

EASTERN SNOW CONFERENCE

Report of the

COMMITTEE ON RESEARCH

February 1964

Following the custom of the last two years, questionnaires were sent to all members of the Eastern Snow Conference on the current mailing list asking them to report on research projects relating to snow and ice of which they had knowledge. Replies were summarized and are presented herewith. An attempt was made to group similar projects together insofar as possible, according to the following outline:

SECTION I - SUMMARY OF CURRENT RESEARCH PROJECTS

Group A - New Projects Not Reported in 1963

1 - 8 - Forecasting (Precipitation, snowmelt, radar use, etc.)

9 -17 - Snow Surveys & Measurements

18 -21 - Snow Climatology

22 -25 - Physics (Soil temperature, heat transfer)

26 -31 - Ice (Physical properties, river and lake ice.)

32 -36 - Engineering Problems Associated with Snow and Ice

Group B - Projects Reported in 1963 - Additional Information

Group C - Projects Reported in 1963 - No Change

SECTION II - SUPPLEMENTAL INFORMATION

A - Publications Not Previously Reported

B - Other Data Sources - No Publications Available

Respectfully submitted,
Committee on Research, ESC.

B. A. Power
C. D. Hopkins, Jr.
G. F. Collins, Chairman

SECTION I - SNOW RESEARCH PROJECTS

GROUP A - NEW PROJECTS

- 64A1 WATER SUPPLY FORECASTING PROCEDURES.
Chief, Hydrologic Services Division, U. S. Weather Bureau, Washington,
D. C.

At each of the water-supply forecast offices improvements are made in existing methods, and investigations are made of basin storage models in seasonal water-supply forecasting procedures, using currently available data and reporting standards under operating conditions. This work is being done at Portland, Sacramento, Salt Lake City, Kansas City and Hartford.

- 64A2 FORECASTING THE BEGINNING DATE OF FRESHET.
L. Shenfeld, Hydro-Electric Power Commission of Ontario, 620 University Ave., Toronto, Ontario.

A graphical correlation between the accumulation of degree-days above 32°F and the beginning of spring freshet has been developed. Combined with short and long range forecasts of temperatures, this correlation is used to forecast the beginning of the freshet on the watersheds in Northeastern Ontario where the beginning date varies from about mid-March to late April.

- 64A3 STREAMFLOW FROM SNOWMELT IN THE TOBIQUE RIVER BASIN, NEW BRUNSWICK, CANADA.
Dr. K. S. Davar, Dept. of Civil Engineering, University of New Brunswick, Fredericton, N. B., Canada.

A general study of the Hydrological and Fluvial Characteristics of the Tobique River Basin has been initiated to get regional parameters from this "pilot basin".

One of the very important seasonal phenomena in this basin is the generation of streamflow from snowmelt. It is hoped to develop techniques for predicting flood flows and seasonal flows by use of available hydrometeorological data. This investigation is part of a more comprehensive and extended study.

Progress Reports have been issued to the Sponsor, The New Brunswick Productivity and Research Council. However, the results are not considered ready for presentation or publication at this stage.

- 64A4 DETERMINATION OF STREAM DISCHARGE UNDER ICE CONDITIONS.
E. P. Collier, Water Resources Branch, Dept. of Northern Affairs and National Resources, 150 Wellington Street, Ottawa, Canada.

To obtain an appreciation of the relative accuracy of winter discharge records computed by several methods when applied to discharge

64A4 (Continued)

measurements obtained by a normal field programme. The programme includes various type rivers in Canada.

64A5

FORECASTING OF SNOWFALL.

Director, Meteorological Research, U. S. Weather Bureau, Washington, D. C.

Development and improvement of methods for objective forecasting of snowfall, and of identifying snow in rain-snow situations, based on climatic, synoptic, physical, and topographic parameters.

64A6

RADAR MEASUREMENT OF PRECIPITATION.

Director, Meteorological Research, U. S. Weather Bureau, Washington, D. C.

Methods are derived for interpreting and presenting radar observations to give areal distribution of rates and amounts of rainfall and snow fall.

