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OBSERVATIONS OF THE SNOW COVER IN THE SOUTHERN PART OF THE BURYAT AUTONOMOUS SOVIET SOCIALIST REPUBLIC

Ye. A. Nefed'eva

Translation of "Nablyudeniya nad snezhnym pokrovom v yuzhnoy chasti Buryatskoy ASSR", IN: Geografia Snezhnogo Pokrova (Geography of Snow Cover), Academy of Sciences of the Soviet Union Press, Moscow, 1960, pp. 37-44

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16. Abstract

The article discusses the characteristics of the snow cover, as a function of various natural factors, in sectors of the southern part of the Buryat Autonomous Soviet Socialist Republic. The thawing process is also discussed.

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OBSERVATIONS OF THE SNOW COVER IN THE SOUTHERN PART OF THE BURYAT AUTONOMOUS SOVIET SOCIALIST REPUBLIC

Ye. A. Nefed'eva

In the Buryat Autonomous Republic, the basic territories of economic development are its steppe and forested steppe regions, which are located chiefly in the vast intermontane depressions of the southern and south-western Transbaikal Region. /37*

The natural conditions of these parts of the Buryat ASSR, although they are the most developed, have been insufficiently studied. Specifically, until recent times, hardly any attention had been given to the study of the snow cover and the potential for its utilization for meliorative purposes, although the problem of the production of additional sources of moisture has especially great significance for the arid regions of the dry steppes of the western Transbaikal Region. The latter was noted by G. D. Rikhter (1953), who includes the flat regions of the Buryat ASSR among the territories which require the application of permanent measures for snow protection, snow accumulation and retention of snow-melt water.

Special studies on the characteristics of the distribution and properties of the snow cover in the territory of the Buryat ASSR have only been carried out in the region of the Gusinoozerskaya Basin (Bashkuyev, 1955). In studies of a generalizing nature, devoted to the study of the snow cover, only some of the characteristics of the winter period and some of the properties of the snow cover of the Transbaikal Region have been reflected (Karol', 1949; Rikhter, 1948, 1953). In this case, until recently, the magnitude of snow accumulation and water reserves in the snow cover have been evaluated in the Buryat ASSR on the basis of the data of hydrometeorological stations, the greater part of which are located in river valleys. Therefore, the factual material gathered by them, in spite of the systematic nature of the observations, may not serve

*Numbers in the margin indicate pagination in the foreign text.

as a sufficiently good basis for evaluation of the magnitude of snow reserves in the mountain regions, and also does not reflect the characteristics of distribution of the snow cover as a function of the conditions of the relief and the vegetation, even within the limits of one and the same topographical zone.

In the spring of 1956, by commission of the Buryat-Mongolian Expedition of the Soviet for the Study of the Productive Forces of the Academy of Sciences of the USSR, we carried out vehicle route observations of the nature of the distribution and sequence of convergence of the snow cover in the steppe, forested steppe, and specifically the marshy-meadow and forested meadow-steppe regions of the Buryat ASSR, namely in the valleys of the Uda River, in the Yeravnin Basin, and the valleys of the Selenga River (in its lower and middle flow) and the Dzhida River. In this case, the observations covered basically the lower stages of the relief. In the course of the field studies, we utilized sectors which differed in the nature /38
of their relief and vegetative cover, within the limits of different types of terrain, for the snow-measurement observations. The visual observations, which consisted of establishment of the degree of coverage of the territory by snow, were accompanied by the measurement of the height and density of the snow cover in the support sectors, where the characteristics of the structure of the snow layer were noted.

The route observations, along with the shortcomings, which were substantial in the given case, mainly the absence of observations of the dynamics of the snow cover, had important advantages. The conduct of observations during roughly one and the same periods (from March 27 through April 11), in regions which are different in their geographic position, absolute altitudes and general natural appearance, made it possible to obtain some comparative data relative to the characteristics of distribution, sequence of convergence and properties of the snow cover in various types of terrain. In this case, the reliability of the obtained results, in spite of the briefness of the studies, was ensured, to some degree, by the massive nature of the observations.

