"Esta sección contiene imágenes en mal estado"

REFERENCIA A NIVEL INTERNACIONAL

STEVENS PRICE LIST

STEVENS Type A/F Logger
STEVENS 420 Level Logger

Bulletins 76 and 81

Note: MINIMUM ORDER CHARGE $50.00

STEVENS Type A/F Logger, MODEL 8901 (P/N 45018) - Basic Logger unit for field logging of single parameter water-level data, or for reading of Data Card information when used in Data Port mode. Built-in 8-digit LCD display and integral membrane keyboard. Slot for accepting Stevens Data Card, listed below. Incorporates fully RS-232D compatible serial port. Designed for use with Stevens Type A/F Encoder, listed below.

(Configuration can be set by user in field.)	[ ] English [ ] Metric	[ ] Data Logger mode [ ] Data Port mode	**Price $7[illegible].00**

STEVENS Type A/F Encoder, MODEL AF-1 (P/N 44903) - Encoding device for use with Type A/F Logger. Designed for easy field attachment to Stevens Type A and Type F recorders for encoding water-level information with Type A/F Logger. Comes complete with installation kit for both Type A and Type F Recorders. Integral 6-foot, 4-conductor shielded cable. For use with 18-inch or 375-mm circumference pulleys only. **Price $280.00**

Encoder Adapter Kit (P/N 46246) - For standalone operation when used with Type A/F Encoder. Does not include float pulley, float, cable, or counterweight. **Price $150.00**

NOTE: For standalone applications, be sure to order both Type A/F Encoder and Encoder Adapter Kit.

Adapter Kit for Punch Tape Recorder (P/N 45278) No Charge

STEVENS 420 Level Logger - Basic Logger unit for remote short- or long-term data logging applications or for reading of Data Card information when used in Data Port mode. Built-in 8-digit LCD display and integral membrane keyboard. Slot for accepting Stevens Data Card, listed below. Incorporates fully RS-232D compatible serial [illegible] Designed for use with Stevens Submersible Depth Transmitter (see Price List 75)

(Configuration can be set by user in the field.)	[ ] High Scale [ ] Low Scale	[ ] Data Logger [ ] Data Port mode	**Price $795.00**

STEVENS Data Card, MODEL DC64 (P/N 45068) - Data card storage unit for use with Stevens Type A/F Logger. Stores up to 30,000 readings at fixed time interval programmed in logger. Can be read out through serial interface [illegible] Type A/F Logger when logger is configured in Data Port mode. Data storage is solid-state, maintained by sm[illegible] [illegible]ium battery. Screwdriver included to access battery compartment. **Price [illegible].00**

NOTE: Quantity discounts for Loggers, Encoders, and/or Data Cards:

1-4	List price as shown
5-9	5%
10 +	10%

NOTE

Prices F.O.B. factory Beaverton, Oregon. Insurance is buyer's responsibility. *Standard packing is provided. Additional charge for export packing.* When ordering replacement parts include serial number of instrument. Authorization number required prior to return of goods to factory (call or write for this number).

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

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There is another indication of age. The landslide dam stopped sediment transportation; thus the alluvial fan of San Gonghe brook did not develop in comparison with fans from adjacent brooks. These facts indicate that the landslide is not very recent, but probably occurred within the Holocene.

References
Feng, X.Y. (1981): Loess in the north of Xinjiang Province. Symposium on Quaternary geology and glaciogeology in Xinjiang, in Chinese.
Han, S.T. (1981): Cause of formation on the Tianchi Lake. Symposium on Quaternary geology and glaciogeology in Xinjiang, in Chinese.

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Landslide Research Organizations

Debris Flows and Their Control in Alma-Ata, Kazakh SSR, USSR

N POPOV

Kazakhstan (Kazakh Soviet Socialist Republic) is located in the southeastern part of the Soviet Union and has an area of 2.17×10^6 km^2. The largest portion of this land is occupied by the north and west Tian-shan and Altai mountain ranges where people suffer from debris-flow disasters. In the highlands, glaciers are widely spread and there are more than 300 hazardous debris-flow river basins. For the past 70 years, more than 650 debris-flows have been recorded in this region and 10 of these were catastrophic disasters. A great variety of geologic conditions in this region result in various causes of debris-flow phenomena, such as debris flows in torrents and glaciers, landslides, and mixed phenomena. Debris flows in Kazakhstan are distinguished by their high debris density, which is 2.0-2.3 t/m^3, and by their considerable variation in dynamic characteristics.