The radar-hydrology program also includes less formal studies at field stations where WSR-57 radars have been installed, particularly Sacramento, Ft. Worth, St. Louis and Kansas City River Forecast Centers, and Missoula, Detroit, Evansville, Wichita and Oklahoma City Airport Stations.

64A7

RELATIONSHIP BETWEEN GAUGE-MEASURED PRECIPITATION RATES AND RADAR-ECHO INTENSITIES.

James W. Wilson, Travelers Research Center, 250 Constitution Plaza, Hartford, Connecticut.

Three storms were studied in regard to rainfall measurements and radar echos. At ranges less than 60 miles, radar detects 86% of the hourly rainfall amounts of 0.01 inch, and rates of 0.04 inches per hour are detected all the time to ranges of 100 miles.

Relationship Between Gauge-Measured Precipitation Rates and Radar-Echo Intensities. Proceedings of the tenth Weather Radar Conference. American Meteorology Society, Boston, April 22-25, 1963.

64A8

EVALUATION OF PRECIPITATION MEASUREMENTS WITH THE WSR-57 WEATHER RADAR.

James W. Wilson, Travelers Research Center, 250 Constitution Plaza, Hartford, Connecticut.

Objectively determine Weather Radar capabilities to quantitatively measure rainfall and snowfall over areas of 100 mile radius from observing station. Hourly rainfall amounts over 700 square mile areas were determined with an accuracy equivalent to 10 rain gauges over the area, and snowfall rate above 1/100th inch (water equivalent) were detectable out to 70 miles.

To be published in 1964 in the Journal of Applied Meteorology.

64A9

PHOTOGRAMMETRIC MEASUREMENT OF SNOW VOLUME.

Charles F. Cooper, Agricultural Research Service, Soil and Water Conservation Research Division, P. O. Box 2724, Boise, Idaho.

Development and testing of Photogrammetric-computer technique for estimating the volume of snow and its spatial and seasonal distribution on a mountain area of diverse topography.

64A10

SNOW SURVEYS IN NOVA SCOTIA.

Mr. J. E. Peters, Dist. Engr., Water Resources Branch Dept. of Northern Affairs and National Resources, N. S. Power Commission, Water Resources Branch, (co-operating), Mr. J. E. Peters, P. O. Box 365, Halifax, N.S.

Collection of snow data in the province, chiefly to get data for studies on the effects of snowmelt on floods.

Data on snow surveys is compiled in Mr. Peter's office.

64A11

GAGE AND NETWORK PERFORMANCE.

Chief, Hydrologic Services Division, U. S. Weather Bureau, Washington, D. C.

The basic observational data essential to forecasting streamflow are examined in a program for assessing reporting criteria, network density, gage exposure, and gage performance under a variety of weather and other conditions. Approximately 200 Fischer-Porter tape-punching weighing-recording gages are being installed for field tests in 1963-64.

64A12

SNOW ACCUMULATION AND MELTING.

Chief, Hydrologic Services Division, U. S. Weather Bureau, Washington, D. C.

Methods are being developed and applied for measuring and estimating, with regularly available data, the accumulated depth and water equivalent of snowpack, its pertinent physical properties and areal extent, day-to-day changes in snowpack caused by melting, and its contribution to runoff. Current investigations include use of observations from meteorological satellites, application of heat-budget methods to operational forecasting of runoff from melting snow, and methods for identifying and evaluating the effects of environment and changing snow properties under field conditions.

64A13

WATER SOURCE HYDROLOGY.

Henry W. Anderson, Pacific S.W. Forest and Range Expt. Sta., P. O. Box 245, Berkeley 1, California.

Snow-terrain analyses. The relationship of snow accumulation and melt to terrain characteristics, including forest type and condition will be determined by analysis at already assembled measurements of snow, terrain, and forests. Basic expressions of terrain and forests in terms of their heat equivalent and meso-turbulence will be sought.