The characteristics of distribution and the nature of the snow cover in various parts of the Buryat ASSR are determined by the nature of the relief and the climatic characteristics of its natural regions.

The basic elements of the topography of the territory being characterized are the ridges of average height (on the order of 1,600-1,800 m), which extend primarily in a northeasterly direction and divide their vast intermontane basins, the largest of which are occupied by the valleys of the Selenga and Uda Rivers and their tributaries. The absolute heights vary from 2,323 m (Mount Sokhor) to 454 m (level of Lake Baikal). The floors of the valleys and the intermontane basins are located in the northern part of the Selenga Basin at heights of 500-600 m, and their elevations increase to 900-1,000 m to the south and east.

Six types of terrain are widespread in this part of the Buryat ASSR: 1) flat meadowlands, 2) dry mountainous steppes on chestnut brown soils, 3) mountainous steppes on black soils, 4) pine forests on sands, 5) mountainous forested steppes and 6) moderately-mountainous taiga (Preobrazhenskiy, Fadeeva, 1956), with the presence of a complex of terrain types being characteristic for it in individual natural regions. As a rule, the terrains of one and the same type are confined, in the southern regions, to higher elevations than in the northern regions (by roughly 200-300 m), and sometimes to elements of the relief which are higher in their hypsometric position. Thus, for example, the dry steppes in the northernmost regions occupy the floors of basins, whereas in the southernmost regions, they are elevated onto the slopes of ridges. At the same time, the specifics of the appearance of each of the natural regions is determined by the predominance of some types of terrain or others. For example, in the middle flow of the Selenga River, steppe complexes predominate, and in its lower flow — marshy meadowlands and partially-forested steppe regions, along the Dzhida Valley — mountainous forested steppes, along the Uda Valley — pine forests and forested steppes, and in the Yeravninskaya Basin — forested-meadow steppes.

The climate of western Transbaikal is inclement. Even in the flat steppe regions, the duration of the period with negative average daily temperatures is six-seven months a year. The small amount of precipitation (350-400 mm/year) in places brings about the dryness of the first half of the year and the small amount of snow in winter. In the larger part of the flat regions, the average thickness of the snow cover is very small, and varies within the range of several dozen centimeters. The lower courses of the Selenga (Kabansk) are included among the regions of least snow, while the regions in its middle flow are characterized by exceptional lack of snow (the Gusinoozerskaya Basin, for example). The lack of snow in winter, the deep freezing of the soil, and the sunny spring with few clouds /39
bring about the unique course of snow melting, and namely the convergence of a considerable part of the snow cover with negative air temperatures (radiation melting), which is reflected both in the nature of the spring erosion processes, and in the spring wetting of the soil.

The characteristics of the winter-spring season of 1955/56, which determined the nature of the distribution and convergence of the snow cover to a considerable extent, consisted of the following. In the winter of 1955/56, the snow cover was characterized (as is usual for average winter conditions) by great nonuniformity of distribution in various regions (Table 1).

Table 1
Height of snow cover (maximum from average ten-day magnitudes)

Natural region	Site of observations	Height of snow cover, cm	
		average data of many years	1955/56
Ivolginsko-Orongoyskiy steppe and swampy meadowland......	Novoselenginsk	6	5
Khamardabansko-Dzhidinskiy mountainous forested steppe	Tsakir.......	15	7
Udinskiy dry steppe.........	Ulan-Ude.....	17	13
The same....................	Khorinsk.....	No data	3
Del'toyyy-Nizhneselenginskiy marshy meadow and steppe...	Kabansk......	26	31
Yeravninskiy meadow and steppe	Sosnovo-Ozersk	No data	13
Kurbinskiy mountainous steppe and forest................	Novaya Kurba..	The same	1