Among these debris flows, the most catastrophic one occurred after heavy rainfall on 7-8 July 1921 in Zaili, Ala-Tau region, when densely populated areas, including Alma-Ata, were affected; approximately 500 lives were lost. The debris flow on the Bolshaya Alma-Atinka River caused great damage in 1950. Active snow melting and rains in April of 1959 gave rise to a powerful debris flow in the Dzungarian Ala-Tau region near Takeli; many lives were lost here, also. In 1963, a significant glacial debris flow, of about 6×10^6 m^3, fell into Lake Issyk resulting in the outbreak and generation of a secondary debris flow in the valley along the Issyk River. As a result, hundreds

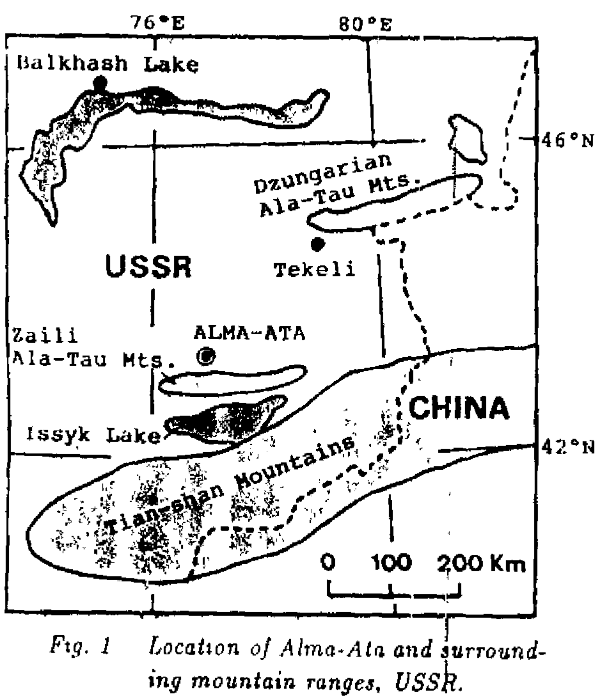

Fig. 1 Location of Alma-Ata and surrounding mountain ranges, USSR.

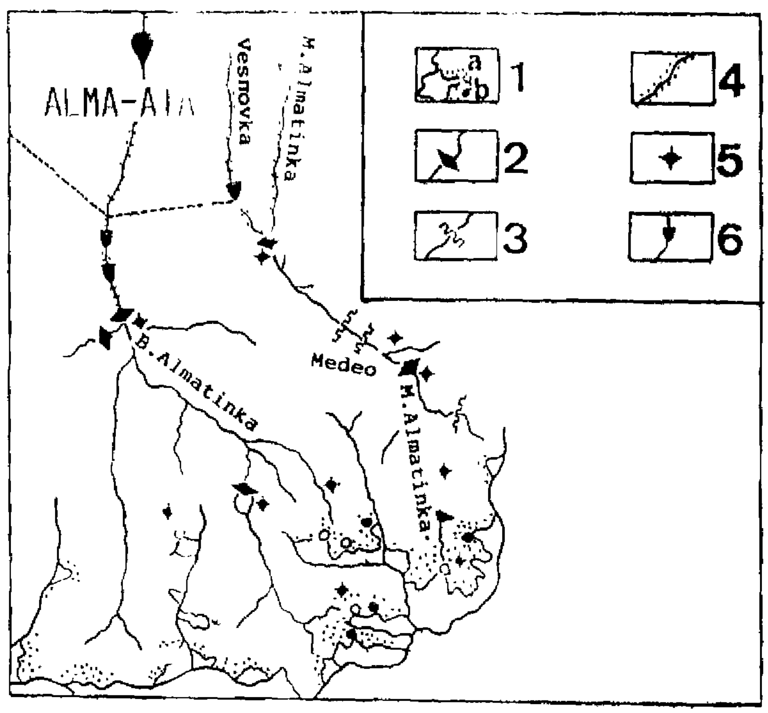

Fig. 2 The scheme of anti-debris flow measures that have been installed to protect Alma-Ata. 1. Glaciers and contemporary moraines, dangerous glacial lakes: a) emptied; b) active 2. Dams 3. Open debris-flow prevention works 4. Reinforced concrete channels 5. Observation and warning stations 6. Debris-flow settlers

of dwellings, enterprises, and roads were damaged, with tens of lives lost.