64A13 (Continued)
Available from above address: 1) Managing California Snow Zone Lands for Water by Henry W. Anderson. U. S. Forest Service Research Paper PSW-P6, 28pp illus., 1963. 2) Snowcover Relations in the Kings River Basin, California by Arnold Court, J. Geophy. Res. 68 (16), 4751-4761, 1963.

64A14 TOPOGRAPHIC INFLUENCES ON PRECIPITATION.
Chief, Hydrologic Services Division, U. S. Weather Bureau, Washington, D. C.

The influence of topography on mean annual, seasonal and storm precipitation is studied by discovery, definition and joint evaluation of objective parameters and their anomalies. These parameters include elevation, slope, orientation, and shape of local terrain. Current emphasis is on storm precipitation in Western mountains, including synoptic meteorological data with the topographic data, and refinement of normal isohyetal patterns.

64A15 RELEVÉ DE L'ENNEIGEMENT - HIVER 1962-63.
(Summary of Snow Cover - Winter 1962-63)
J. A. Raymond Perrier, M.A., Service De Meteorologie, Ministere Des Richesses Naturelles, Quebec, P. Q.

Etude des debits de rivieres.

Feuillet Meteorologique, Juin - 1963, Vol. II, No. 6.

64A16 FACTORS AFFECTING SNOW ACCUMULATION AND MELT ON UNIT SOURCE AREAS IN THE SAGEBRUSH REGION OF SOUTHWESTERN IDAHO.
Charles F. Cooper, Agricultural Research Service, Soil and Water Conservation Research Division, P. O. Box 2724, Boise, Idaho.

To identify some of the physical and meteorological factors contributing to non-uniformity of snow accumulation and melt in a shrub-covered area, by repeated measurements at randomly located permanent sampling points representing a wide range of environmental characteristics.

64A17 LOCAL AND SEASONAL VARIATIONS IN SNOW DENSITY IN A MOUNTAIN AREA.
Charles F. Cooper, Agricultural Research Service, Soil and Water Conservation Research Division.

To determine the intensity of sampling required to estimate snow density with sufficient precision to be used in photogrammetric estimates of snow water storage, and to determine the variability of snow density within a mountain sub-basin of 100 acres or less, as affected by topography, vegetation, and antecedent weather conditions.

64A18 ARCTIC AND ANTARCTIC INVESTIGATIONS.
Chief, Polar Operations Project, U. S. Weather Bureau, Washington,
D. C.

Studies of physical properties, accumulation and ablation of snow and ice in polar regions.

64A19 STORM CHARACTERISTICS.
Chief, Hydrologic Services Division, U. S. Weather Bureau, Washington,
D. C.

Estimates are made of frequency-duration-area-depth and extreme values of storm rainfall, snowfall and snow accumulation, with seasonal and regional generalization. Current work includes storm sequences and inter-storm intervals, testing of a Markov chain probability model, storm rainfall depth-duration relations for 2 to 10 day periods, improved definition of area-depth-frequency relationships for small areas, and frequency analysis of water equivalent of snow on the ground in the western Great Lakes region. This work is sponsored largely by the Soil Conservation Service for design and planning criteria for its watershed protection program.

64A20 PROBABLE MAXIMUM PRECIPITATION.
Chief, Hydrologic Services Division, U. S. Weather Bureau, Washington,
D. C.

Estimates are made of physical upper limits of storm rainfall and snowmelt over particular or generalized drainage areas for specific durations. Investigations include derivation and testing of meteorological storm models and extrapolation of jointly operating causative factors. Current work includes estimates for small drainage areas in the Columbia River Basin, Pacific Drainage of Washington and Oregon, and the Susquehanna River Basin plus several of its tributary basins. Another area is the Yukon River above Rampart dam site, Alaska, with emphasis on accumulation and melting of snow.

64A21 MAXIMUM 24-HOUR SNOWFALL IN NEW JERSEY.
Donald Vern Dunlap, Rutgers University, Department of Meteorology,
College of Agriculture, New Brunswick, New Jersey.

