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# Sixth Conference Sixième Congrès

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It would be impossible to list, in acknowledgment, all the others who helped in various ways to ensure the success of the Conference, but the Organizing Committee wishes to record its special thanks to:

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J. L. E. Price and Company Limited, General Contractors of Montreal, for the assistance they gave to their Past President, Mr. A. Turner Bone, in his service as Chairman of the Finance Committee, who joins the undersigned in recording, on behalf of the Organizing Committee, thanks to all those listed on the following pages for their financial contributions that assisted so materially with the conduct of the Conference;

McGill University for allowing the use of some of its student residences;

The staff of the Montreal Tourist and Convention Bureau for handling all hotel arrangements;

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The many other organizations, mentioned on pp. 41–44 who assisted with the field trips and the Trans-Canada Tour;

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National Research Council
Ottawa, Canada
July, 1966

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Le personnel du Bureau du tourisme et des congrès de Montréal, qui s'est chargé de toutes les réservations d'hôtel;

Le personnel de la Place des Arts de Montréal qui a collaboré au succès des sessions techniques en s'occupant de l'équipement nécessaire;

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## YUGOSLAVIA/YOUGOSLAVIE

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Drnovšek, J., University of Ljubljana, Miklosiceva 8
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Nonveiller, E., University of Zagreb, Zagreb

EXTERIOR VIEW, PLACE DES ARTS, MONTREAL—SITE OF THE SIXTH INTERNATIONAL CONFERENCE—8–15 SEPTEMBER 1965.

INTERIOR VIEW, LA GRANDE SALLE, PLACE DES ARTS, MONTREAL.

# Programme

TUESDAY, 7 SEPTEMBER

09:00–17:00 hours
Meeting of the Executive Committee—Salon St. Maurice, Queen Elizabeth Hotel

WEDNESDAY, 8 SEPTEMBER

09:00–17:00 hours
Registration for members of Conference—Place des Arts

09:00–10:45 hours
Meeting of the Executive Committee—Place des Arts

11:00–12:00 hours
Terzaghi Memorial Session

14:00–14:50 hours
Opening Session—Presidential Address: Professor A. CASAGRANDE, Harvard University, Cambridge, Massachusetts, U.S.A.

15:00–17:00 hours
First Technical Session—Division 1: Soil Properties—General

General Reporter: J. E. JENNINGS (Republic of South Africa)
Chairman: J. KÉRISEL (France)
Deputy Chairman: G. G. MEYERHOF (Canada)
Panel Members: I. TH. ROSENQVIST (Norway)
F. P. SILVA (Brazil)
A. W. SKEMPTON (Great Britain)
J. G. ZEITLEN (Israel)

18:00–20:00 hours
Reception: City of Montreal—Chalet de la Montagne

THURSDAY, 9 SEPTEMBER

09:00–12:00 hours
Second Technical Session

09:00–09:50 hours
Special Lecture—The Geology of Canada: J. M. HARRISON, Department of Mines and Technical Surveys, Ottawa, Canada

10:00–12:00 hours
Division 2: Soil Properties—Shear Strength and Consolidation

General Reporter: O. MORETTO (Argentina)
Chairman: L. F. COOLING (Great Britain)

MARDI 7 SEPTEMBRE

9 h–17 h
Réunion du Comité exécutif—Salon St-Maurice, Hôtel Reine-Elizabeth

MERCREDI 8 SEPTEMBRE

9 h–17 h
Inscription des congressistes—Place des Arts

9 h–10 h 45
Réunion du Comité exécutif—Place des Arts

11 h–12 h
Séance commémorative Terzaghi

14 h–14 h 50
Séance d'ouverture—Exposé du Président: Professeur A. CASAGRANDE, Harvard University, Cambridge, Massachusetts, U.S.A.

