullest extent of the recreational area provided by our nearby forests can be accomplished, especially in peacetime, only by making them accessible for snow sports.

## OPERATIONS

With this brief summary of the situation in mind, some of the practical features of snow removal may be considered. Probably the most difficult part of the problem arises from the extreme variations in the volume to be handled. In many locations there is no snowfall at all

for periods of several years; then the really unusual weather occurs and there is a fall of several feet and, as might be expected, no adequate equipment is available, not even a good snow shovel. In many locations, falls of less than a foot occur for many years and then a record of five or six feet is noted. Operations also are complicated by the fact that many of the roads involved are rather narrow on side hill locations, and have many curves. Often, the section requiring attention is remote from sources of qualified operators and equipment.

Probably the most universally accepted rule in snow removal is to start clearing when it starts snowing. This practice, however, in our mountainous areas does not result in a perfect record, although nearly so. It is unbelievable how quickly, on a few occasions, that lovely blanket of fluff can settle down and stop the most powerful equipment. In addition, the development of snow slides during a heavy fall is a source of considerable hazard to men and equipment. To follow the practice of prompt starting of the work, requires trained men on the job with proper equipment. Incidentally, it is of considerable importance that the business end of the equipment be headed out. The operator who stores his plow otherwise, and finds three or four feet to be shoveled by hand before the plow can be backed out, will not soon forget it. It may or may not be true, but it appears that most of the snow falls during the night. After men have the experience of getting out during the night, time after time, and then finding that a fall of a few inches could just as well have been swept off in the morning, it becomes more and more difficult to keep them convinced of the necessity of prompt action.

Some very important steps can be taken during the summer months. They consist of: placing snow stakes six or eight feet high to indicate the location of the roadway and the location of drainage structures, such as culverts, ditches and outlets; careful clearance of rocks and other debris, which is a wrecker of rotary plow equip-

ment; provision of adequate drainage channels because of the runoff which occurs under the snow; and, of great importance, the preparation of equipment for the fight to come.

To start promptly in storms that begin during the daylight hours presents no particular problem, but the important feature is to enlist the services of someone who works nights, to inform the gang of the first flake that falls. With this help, a light blade plow can be under way within an hour of the beginning of the storm. Our interest is inclined to center on the spectacular rotary plow, and this is important, but the blower without the blade is seriously handicapped. Conditions vary, but in general accepted procedure consists of starting early with a blade attached to the forward end of a comparatively light truck and pushing the snow to the outer edge of the roadway. On side hill locations only, the outer edge can be used, thus developing the necessity of a reversible blade. In the event that the storm continues during this preliminary operation, the blade plow is gradually restricted in its width of operation, and the rotary plow must be placed in operation to blow the accumulated windrow of snow away from the roadway or over the bank. Both the blade type and the rotary type of plow are seriously affected in their operation by the condition of the snow. During periods of low temperature, when snow remains granular, the operation proceeds with little difficulty, but as alternate melting and freezing take place, it is often found that expert technique on the part of the operator is required to make reasonable progress. In many cases, it is found desirable to stop operations until a change in temperature has altered the consistency of the snow, and thereby to increase the rapidity with which it can be removed.

#### EQUIPMENT

Considerable study has been made by manufacturers of equipment to perfect the various types of snow plows, one of the simplest designs being the reversible plow for attachment to the forward end of a one-and-a-half ton truck. An effort is made to keep the equipment as light as possible in order to relieve the load on the front axle of the truck. The blade is mounted on a center pin, and can be rotated manually to plow in either direction. Considerable care is given to the curvature of the blade, as this feature has an important effect in throwing the snow clear off the roadway if the truck is able to travel at speeds of 20 or 25 *m.p.h.* In general, the forward

frame is supported by arms extending to the rear end of the truck, and the whole mechanism can be raised and lowered by a small hydraulically-operated ram.

The rotary-type plow consists essentially of a simple power drive rotary fan individually driven by a separate gasoline motor. Methods devised to feed the snow to the rotor consist of various blade arrangements or a series of screw conveyors. It is found very desirable to have the rotor arrangement as simple as possible in order to facilitate repairs, because, in spite of the best care possible, rocks will be delivered, and may damage the fan blades. Rotary type plows are, in general, mounted on very powerful four-wheel drive trucks. Careful attention must be given to balance the power and capacity of the rotor with the power and speed of the truck. This is necessary in order that the amount of snow fed into the rotor may not overload it. This feed is controlled by the truck speed. Some of the trucks are able to move at speeds of less than one half mile per hour with motor at full governed speed, thus developing a powerful thrust but at a speed best suited to the rotor capacity.

Many other types of equipment, in addition to specialized snow plows, have been found effective as an expedient, or for some specialized purpose. In general, however, such equipment as the bulldozer, the motor grader and the tractor loader is limited in its usefulness in heavy snow by its inability to dispose of accumulations. In addition, the track-laying type of equipment often injures existing road surfaces to a rather serious extent. During the more serious type of storm, conditions involving snow slides, mixed with debris, eliminate the possibility of using plowing equipment, and dictate the use of bulldozers or, in some cases, power shovels. The use of bulldozers, in combination with industrial type loaders, often proves very satisfactory. With this combination, the snow is piled and then shoveled over the side with the loader. One of the serious deficiencies of this type of equipment is the lack of adequate shelter and heating provisions for protection of operators.