Maximum 24-hour snowfall for New Jersey and immediately adjacent areas was determined by using the Lieblein method of extreme probability. Maxima for 10, 20, 25, 40, 50, and 100-year return periods were calculated. Determination of water content of the greatest 24-hour snowfalls was made. An evaluation of snow cover on the ground at the time of each of these snowstorms was made, in order to estimate the maximum snow load which might be anticipated.

This was a thesis towards the M. S. Degree in Meteorology, and has not yet been published.

- 64A22 A STUDY OF THE INFLUENCE OF SNOW COVER ON GROUND TEMPERATURE.
L. W. Gold, Division of Building Research, National Research Council,
Ottawa, Ontario.
- L. W. Gold, Influence of Snow Cover on the Average Annual Ground
Temperature at Ottawa, Canada., Int. Un. Geod. and Geophys., Int. Assoc.
of Sci. Hydrol., Publ 61, 82-91, 1963 (NRC 7505).
- 64A23 A STUDY OF THE FACTORS CONTROLLING HEAT TRANSFER AT SNOW, ICE AND WATER
SURFACES.
L. W. Gold - G. P. Williams, Division of Building Research, National
Research Council, Ottawa, Ontario.
- G. P. Williams, Heat Transfer Coefficients for Natural Water
Surfaces, Int. Un. Geod. and Geophys., Int. Assoc. of Sci. Hydrol., Pub
62, 203-212, 1963 (NRC 7495).
- G. P. Williams, Ice Growth Rates and Heat Exchange. T.M. 78,
Proceedings of Symposium on Heat Exchange at Snow and Ice Surfaces,
Assoc. Comm. on Soil and Snow Mech., National Research Council, Ottawa,
1963, 14-26.
- 64A24 SNOW AND FROST RELATIONS.
George Hart, Northeastern Forest Experiment Station, Forestry Building,
Laconia, New Hampshire.
- To measure snow accumulation and melt and soil frost under a white
pine and red pine plantation, under mixed hardwoods, and in a grassy
field, over two winters.
- Journal of Forestry, Vol. 61, No. 4, pg. 287-289.
- 64A25 HYDROLOGIC HEAT BALANCE.
Chief, Hydrologic Services Division, U. S. Weather Bureau, Washington,
D. C.
- Methods are investigated for estimating gross and net heat exchange
between the atmosphere and the surface of drainage areas, with applica-
tion to snowmelt, evaporation, and evapotranspiration. Studies include
long and shortwave radiation, and turbulent exchange of sensible and
latent heat. Sub-projects include influence of forest cover on radia-
tional exchange in the Susquehanna River Basin; estimation of incoming
long-wave radiation by regularly observed air temperature, dewpoint,
and estimated solar radiation; and study of low-level wind profiles for
relating special wind data to wind data at standard anemometer heights.
- 64A26 A STUDY OF THE DEFORMATION BEHAVIOR OF ICE.
L. W. Gold - A. S. Krausz, Division of Building Research, National
Research Council, Ottawa, Ontario.
- L. W. Gold, Deformation Mechanisms in Ice and Snow, Proceedings
of Conference on Glaciological Engineering, M.I.T. Press, 1963, p 12-
16 (NRC 7569).

- 64A27 ULTIMATE STRENGTH OF ICE - A STUDY OF THE FACTORS CONTROLLING THE FAILURE BEHAVIOR OF ICE.
L. W. Gold, Division of Building Research, National Research Council, Ottawa, Ontario.

L. W. Gold, Crack Formation in Ice Plates by Thermal Shock. Can. Jour. Phys., 1963, 41, (10), 1712-1728. (NRC 7548).
- 64A28 A STUDY OF FACTORS DETERMINING THE LOAD BEARING CAPABILITY OF ICE COVERS.
L. W. Gold, Division of Building Research, National Research Council, Ottawa, Ontario.
- 64A29 ICE COVER ON THE GREAT LAKES.
T. L. Richards, Lakes Investigation Unit, Hydrometeorology Section, Meteorological Branch, Department of Transport, 315 Bloor Street West, Toronto 5, Ontario, Canada.