15 h–17 h
Première session technique—Division 1:
Propriétés des sols—Générale

Rapporteur général: J. E. JENNINGS (République de l'Afrique du Sud)
Président: J. KÉRISEL (France)
Président adjoint: G. G. MEYERHOF (Canada)
Membres du Groupe de discussion
I. TH. ROSENQVIST (Norvège)
F. P. SILVA (Brésil)
A. W. SKEMPTON (Grande-Bretagne)
J. G. ZEITLEN (Israël)

18 h–20 h
Réception: Ville de Montréal—Chalet de la Montagne

JEUDI 9 SEPTEMBRE

9 h–12 h
Deuxième session technique

9 h–9 h 50
Conférence spéciale—La Géologie du Canada: J. M. HARRISON, Ministère des mines et des relevés techniques, Ottawa, Canada

10 h–12 h
Division 2: Propriétés des sols—Résistance au cisaillement et consolidation

Rapporteur général: O. MORETTO (Argentine)
Président: L. F. COOLING (Grande-Bretagne)

Deputy Chairman: C. B. CRAWFORD (Canada)
Panel Members: G. D. AITCHISON (Australia)
A. W. BISHOP (Great Britain)
H. LEUSSINK (Germany)
R. J. MARSAL (Mexico)

14:00–17:00 hours
Third Technical Session

14:00–14:50 hours
Special Lecture—Rock Mechanics: A. MAYER, Centre d'Etudes et de Recherches de l'Industrie des Liants Hydrauliques, Paris, France

15:00–17:00 hours
Division 2: Soil Properties—Shear Strength and Consolidation

General Reporter: O. MORETTO (Argentina)
Chairman: L. BJERRUM (Norway)
Deputy Chairman: R. M. HARDY (Canada)
Panel Members: T. W. LAMBE (U.S.A.)
F. E. RICHART, JR. (U.S.A.)
E. SCHULTZE (Germany)
W. L. SHANNON (U.S.A.)

FRIDAY, 10 SEPTEMBER

09:00–12:00 hours
Fourth Technical Session

09:00–09:50 hours
Special Lecture—The Geology of Montreal: J. HODE KEYSER, Department of Public Works, City of Montreal, Canada

10:00–12:00 hours
Division 3: Shallow Foundations and Pavements

General Reporter: E. DE BEER (Belgium)
Chairman: A. CROCE (Italy)
Deputy Chairman: J. E. HURTUBISE (Canada)
Panel Members: H. BOROWICKA (Australia)
Y. KOIZUMI (Japan)
R. L'HERMINIER (France)
J. A. J. SALAS (Spain)

14:00–16:30 hours
Fifth Technical Session

14:00–14:50 hours
Special Lecture—Creep and Progressive Failure in Snow, Soil, Rock, and Ice: Professor R. HAEFELI, Zürich, Switzerland

15:00–16:30 hours
Division 3: Shallow Foundations and Pavements

General Reporter: E. DE BEER (Belgium)
Chairman: G. D. AITCHISON (Australia)
Deputy Chairman: C. E. LEONOFF (Canada)
Panel Members: B. A. KANTEY (Republic of South Africa)
R. L. MITCHELL (Rhodesia)
W. J. TURNBULL (U.S.A.)

17:30 hours
Departure of S.S. *Tadoussac* from Victoria Pier for Mid-Conference Cruise and Study Tour

18:00 hours
Departure of ground transportation from Queen Elizabeth Hotel for Tour 61: MANICOUAGAN

Président adjoint: C. B. CRAWFORD (Canada)
Membres du Groupe de discussion
G. D. AITCHISON (Australie)
A. W. BISHOP (Grande-Bretagne)
H. LEUSSINK (Allemagne)
R. J. MARSAL (Mexique)

14 h–17 h
Troisième session technique

14 h–14 h 50
Conférence spéciale—La Mécanique des roches: A. MAYER, Centre d'études et de recherches de l'Industrie des liants hydrauliques, Paris, France

15 h–17 h
Division 2: Propriétés du sol—Résistance au cisaillement et consolidation

Rapporteur général: O. MORETTO (Argentine)
Président: L. BJERRUM (Norvège)
Président adjoint: R. M. HARDY (Canada)
Membres du Groupe de discussion
T. W. LAMBE (E.U.A.)
F. E. RICHART, JR. (E.U.A.)
E. SCHULTZE (Allemagne)
W. L. SHANNON (E.U.A.)