#### BATTLE TO THE END

In many respects, the operation is a real battle against the elements. As a consequence, it cannot be performed on an eight-hour basis. When this job is started, it must be fought through until the storm is ended and the road is clear, or it is lost. This often means continuous operation for 48 hours or more. Equipment must be repaired and supplied with fuel, in many cases, over damaged

AT RIGHT:

FIG. 4. Big Pines Road, 1944.



and partly blocked roads. Operators must be relieved, rested and fed. To accomplish these things, supply stations must be maintained and stocked with essential supplies and materials. Minor repairs, such as replacement of damaged motor blades, are ordinarily made where they happen, but when more extensive repairs are called for, a heated building is required. It is disagreeable enough to make repairs, but when the patient is encased in several inches of frozen snow and ice, it is a discouraging prospect.

Well-constructed, heated, operating compartments on equipment are not only desirable but essential for effective work. In some cases, they constitute the minimum of safety for personnel. In the heavier types of work, at least two men should be assigned to each operation, and, in general, should not separate during the period of storm. There have been cases where near fatalities occurred because one member of a crew attempted to "walk out" when equipment stalled.

The need for well trained, energetic men in snow removal operations is of primary importance. The entire operation appears simple while the sun shines and the ground is bare, but when the fight is on, an inexperienced operator soon becomes a liability, and, in addition to being a hazard to himself and fellow-employees, may cause actual physical damage to the road structure. A case to illustrate this fact was brought about by the plowing of a single roadway in mountainous country during a three foot fall, which created a sluice-way, down which melted snow, water and ice rushed to form an ice jam, which, in turn, diverted the flow over an embankment, and resulted in several thousand dollars' damage which might have been prevented if precautions had been taken.

Snow is an asset to this warm, desirable climate if, like most assets, it is handled with care and understanding. From the viewpoint of purely physical enjoyment, what is more pleasing and invigorating than a drive through the frosty, snow-covered mountains into the summery climate of the valleys below? There are many who have experienced this pleasure and there are many who look forward to it when peace comes again. If you enjoy the ride, just remember that someone has probably toiled through the chilly night to make it possible.

### Rhumba Run

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one of these holes, much less crawl through and eat his fill. The engineer in charge, a man whose temper has been shortened by 20 years of such trials in South America's out sections, took just one look. With an acrid Spanish oath he ripped the cover from a single can. A driver ant, too long to go in any other way, was curled up and deposited inside. This can with the cover replaced was air-expressed back to the manufacturer by the same plane it arrived on.

Much of the airport work is done by Indians. They vary in type and appearance as much as Bolivia's geography. All along the Cordillera are the copper-skinned Quechuas and Ayamarás. An almost pure race, these people still speak no Spanish, only the tongue of their Pre-Incaic forebears. Heavy boned, with enormous chest development and apparently no feeling of cold, they are well adapted to their high environment. The Indians in the low regions are much more primitive. Printed across one jungle portion of the excellent map compiled by the

Bolivian Cartographic Commission are the words *Gentios Salvajes*. This means Savage People. Whether these people are really savage or not is a common conversational topic. The consensus is generally with the "nots." But at least they have the equipment for making any unwanted visitor exceedingly unhappy should they choose to do so. No archer from Robin Hood to Ralph Hoogerhyde ever dreamed up a siege gun of the sort these boys use. The author has in his possession a number of *Gentio Salvaje* arrows and a bow. The arrows are 11 feet long, longer than an Olympic Games javelin and somewhat more vicious, being sharply barbed over the first 15 inches of the business end. The bow is a section of dense black-palm only a little less stiff than a piano leg. It is strung with a raw-hide thong as thick as a piece of sash cord. The bowman sits on the ground, places this little number across both feet, and hauls back the bow string with both hands.

Fortunately the chances of a Rhumba Run passenger ever finding out first hand if these people are savage or not is very remote. In the first place the route does not cross the area that is their usual habitat. In the second place the people setting up the methods of operation have been more conservative than a bunch of Coolidge era Republicans. All the planes are multi-motored craft capable of flying with one engine dead. They carry a separate radio operator which permits the taking of constant position checks by radio bearings and gives the first officer more time to spend on straight navigation. Gasoline loads are high. On the Rhumba Run enough fuel is carried not only to permit the pilot to reach an alternate airport in bad weather, but to return to his point of departure should he so desire. As additional trouble insurance in the event of a forced landing at some place in the wilds, the planes carry a bewildering assortment of equipment never seen on more domestic airlines. A list of these items looks like the inventory of an Army-Navy department store. They range from a shotgun and machete to a two-quart pot for cooking beans. Fish hooks, bait, and a Boy Scout knife are only three more items in a list of 50. A separate medical kit contains everything from benzedrine to a bottle of Haig and Haig. There probably never will be a fool-proof airplane so long as human beings build and fly them. Anyhow, it doesn't hurt to push the chance for trouble right out to the last limit of probability.

In spite of all obstacles such as hard center clouds, altitude airports, ants, and an ox-cart fuel supply in places, the Bolivians have a goal worth the long haul their airline development will take. One day the natural resources tapped and the new areas opened will prove it. Long before this happens *Lab* and the Rhumba Run may mean a great deal to many people who will never see Bolivia. The cargoes moving in and out of Latin American airports are now peaceful ones of salt, meat, sewing machines, and plowshares. When the time comes that these must be replaced by swords, soldiers, and bombs, the Americas, both North and South, will prove that they can do this, too.

### FOOTBALL SCORES

The following, are the season's football scores:

Sept. 15	CIT—67	Univ. of Redlands.....	0
Sept. 22	CIT—39	Univ. of Redlands.....	0
Sept. 30	CIT—20	USC Jr. Varsity.....	0
Oct. 6	CIT—33	UCLA Jr. Varsity.....	0