Objective consideration of ice cover (%) versus freezing degree-days and antecedent heating in thawing degree-days accumulated during heating season.
Subjective consideration of other meteorological factors (including wind, radiation, condensation) and heat storage capacity of each lake.

Meteorological Factors Affecting Ice Cover On The Great Lakes" (Erie and Superior) - in press. Proceedings of Sixth Conference on Great Lakes Research, April 1963, Univ. of Michigan. Preprints available, reprints soon.
Meteorological Aspects of Ice Cover On The Great Lakes (all lakes) to be presented at A.M.S.-A.A.A.S. Cleveland, Dec. 27, 1963 - Preprints will be available.
- 64A30 A STUDY OF THE FORMATION, GROWTH AND BREAK-UP OF ICE ON LAKES AND RIVERS.
G. P. Williams, Division of Building Research, National Research Council, Ottawa, Ontario.

G. P. Williams, Probability Charts for Predicting Ice Thickness. Eng. Jour. (Canada) June 1963, (NRC 7419)
G. P. Williams, and L. W. Gold, The Use of Dust to Advance the Break-up of Ice on Lakes and Rivers. Proceedings of Eastern Snow Conference, 1963, p. 31-56 (NRC 7725)
L. W. Gold and G. P. Williams, An Unusual Ice Formation on the Ottawa River. Jour. of Glac., 1963, 4 (35), 569-573, (NRC 7233)
- 64A31 DYNAMICAL ICE JAMS IN RIVERS.
B. Michel, Dr. Eng. and C. E. Deslauriers, P. Eng., Université Laval, Cité Universitaire, Ste-Foy, Québec, Canada.

To study with simulated ice floes in a laboratory flume the formation and characteristics of the type of ice jams in rivers, that block completely the river flow.

64A32 PREPARATION OF A HANDBOOK FOR SNOW AND ICE ENGINEERING PROBLEMS.
G. P. Williams, Division of Building Research, National Research Council, Ottawa, Ontario.

64A33 SNOW LOADS ON INDUSTRIAL ROOFS.
B. Michel, Dr. Eng., Université Laval, Cité Universitaire, Ste-Foy, Québec, Canada.

Experimental study to determine the effect of wind on snow deposits in multi-levels roofs of industrial buildings.

Starting in collaboration with National Research Council of Canada.

64A34 A STUDY OF FACTORS AFFECTING SNOW DRIFTING AND SNOW CLEARING.
L. W. Gold, Division of Building Research, National Research Council, Ottawa, Ontario.

64A35 DESIGN OF SNOW FENCES.
B. Michel, Dr. Eng., Université Laval, Cité Universitaire, Ste-Foy, Québec, Canada.

Experimental study of Snow Deposits Behind Snow Fences In Order to Improve the Design of These Works.

Preliminary stage.

64A36 STAINLESS STEEL PLOUGH BLADES.
Mechanical Superintendent, Corporation of City of Ottawa, 111 Sussex Drive, Ottawa, Canada.

Test the life and unit cost of a new type of snow plough blade.

GROUP B: PROJECTS LISTED PREVIOUSLY

64B1 RADAR DETECTION OF SNOW.
B. L. Wiggin, U. S. Weather Bureau, Airport Mail Facility, PTS, Buffalo, New York.

To observe, and record by radar and radar photography growth, distribution and decay of convective cells originating over Lakes Erie and Ontario.

None presently available. (Paper presented at Cleveland Dec. 27, 1963 at combined A.A.A.S.-A.M.S. Meeting.)

64B2 FOREST HEAT BUDGET STUDIES.
William E. Reifsnyder, Yale School of Forestry, Marsh Hall, 360 Prospect Street, New Haven, Connecticut.

To determine the complete energy and moisture budget for selected forest stands and to relate the components of the budget to stand

64B2

(Continued)

parameters. A pine plantation near New Haven is currently being investigated and measurements will be taken in this stand under various meteorological conditions and at various times of the year, including situations with snow on the ground. It is expected that the measurements will be replicated by observations in other stands in other sections of the country. Such analytical systems for predicting heat budgets as are developed will be tested in these other stands.