VENDREDI 10 SEPTEMBRE

9 h–12 h
Quatrième session technique

9 h–9 h 50
Conférence spéciale—La Géologie de Montréal: J. HODE KEYSER, Service des Travaux publics, Ville de Montréal, Canada

10 h–12 h
Division 3: Fondations peu profondes et chaussées

Rapporteur général: E. DE BEER (Belgique)
Président: A. CROCE (Italie)
Président adjoint: J. E. HURTUBISE (Canada)
Membres du Groupe de discussion
H. BOROWICKA (Autriche)
Y. KOIZUMI (Japon)
R. L'HERMINIER (France)
J. A. J. SALAS (Espagne)

14 h–16 h 30
Cinquième session technique

14 h–14 h 50
Conférence spéciale—Fluage et rupture progressive dans la neige, le sol, le roc et la glace: Professeur R. HAEFELI, Zürich, Suisse

15 h–16 h 30
Division 3: Fondations peu profondes et chaussées

Rapporteur général: E. DE BEER (Belgique)
Président: G. D. AITCHISON (Australie)
Président adjoint: C. E. LEONOFF (Canada)
Membres du Groupe de discussion
B. A. KANTEY (République de l'Afrique du Sud)
R. L. MITCHELL (Rhodésie)
W. J. TURNBULL (E.U.A.)

17 h 30
Départ du S.S. *Tadoussac* du quai Victoria pour la croisière d'étude de la fin de semaine du Congrès

18 h
Départ des autobus de l'Hôtel Reine-Elizabeth pour l'excursion 61: MANICOUAGAN

SATURDAY, 11 SEPTEMBER

06:45 hours
Departure of ground transportation from Queen Elizabeth Hotel for Tour 51: NIAGARA FALLS

08:00 hours
Departure of buses from Queen Elizabeth Hotel for Tour 21: OTTAWA/SEAWAY

09:00 hours
Departure of buses from Queen Elizabeth Hotel for Tour 11: MONTREAL CONSTRUCTION

SUNDAY, 12 SEPTEMBER

08:30 hours
Departure of ground transportation from Queen Elizabeth Hotel for Tour 41: ST. LAWRENCE/QUEBEC

MONDAY, 13 SEPTEMBER

07:00 hours
Arrival of S.S. *Tadoussac* at Victoria Pier

09:00–12:00 hours
Sixth Technical Session

09:00–09:50 hours
Special Lecture—Muskeg: N. W. RADFORTH, McMaster University, Hamilton, Ontario, Canada

10:00–12:00 hours
Division 4: Deep Foundations

General Reporter: Á. KÉZDI (Hungary)
Chairman: P. C. RUTLEDGE (U.S.A.)
Deputy Chairman: J. P. CARRIÈRE (Canada)
Panel Members: G. G. MEYERHOF (Canada)
L. PAREZ (France)
C. VAN DER VEEN (Netherlands)
L. ZEEVAERT (Mexico)

14:00–17:00 hours
Seventh Technical Session

14:00–14:50 hours
Special Lecture—Permafrost in the U.S.S.R. as Foundations for Structures: N. A. TSYTOVICH, Professor, Permafrost Soil Mechanics Laboratory, Research Institute of Bases and Underground Structures, Moscow, U.S.S.R.

15:00–17:00 hours
Division 5: Earth and Rock Pressures

General Reporter: V. MENCL (Czechoslovakia)
Chairman: W. C. VAN MIERLO (Netherlands)
Deputy Chairman: R. PETERSON (Canada)
Panel Members: J. BRINCH HANSEN (Denmark)
G. STEFANOFF (Bulgaria)
J. VERDEYEN (Belgium)
W. H. WARD (Great Britain)

17:00–20:00 hours
Reception: Province of Quebec—Windsor Hotel

TUESDAY, 14 SEPTEMBER

09:00–12:00 hours
Eighth Technical Session

SAMEDI 11 SEPTEMBRE

6 h 45
Départ des autobus de l'Hôtel Reine-Elizabeth pour l'excursion 51: CHÛTES DU NIAGARA