In 1973, a catastrophic debris flow occurred after the outbreak of a morainal lake on the Malaya Alma-Atinka River. After leaving the mountains, the debris flow was blocked by the Medeo Dam, which had been built for debris-flow prevention.

Debris flows flooded the city of Alma-Ata in 1975 and 1977. They damaged 12 km of highway, electric power lines, and hydrotechnical structures. A debris flow in the Bolshaya Alma-Atinka river in 1988 was stopped by the dam, but the liquid part of the flow flooded the city. Significant debris-flow disasters were recorded in the Dzungarian Ala-Tau region along the Aksu River in 1971, 1976, and 1986, and along the Sarkand River in 1982.

According to experts, debris-flows have accounted for an estimated 700 million Rubles (1,200 million US$) in the Kazakh Republic.

Taking into consideration the noticeable debris-flow activity and the devastation of mountainous regions, protection of the lives of the people is now a most serious national problem.

"Kazselezashchita" (Kazakh SSR debris-flow prevention) is the first special-

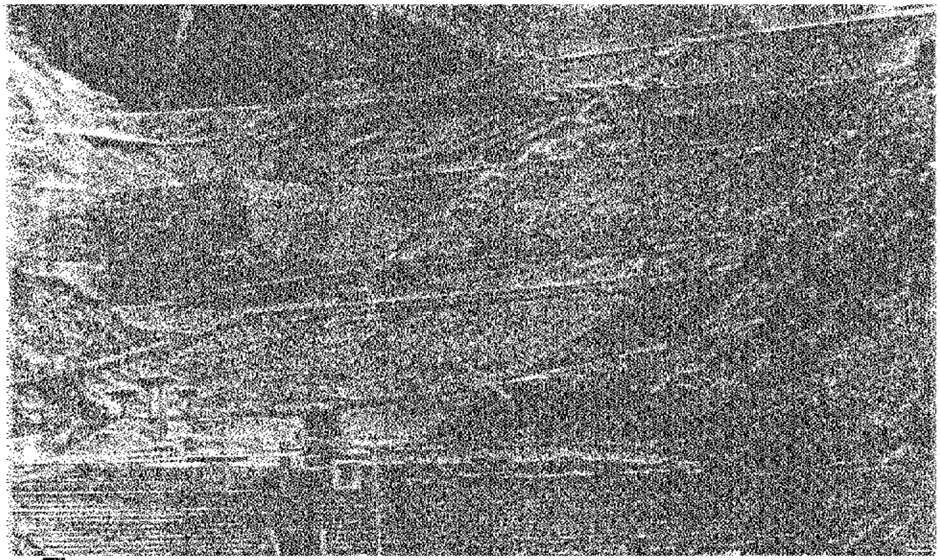

Fig. 3 Medeo Dam on the Malaya Alma-Atinka River (dam height:150 m; capacity of debris-flow storage: 12.6×10^6 m^3).