Techniques of Measuring, Recording and Processing Micro-Meteorological Variables in Forest Energy-Budget Studies. Published in Symposia on Water Balance of the Soil and Forest Meteorology, Papers presented at a scientific session of the W M O Technical Commission for Agricultural Meteorology, Toronto, July 13, 1962. Andrew Thomson, Editor. Reprints available from author.

64B3

SNOWFALL FREQUENCIES AND SNOWCOVER DATA

Robert E. Lautzenheiser, USDC, Weather Bureau, State Climatologist, 1900 P. O. Bldg., Boston, Massachusetts.

Additional stations now available:

Massachusetts: East Wareham, Plymouth, Rockport

New Hampshire: Woodstock

Vermont : Cornwall, Newport

64B4

DEPOSITS OF FRAZIL ICE ON HYDRAULIC STRUCTURES.

B. Michel, Dr. Eng., Université Laval, Cité Universitaire, Ste-Foy, Québec, Canada.

This project has been completed in an experimental flume.

*Studies are now being pursued in nature at the intake of an hydro-electric plant, to determine the main factors affecting deposits on thrash racks.

*Theory of Formation and Deposit of Frazil Ice, Eastern Snow Conference - 20th Meeting, Québec, 1963.

GROUP C - STILL ACTIVE BUT UNCHANGED

64C1

PRECIPITATION CHARACTERISTICS.

Edwin T. Engman, Agric. Research Serv., Sleepers River Research Watershed, Danville, Vt.

64C2

INFLUENCE OF SNOW AND FROZEN SOILS ON RUNOFF.

Martin L. Johnson, Agric. Research Serv., Sleepers River Research Watershed, Danville, Vt.

- 64C3 INFLUENCE OF SOIL AND LAND USE ON RUNOFF.
George Comer, Agric. Research Serv., Sleepers River Research
Watershed, Danville, Vt.
- 64C4 WATERSHED MANAGEMENT RESEARCH PROJECT - 1601
Robert S. Pierce, Northeastern Forest Experiment Station, Forestry
Building Laconia, New Hampshire.
- 64C5 WATER RESOURCES NEW ENGLAND.
G. J. Bulgarelli, 23 Howe Road, Pittsfield, Massachusetts.

SECTION II - SUPPLEMENTAL INFORMATION

A - PUBLICATIONS NOT PREVIOUSLY REPORTED

1. HYDRAULIC RESEARCH IN THE UNITED STATES, 1963
U. S. Department of Commerce, National Bureau of Standards, Miscellaneous Publication 249, Washington, D. C.
2. CURRENT FEDERAL METEOROLOGICAL RESEARCH AND DEVELOPMENT ACTIVITIES,
FISCAL YEAR 1963
U. S. Department of Commerce, Weather Bureau, Washington, D.C.

B - OTHER DATA SOURCES - NO FORMAL PUBLICATIONS AVAILABLE

1. Ice jam formations in Montreal harbour and operational procedures of
an ice boom to control ice in the Laprairie Basin.
Source - E. Pariset, P. Eng.
Vice President
Lasalle Hydraulic Laboratory, Ltd.
0250 St. Patrick Street
Lasalle, P.Q.
Canada
2. Bridge deck insulation (New York, Vermont)
Source - Mr. Robert F. Baker
Director of Research & Development
U. S. Bureau of Public Roads
Matomic Bldg., 1717 H. St., N. W.
Washington 25, D. C.
U. S. A.
3. Snow removal costs on Vermont State Highway System
Source - Mr. Sheldon Miller
Vermont Department of Highways
Montpelier, Vermont
U. S. A.
4. Snow surveys on the Ottawa River Basin
Source - Mr. D. F. Witherspoon
Senior Assistant Engineer
Dept. of Northern Affairs and National Resources
Water Resources Branch
Post Office Building
Cornwall, Ontario
Canada