8 h
Départ des autobus de l'Hôtel Reine-Elizabeth pour l'excursion 21: OTTAWA/VOIE MARITIME

9 h
Départ des autobus de l'Hôtel Reine-Elizabeth pour l'excursion 11: CONSTRUCTION À MONTRÉAL

DIMANCHE 12 SEPTEMBRE

8 h 30
Départ des autobus de l'Hôtel Reine-Elizabeth pour l'excursion 41: ST-LAURENT/QUÉBEC

LUNDI 13 SEPTEMBRE

7 h
Arrivée du S.S. *Tadoussac* au quai Victoria

9 h–12 h
Sixième session technique

9 h–9 h 50
Conférence spéciale—Muskeg: N. W. RADFORTH, McMaster University, Hamilton, Ontario, Canada

10 h–12 h
Division 4: Fondations profondes

Rapporteur général: Á. KÉZDI (Hongrie)
Président: P. C. RUTLEDGE (E.U.A.)
Président adjoint: J. P. CARRIÈRE (Canada)
Membres du Groupe de discussion
G. G. MEYERHOF (Canada)
L. PAREZ (France)
C. VAN DER VEEN (Pays-Bas)
L. ZEEVAERT (Mexique)

14 h–17 h
Septième session technique

14 h–14 h 50
Conférence spéciale—Étude sur le pergélisol en tant que fondations des édifices en U.R.S.S.: N. A. TSYTOVICH, Professeur, Laboratoire de mécanique du pergélisol, Institut de recherches sur les Assises et Fondements, Moscow, U.R.S.S.

15 h–17 h
Division 5: Poussée des terres et des roches

Rapporteur général: V. MENCL (Tchécoslovaquie)
Président: W. C. VAN MIERLO (Pays-Bas)
Président adjoint: R. PETERSON (Canada)
Membres du Groupe de discussion
J. BRINCH HANSEN (Danemark)
G. STEFANOFF (Bulgarie)
J. VERDEYEN (Belgique)
W. H. WARD (Grande-Bretagne)

17 h–20 h
Réception: Province de Québec—Hôtel Windsor

MARDI 14 SEPTEMBRE

9 h–12 h
Huitième session technique

09:00–09:50 hours
Special Lecture—Modern Canadian Dams: J. K. SEXTON, Montreal Engineering Company Ltd., Montreal, Canada

10:00–12:00 hours
Division 6: Earth and Rock Dams, Slopes, and Open Excavations

General Reporter: D. MOHAN (India)
Chairman: R. J. MARSAL (Mexico)
Deputy Chairman: M. MINDESS (Canada)
Panel Members: J. FOLQUE (Portugal)
H. Q. GOLDER (Canada)
E. NONVEILLER (Yugoslavia)
L. A. QUEIROZ (Brazil)

14:00–17:00 hours
Ninth Technical Session

14:00–14:50 hours
Special Lecture—The Factor of Safety in Soil and Rock Problems: J. FELD, Consulting Engineer, New York, U.S.A.

15:00–17:00 hours
Division 6: Earth and Rock Dams, Slopes, and Open Excavations

General Reporter: D. MOHAN (India)
Chairman: J. HUDER (Switzerland)
Deputy Chairman: G. PIETTE (Canada)
Panel Members: B. KJAERNSLI (Norway)
A. B. S. LÖFQUIST (Sweden)
C. SCHAERER (Switzerland)
F. C. WALKER (U.S.A.)