In this case, as shown by the materials of the hydrometeorological stations, the height of the snow cover changed weakly in the majority of the regions in the course of three-four winter months (from the end of December through March), *i.e.*, a sharply-pronounced maximum was absent, which, in the opinion of G. D. Rikhter (1948), is a characteristic feature of the entire Transbaikal Region. The density of the snow cover of Transbaikal, as indicated by G. D. Rikhter (1948) and B. P. Karol' (1949), is comparatively low (0.15-0.18, rarely 0.20). It changes little in the course of winter, which is explained by the durable frosts, rare snowstorms and the absence of thaws. In 1956, by the end of March, the density of the snow was 0.13-0.20 in the majority of the steppe and forested steppe regions of the Buryat ASSR. Direct observations showed that, in the open steppe regions, the snow cover, in spite of the low average density, is characterized by a rather high nonuniformity of position, brought about by the redistribution of the snow by wind. The same was noted by B. V. Bashkuyev (1956) for the Gusinoozerskaya Basin. As a result of wind transportation, snow accumulations form in depressions in the relief, and also at natural and artificial barriers. The magnitude of the water reserves in the snow increases in wind-blown drifts, as compared with the average magnitude for the given terrain, by 5-10 times, the density of the snow increases in them up to 0.30-0.35, and the thickness of the accumulations rarely reaches 1-1.5 m. The process of recrystallization of the snow layer during the winter season proceeded in the direction of enlargement of the firn granules, and was accompanied by the appearance of a deep frost in the lower levels.

Two stages were rather well discerned in the melting process of the snow cover.

In the course of the first stage of snow melting, which en- /40
compassed all of March[1], there occurred partial convergence of the snow cover, and in some regions (Borgoyskaya Steppe), its total disappearance, associated with the radiation course of snow melting.

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[1]In the northernmost regions, and also with an increase in the absolute heights of the terrain, a shift was observed in the time of the basic stages of snow melting.

Fig. 1. Snow accumulations in a ravine, cut into the slopes of a bench of the Uda River.

Evidently, these early periods of total convergence of the snow in the steppe regions are brought about, to a considerable degree, by the lack of snow in winter, and, what is more, in the open sectors, a solid snow cover is rarely retained, and with partial bareness of the surface, the intensity of radiation snow melting increases.

The second stage of snow melting began with the appearance of spring thaws, which was observed during the last days of March in greater part of the regions. Active snow melting in the forested and forested steppe regions was characteristic for this period. By this time, the snow cover had basically melted in the open sectors. It remained the longest in shaded spots: in ravines, hollows, and under the scarps of benches (Fig. 1). During this period (end of March — beginning of April), the nature of distribution, thickness, degree of deformation of the snow cross-section and percent coverage of the surface are especially closely connected to the latitude and absolute height of the terrain, the exposure of the slopes and the extent of forestation of the territory. At the same time, contrasts are revealed which are associated with the wind redistribution of the snow during the winter period, since, because of the slowed melting of the snow masses, the sites of snow accumulation are well-delineated on the terrain after the convergence of the solid snow cover (Fig. 2). Thus, in the Selenga Delta, we observed snow accumulation up to 1.5 m in height, and in the surrounding terrain, the snow cover had already disappeared. In the region of the village of Sosnovo-Ozersk, during the first ten days of April, snow areas up to 20 m wide with a thickness of about 1 m remained in some enclosed pastures and wattles, and in the open sectors, the distribution of the snow cover had a /41 blotchy nature, and its height did not exceed 8-10 cm. In the fields, the distribution of the snow cover was often associated with the nature of their agricultural cultivation.