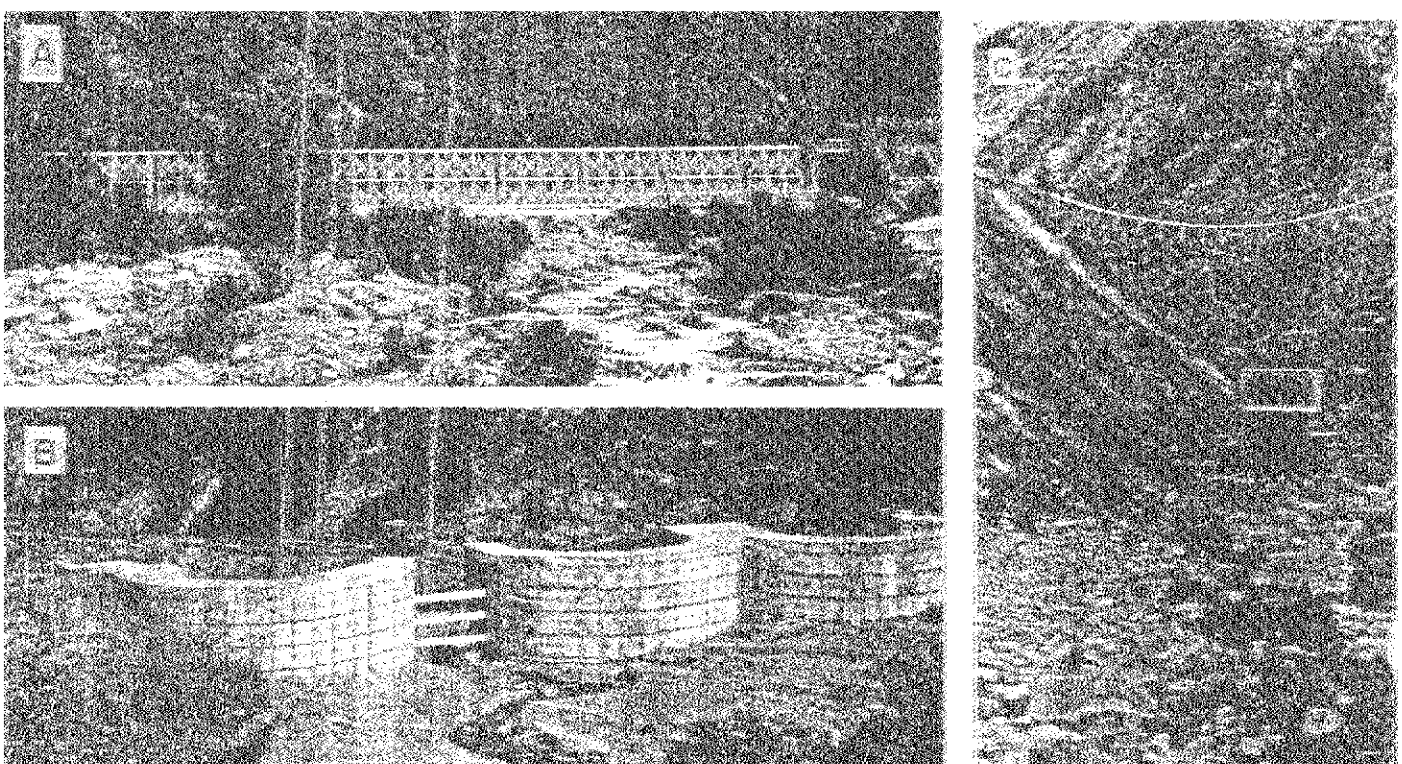

Fig. 4 Debris-flow prevention works
A: Open debris-flow prevention works of metal structures (Malaya Alma-Atinka River).
B: Concrete block dam (near Alma-Ata).
C: Grid-shaped debris-flow catchment made of metal rings (Sary-Sai River).

ized organization in our republic which has been established for systematic prevention efforts; comprehensive schemes of protecting the people of Kazakhstan from debris flows are being developed and realized.

The region of the Zaili Ala-Tau slopes, adjacent to Alma-Ata, the capital of Kazakhstan, is a remarkable place for debris-flow activity.

To construct the prevention works, where more than one million people are living, has proven to be very difficult, because Alma-Ata is situated on the combined alluvial fans from the Malaya Alma-Atinka River and the Bolshaya Alma-Atinka River (Fig. 2), and residential areas are in the debris-flow path. After thorough consideration, a project of protecting the city from debris flows has been developed by the "Kazhydroproject" Institute and was substantially completed by special measures. The essential part of this project is construction of large dams to block debris flows at hazardous rivers in mountain areas and construction of concrete-reinforced channels in the city areas to let the debris flows' fluid component flow safely through the city. The most important task of the project was the construction of the "Medeo" dam (Fig. 3) on the Malaya Alma-Atinka river. This was accomplished by directed explosions in material comprising the valley walls. In addition, a reinforced concrete dam was built on the Bolshaya Alma-Atinka River. Many small check dams were constructed with water outlet systems that allow the water to discharge into the river bed at a rate smaller than the critical value. Total capacity of debris-flow storage provided by the dams exceeds 30×10^6 m^3. The efficiency of the check dams and the open debris-flow catchments was proven in practice. In July 1973, the Medeo Dam stopped a debris flow that had a volume of 4×10^6 m^3 and maximum discharge of 10,000 m^3/s.

As a preventive measure, it is advisable to make use of small dams to catch the outbreak floods while they are in high mountain areas, i.e., before they become debris flows.

The use of grid like debris-flow catchments designed to catch rocks of the debris flow (large boulders, debris, etc.) is very promising (Fig. 4). Experience in the valleys has shown that, in the case of debris flows having a high density, the above-mentioned structures can operate in the same manner as check dams. On the other hand, only expenditures for their constructions are 2/3 that of check dams.

