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 here-with. 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.  

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
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 snowfall. 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 85% 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.


**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 quantitively 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.
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.

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.

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.

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.

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.
(Continued)


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.

(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 rivières.


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.

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.
ARCTIC AND ANTARCTIC INVESTIGATIONS.

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

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.

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.

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.
A STUDY OF THE INFLUENCE OF SNOW COVER ON GROUND TEMPERATURE.
L. W. Gold, Division of Building Research, National Research Council, Ottawa, Ontario.


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.


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.


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 application 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 radiational 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.

A STUDY OF THE DEFORMATION BEHAVIOR OF ICE.

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.


A STUDY OF FACTORS DETERMINING THE LOAD BEARING CAPABILITY OF ICE COVERS.
L. W. Gold, Division of Building Research, National Research Council, Ottawa, Ontario.

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.

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.


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
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.


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

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 trash racks.

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

GROUP C - STILL ACTIVE BUT UNCHANGED

PRECIPITATION CHARACTERISTICS.

INFLUENCE OF SNOW AND FROZEN SOILS ON RUNOFF.
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

2. CURRENT FEDERAL METEOROLOGICAL RESEARCH AND DEVELOPMENT ACTIVITIES, FISCAL YEAR 1963

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. Pariet, P. Eng.
   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
   Matomick 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