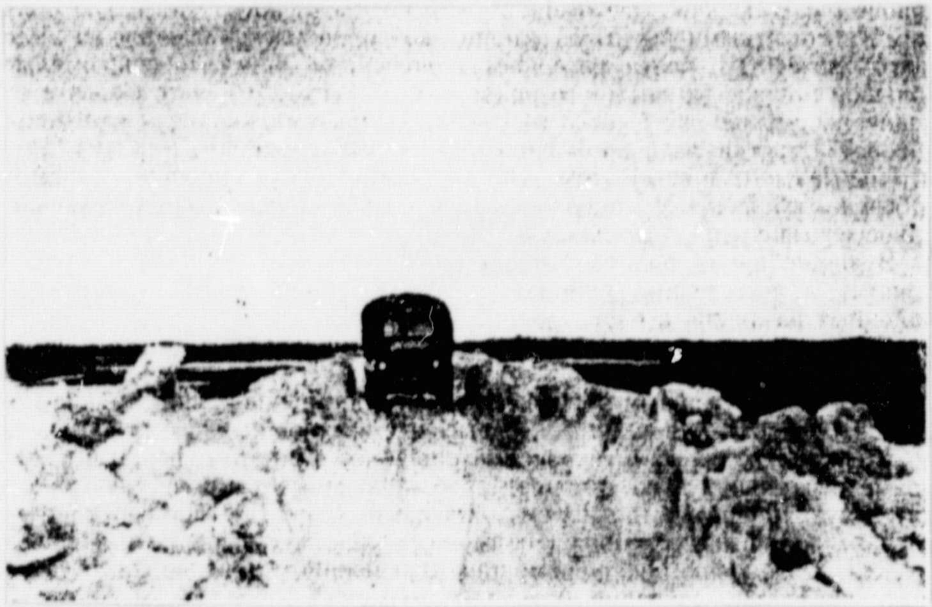

Fig. 2. Snow accumulations on a road in the region of the village of Tvorogovo (lower part of Selenga River).

Thus, for example, in the region of the village of Klyuchi (mountainous steppe on black soils), the height of the snow cover at the end of March was 20-25 cm on the stubble fields, and a total of 10-12 cm on plowed fields. In the open sectors of the mountainous forested steppe on the north slope of the Khudunskiy Ridge, the difference was even more considerable: in the stubble fields with a snow coverage of up to 60-70%, the height of the snow cover reached 8-12 cm, and on the plowed fields, it was a total of 4-5 cm with a coverage of up to 10-15%.

As was already indicated, the observations of the snow cover were carried out basically from the end of March to the middle of April, which roughly coincides with the second stage of snow melting. In the course of the observations, we revealed some regularities in the distribution of the snow cover, and also in the course of snow melting, both in different natural regions, and in different types of terrain.

The earliest convergence of the snow — during the second half of March — was observed in the central part of the Selenga Basin, where comparatively small absolute heights (500-600 m) and the southern position of the region brought about the small height of the snow cover. The convergence of the snow in the southwestern part of the Buryat ASSR, in the Khamardabansko-Dzhidinskiy mountainous forested steppe region, was confined to the later dates, namely the beginning of April, which was associated with an increase in the absolute heights of the terrain (Dzhida benches are located at elevations of 800-830 m) and the height of the snow cover (up to 15 cm during the period of the maximum in the open sectors near the village of Tsakir), and also with the narrowing of the Dzhida Valley and its considerable forestation. The latest convergence of the snow — in the middle of April — was observed in the eastern part of the territory being studied: in the Yeravninskiy meadow and forested steppe region, and also in the delta and forested steppe region of the lower course of the Selenga River. In the Yeravninskiy Region, the later snow melting /42 was brought about by the comparatively large absolute heights (floors of the basins are located at heights of about 840 m), the more northerly position of the region, and the relatively great thickness of the snow cover (up to 13 cm). In the Selenga Delta, the slowed melting of the snow was brought about by the maximum magnitude of the snow reserves (on the order of 60-100 mm) for the lowland regions of the Buryat ASSR. The considerable snow reserves in this region are explained by its position on the shores of Baikal at the foot of the windward slopes, which delay the precipitation brought in from the west.