The particular interest in the scheme of city debris-flow protection is trouble-free accumulation in debris-flow flood channels (Fig. 5). Barrages and basins are used for retention of the entrained and suspended debris. A large debris flow, occurred with a discharge of 1,000 m^3/s, in August 1988 in Alma-Ata. The debris flow was contained by the concrete dam–debris flow retention facilities. As the debris passed through the city, it was partially deposited and the discharge decreased to 20–40 m^3/s. In spite of the considerable duration of the debris flow, the damage was small. Only one spillway / outlet channel was damaged. Preventive measures, constructed in the Alpine-glacial area of the Zaili Ala-Tau region, are a substantial supplement to the establishment of large engineering works, dams, and channels. The prevention works in the glacial area drain dangerous glacial lakes, and are in control of melting glacial fields. In 1985, the cost of debris-flow prevention works in Alma-Ata was more than 120 million Rubles (200 million US$).

As one of the measures for debris-flow control, a Debris Flow Warning Service System is going to be established. The system will consist of observation stations used to transmit debris-flow information to Alma-Ata by radio and telephone.

To evaluate the risk of debris-flow occurrence, the condition of glaciers and glacial lakes is observed by aero-cosmos survey and regular helicopter patrol.

To further develop anti-debris flow measures in Kazakhstan, it is desired to do the following: i) develop a short-term debris flow forecast method, ii) establish an automatic monitoring system by using satellites, and iii) prepare a debris-flow hazard map which will include field conditions and the design characteristics of control works.

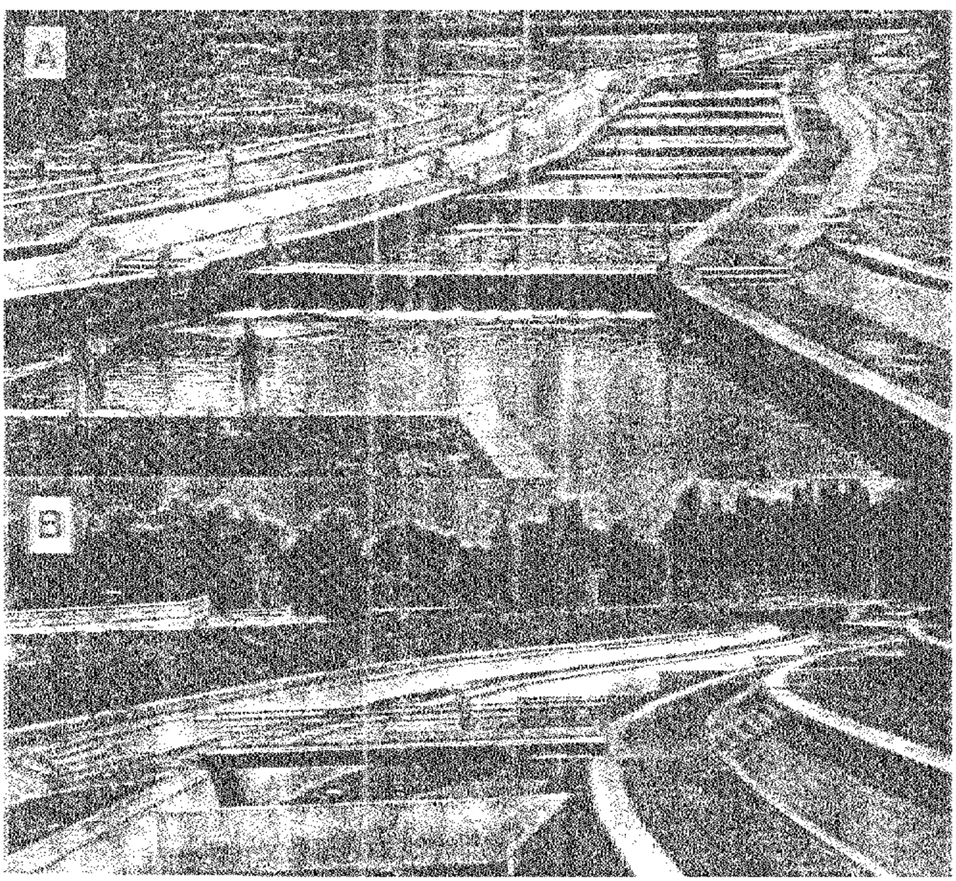

Fig. 5 Concrete channels for debris flows and flood water.
A: The Bolshaya Alma-Atinka river in Alma-Ata city.
B: The Vesnovka River.