19:00 hours
Banquet—Grand Ballroom, Queen Elizabeth Hotel

WEDNESDAY, 15 SEPTEMBER

10:00–12:00 hours
Closing Session

14:00 hours
Departure of buses from Queen Elizabeth Hotel for Tour 13: MONTREAL CONSTRUCTION

14:40 hours
Departure of ground transportation from Queen Elizabeth Hotel for Tour TC: TRANS-CANADA

THURSDAY, 16 SEPTEMBER

08:00 hours
Departure of buses from Queen Elizabeth Hotel for Tour 22: OTTAWA/SEAWAY

09:00 hours
Departure of buses from Queen Elizabeth Hotel for Tour 12: MONTREAL CONSTRUCTION

## LADIES' PROGRAMME

WEDNESDAY, 8 SEPTEMBER

09:00–17:00 hours
Registration—Place des Arts

09:00–17:00 hours
Salon St. Laurent, Queen Elizabeth Hotel

18:00–20:00 hours
Reception: City of Montreal—Chalet de la Montagne

9 h–9 h 50
Conférence spéciale—Barrages modernes canadiens: J. K. SEXTON, Montreal Engineering Company Ltd., Montréal, Canada

10 h–12 h
Division 6: Barrages de terre et de roches, talus et tranchées ouverts

Rapporteur général: D. MOHAN (Inde)
Président: R. J. MARSAL (Mexique)
Président adjoint: M. MINDESS (Canada)
Membres du Groupe de discussion
J. FOLQUE (Portugal)
H. Q. GOLDER (Canada)
E. NONVEILLER (Yougoslavie)
L. A. QUEIROZ (Brésil)

14 h–17 h
Neuvième session technique

14 h–14 h 50
Conférence spéciale—Le coefficient de sécurité dans les problèmes posés par les sols et les roches: J. FELD, Ingénieur-conseil, New York, E.U.A.

15 h–17 h
Division 6: Barrages de terre et de roches, talus et tranchées ouvertes

Rapporteur général: D. MOHAN (Inde)
Président: J. HUDER (Suisse)
Président adjoint: G. PIETTE (Canada)
Membres du Groupe de discussion
B. KJAERNSLI (Norvège)
A. B. S. LÖFQUIST (Suède)
C. SCHAERER (Suisse)
F. C. WALKER (E.U.A.)

19 h
Banquet—Grand Salon, Hôtel Reine-Elizabeth

MERCREDI 15 SEPTEMBRE

10 h–12 h
Séance de clôture

14 h
Départ des autobus de l'Hôtel Reine-Elizabeth pour l'excursion 13: CONSTRUCTION À MONTRÉAL

14 h 40
Départ de l'Hôtel Reine-Elizabeth pour le voyage transcanadien

JEUDI 16 SEPTEMBRE

8 h
Départ des autobus de l'Hôtel Reine-Elizabeth pour l'excursion 22: OTTAWA/VOIE MARITIME

9 h
Départ des autobus de l'Hôtel Reine-Elizabeth pour l'excursion 12: CONSTRUCTION À MONTRÉAL

## PROGRAMME POUR LES DAMES

MERCREDI 8 SEPTEMBRE

9 h–17 h
Inscription—Place des Arts

9 h–17 h
Salon St-Laurent, Hôtel Reine-Elizabeth

18 h–20 h
Réception: Ville de Montréal—Chalet de la Montagne

VIEW OF CITY OF MONTREAL FROM CHALET DE LA MONTAGNE AT RECEPTION TENDERED BY THE CITY OF MONTREAL, 8 SEPTEMBER 1965.

RECEPTION TENDERED BY THE PROVINCE OF QUEBEC AT THE WINDSOR HOTEL, MONTREAL, 13 SEPTEMBER 1965.

THURSDAY, 9 SEPTEMBER

08:00 hours
Departure of buses from Queen Elizabeth Hotel for Ladies' Tour L1: OTTAWA

09:00 hours
Departure of buses from Queen Elizabeth Hotel for Ladies' Tour L2: UPPER CANADA VILLAGE

09:00–17:00 hours
Salon St. Laurent, Queen Elizabeth Hotel

FRIDAY, 10 SEPTEMBER

09:00–17:00 hours
Salon St. Laurent, Queen Elizabeth Hotel
Sightseeing tour of Montreal