At the same time, a number of characteristics of snow accumulation and snow melting in the steppe and forested steppe regions of western Transbaikal does not depend on regional differences, but is determined solely by the type of terrain.

In the meadow, mainly bottomland lowlands, the snow melting takes place more slowly than in the sloped and benched lowlands, which are higher in their hypsometric position. In this case, the snow cover of the bottomland lowlands, even during the period of snow melting, has a considerable thickness (up to 40 cm in the lower course of the Selenga) in a number of cases. The longest retention of snow patches in the bottom land sectors is evidently a result of the increased thickness of the snow cover in the meadow lowlands, because of the blowing of snow there during the winter period from the higher open sectors, and its accumulation in the high grass and near hillocks. What is more, the slowed melting in the bottomland may be brought about by the shading of the surface by shrubbery, and also by the presence of frozen soils with ice lenses. In the lower weakly-sloped meadow lowlands, located in the peripheral sectors of the debris cones, the height of the snow cover, because of the wind accumulation of snow during the winter, is also slightly greater than in the dry steppes or on benches. In these sectors, the snow converges later than in the dry steppes.

Characteristic for the mountainous dry steppes is the earliest freeing of the surface of snow, as compared with the lower (meadow lowlands) and also the higher (black soil mountainous steppes) levels of the relief. This is most likely associated with the active carrying out of snow, as a result of the openness of the terrain, which brings about the comparatively low height of the snow cover. The broad dissemination of the snow drifts indicates the great activity of the wind transfer of snow in terrain of this type. What is more, the reduced magnitude of the snow reserves in the dry steppes may be partially brought about by the specific distribution of precipitation in the intermontane basins.

In the mountainous black soil steppes, the snow usually remains somewhat longer, which is evidently associated with the great thickness of the snow cover, which is brought about both by the increase in the snow reserves because of the solid precipitations with an increase in the absolute heights of the terrain, and by the lesser carrying away of snow by wind, because of the protection of these sectors by mountain slopes. Thus, in the Ivolginskaya Basin, the height of the snow cover at the end of March reached 5-10 cm in the meadow lowlands and the dry steppes, and 10-25 cm in the black soil steppes. It is possible that the formation of black soils in the lowlands below the mountains is brought about, to some extent, by their moistening, which is better as compared with the regions of the dry steppes, because of the thicker snow cover and the comparatively greater percentage of covering of the territory by it.

The dependence of the intensity of snow melting on thermal and insulation conditions, as well as the degree of shading of the underlying surface, is also emphasized by the sequence of convergence of the snow after snowfalls. Thus, to the east of the village of Petropavlovka, the snow, having fallen at night on March 28, covered the /43 entire surface with an even layer 2-4 cm thick. In spite of the negative temperatures of the air (-3° at 1:00 p.m.), the freshly-fallen snow disappeared on the high benches (dry steppe) by 2:00 p.m., by 3:00 p.m. on the hilly slopes with a southern exposure (open sectors of the forested steppe), by 5:00 p.m. on the train below the mountains (black soil steppe), and it remained until the following day on the bottomland partially shaded by shrubbery.

Evidently, one may assume that the difference in the distribution of snow reserves, and consequently the specifics of snow melting in various types of terrain, are brought about, to a certain extent, by the confinement of the latter to certain levels of the relief, basically those which determine their wind and insulation conditions. In this case, on the open lowlands and weakly-sloping sectors in the intermontane basins and the valleys, the magnitude of snow accumulation and the characteristics of distribution of the snow are determined, to a very considerable extent, by the characteristics of redistribution of the snow with its wind transfer.

For terrain of the forested steppe, and especially forested types, later convergence of the snow cover is characteristic, as compared with terrain of the steppe and meadow type, which is basically associated with an increase in the amount of solid precipitation with an increase in the absolute heights. What is more, in the open sectors of the terrain of the forested steppe type, the snow converges somewhat later, also because of the reduced wind carry-off. In pine forests, basically located on the high benches of the Uda, and in the mountainous taiga regions, the shading of the surface evidently limits the development of radiation melting, and slows the general course of snow melting, which is comparable to its course in sectors with the very same conditions of relief in the dry steppes and in the small-leaved and mixed forests.