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Flow Protection
Alma-Ata
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tigated in surficial materials, particularly in Pleistocene glaciolacustrine sediments which form an important component in Quaternary valley fills in the Cordillera. Big Slide, on the Fraser River north of the town of Quesnel, is a classic example of multiple retrogressive mudflow complex (Fig. 3). Along the Thompson River, near Ashcroft, many significant landslides have occurred in the historical period. Several have temporarily blocked the Thompson River. For example, in 1880 a massive lateral spread involving 15×10^6 m^3 blocked the Thompson River 7.5 km south of Ashcroft for 44 hrs.

In semi-arid parts of southern British Columbia, subsidence associated with piping in the glaciolacustrine silts of the South Thompson, Okanagan, and Columbia valleys has been a significant problem in urban development.

Although limited in extent, sensitive glaciomarine sediments underlie much of the populated areas of the Fraser Lowland of British Columbia and are also found along the coastal margin of the Cordillera. Lateral spreads took place in these deposits at Haney in 1880 (est. vol. = 1×10^6 m^3) and at Lakelse Lake in the Terrace-Kitimat area in 1962.

Debris flows (or torrents) originating in steep mountain watersheds and triggered by heavy rains are the most costly ground-failure hazard in the Cordillera. They have caused between 62 and 89 deaths since 1855 and extensive direct and indirect property damage. In the last 10 years or so, protective structures have been constructed in populated areas of several debris flow tracks at a cost of over CA\$30M (Fig. 4).

Attention has also been focused on the stability of natural debris dams in general and moraine dams in particular. Several spectacular breaches of moraine dams have occurred in the southern Cordillera since 1945 involving the failure of 'Little Ice Age' moraines which date from the nineteenth century. Between 1971 and 1973, approximately 1.7×10^6 m^3 of water was suddenly released from a moraine-dammed lake at the head of Klattasine Creek and triggered a massive debris flow (estimated volume = $2 \sim 4 \times 10^6$ m^3) which traveled 8 km downvalley to block the Homathko River. In 1983 approximately 7×10^6 m^3 of water escaped from one of the moraine-dammed Nostetuko Lakes (Fig. 5). The breach was initiated

Fig. 3. P[illegible]t of the [illegible] slide complex, on the Fraser River near Quesnel, British Columbia, a classical example of a retrogressive mudflow in Pleistocene [illegible]ustrine sediments. At the head of the complex, ([illegible]ckground) rates of retrogression have varied between 6 and 12 m/yr. Movements measured in the mudflow (foreground) between 19[illegible] and 19[illegible] have yielded extraordinary rates of up to 271 m/yr. Volume calculations show that between 1973 and 1982 $5.6 \times 10^6 m^3$ of material was moved within the complex; $1.9 \times 10^6 m^3$ mass was deposited, resulting in a net yield into the Fraser River of $3.[illegible] \times 10^6 m^3$.

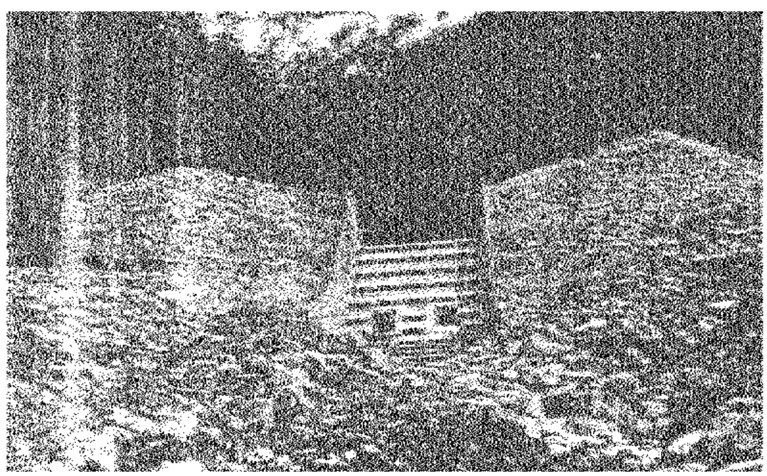

Fig. 4. Debris flows initiated in steep mountain watersheds are a widespread hazard in the Cordillera. Protective works, such as this debris-retention structure on Harvey Creek, have been built at a cost of millions of CA dollars in the vicinity of some settlements in southwest British Columbia to protect homes from debris-flow impact.