In the comparatively strongly broken-up forested steppe and partially steppe regions, the sequence of convergence of the snow cover is usually determined by the exposure of the slopes and the degree of shading of the surface. Thus, for the forested and open sectors, the sequence of convergence of the snow is usually as follows: the slopes of southern exposure are free of snow first of all, then those of western exposure, the eastern somewhat later, and finally, the northern faces. In this case, the forested slopes of southern exposure are free of snow roughly at the same time as the open lowland sectors, and sometimes even earlier. On the steep northern slopes, the thickness of the snow cover in their lower part is slightly less than on the forested sectors of the lowlands, as a result of which the snow converges on these sectors roughly simultaneously. The difference in the periods of convergence of the snow in forested and open sectors of identical exposure is several days. The thickness of the snow cover in the forested sectors and in the taiga regions, even in the spring period when part of the snow has already managed to melt, was considerably greater, in a number of cases, than on the open sectors during the period of maximum snow accumulation (Table 2). An especially considerable increase in the height of the snow cover is observed in the mountainous regions (Table 3).

The specifics of the winter period, and the characteristics of the conditions of the snow cover, determine the degree of its participation in the naturally, and specifically geomorphological, processes. Thus, a small overall thickness of the snow cover on the territory of the Buryat ASSR, the extended nature of the snow melting, when part of the snow converges with a radiation type of melting, and the great water-absorbing capacity of the soils, which, as a result of weak autumn moistening, remain porous, in spite of their thorough freezing through, weakens the eroding effect of the snow melt water (Bashkuyev, 1956). The spring erosion is manifested, in the majority of cases, only in deepening and widening of ravines, where large snow accumulations formed.

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Table 2
Height of snow cover (in cm) in forested and open sectors in 1955/56

Natural region	Data of observations			Data of hydrometeor. stations	
	types of terrain	dates	Height of snow cover in cm	Observation site, on open areas	Max. ht. of snow cover for winter, mm*
Khamardabansko-Dzhidinskiy mount. steppe	Forested sectors of steppe	20—31.III	11—16	Tsakir	7
Kurbinskiy mount. step and forests	Pine forests	4.IV	5—6	Novaya Kurba	1
Udinskiy dry steppe	Forested sectors of steppe	5.IV	11—14	Khorinsk	3
Del'tobyy-Nizhneselenginskiy marshy meadow and steppe	Meadow (bottomland) lowland w/shrubs	10—11.IV	25—45	Kabansk	—
	Pine forest	Same	30—40		31
	Forested sectors of steppe	» »	20—50		—

*According to average ten-day data.

Among the forms of the relief, which form during nival processes, one should recall microforms of the "aerial trough" type, which occur under the effect of snowflakes in depressions of the relief under the scarps of benches, and in places on the northern slopes of hills and elevations in the Uda Valley, for example, near the village of Poperechnoye. Their dimensions, as a rule, are small, and reach 1-2 m in diameter vertically and 1-1.5 m horizontally at a depth of 1-1.5 m. What is more, on the northern slopes of hills, broad gentle depressions are encountered, which are occupied by vast

Table 3
Change in height of snow cover in forested sectors in the forested steppe and in mountinous taiga regions, as a function of the absolute height of the terrain (March 31)

Natural region	Site of observations	Abs. ht., m	Ave. thickness of snow cover, cm
Khamardabansko-Dzhidinskiy mount. steppe	Slopes of valley of Dzhida River east of Tsakir	1000	10
The same	Takirka River Valley	1200	17
Khamardabanskiy bald peak-taiga	Pass through Klyuchevskiy Ridge to Bayangol	1550	50

snow accumulations, and may develop as negative forms of the relief, under the effect of the nivation processes, to a considerable extent.

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