17:30 hours
Departure of S.S. *Tadoussac* for Mid-Conference Cruise

SATURDAY, 11 SEPTEMBER

09:00–17:00 hours
Salons Peribonca and Richelieu, Queen Elizabeth Hotel

SUNDAY, 12 SEPTEMBER

09:00–17:00 hours
Salon St. Laurent, Queen Elizabeth Hotel

MONDAY, 13 SEPTEMBER

09:00–17:00 hours
Salon St. Laurent, Queen Elizabeth Hotel

17:00–20:00 hours
Reception: Province of Quebec—Windsor Hotel

TUESDAY, 14 SEPTEMBER

09:00–17:00 hours
Salon St. Laurent, Queen Elizabeth Hotel

10:00 hours
Departure of buses from Queen Elizabeth Hotel for Ladies' Tour L3: LAURENTIANS

19:00 hours
Banquet—Grand Ballroom, Queen Elizabeth Hotel

WEDNESDAY, 15 SEPTEMBER

09:00–17:00 hours
Salon St. Laurent, Queen Elizabeth Hotel

## TOURS

### MONTREAL CONSTRUCTION

Tour No. 11, Saturday, September 11
Tour No. 12, Thursday, September 16

The tour visited a completed section, and a section under construction, of the Montreal Metro. The total cost of this project will be 180 million dollars, which includes the execution of all the construction, the purchase of the rolling

JEUDI 9 SEPTEMBRE

8 h
Départ des autobus de l'Hôtel Reine-Elizabeth pour l'excursion L1: OTTAWA

9 h
Départ des autobus de l'Hôtel Reine-Elizabeth pour l'excursion L2: VILLAGE DU HAUT-CANADA

9 h–17 h
Salon St-Laurent, Hôtel Reine-Elizabeth

VENDREDI 10 SEPTEMBRE

9 h–17 h
Salon St-Laurent, Hôtel Reine-Elizabeth
Visite de Montréal

17 h 30
Départ du S.S. *Tadoussac* pour la croisière de fin de semaine du Congrès

SAMEDI 11 SEPTEMBRE

9 h–17 h
Salons Péribonca et Richelieu, Hôtel Reine-Elizabeth

DIMANCHE 12 SEPTEMBRE

9 h–17 h
Salon St-Laurent, Hôtel Reine-Elizabeth

LUNDI 13 SEPTEMBRE

9 h–17 h
Salon St-Laurent, Hôtel Reine-Elizabeth

17 h–20 h
Réception: la Province de Québec—Hôtel Windsor

MARDI 14 SEPTEMBRE

9 h–17 h
Salon St-Laurent, Hôtel Reine-Elizabeth

10 h
Départ des autobus de l'Hôtel Reine-Elizabeth pour l'excursion L3: LAURENTIDES

19 h
Banquet du Congrès—Grand Salon, Hôtel Reine-Elizabeth

MERCREDI 15 SEPTEMBRE

9 h–17 h
Salon St-Laurent, Hôtel Reine-Elizabeth

## EXCURSIONS

### CONSTRUCTION À MONTRÉAL

Excursion n° 11, samedi 11 septembre
Excursion n° 12, jeudi 16 septembre

Les congressistes ont visité une section complétée et une section en construction du métro de Montréal. Le coût total de cette entreprise atteindra 180 millions de dollars, somme qui comprend l'exécution de toute la construction, l'achat du stock, and the installation of track facilities for 15 miles of subway serving the city of Montreal and suburbs. Construction was started in 1961, with completion forecast for 1966. This subway is similar in concept to that of the Paris Metro. Technical advisors from R.A.T.P. (The Autonomous Transport Board of Paris) collaborated with the Public Works Department of the city of Montreal in the design. All possible rock and soil formations in the city of Montreal will be encountered in the construction of the subway.

In the afternoon, the tour visited the site of Expo 67. The 1967 exposition is the first of its kind in North America—the first world exposition of the First Category authorized by the International Exhibition Bureau. This will be a memorable and exceptional occasion since it will coincide with the centennial of Canadian confederation. The theme of the 1967 universal exhibition will be "Man and His World". Nations from all parts of the world will demonstrate their faith in man, his achievements, his aspirations, and his future, through pavilions dedicated to science, exploration, modern living, the arts, and industry. The group was given a view of the construction in progress and an opportunity to look at models of the work proposed.

matériel roulant et l'installation de 15 milles de voies ferrées du métro destinées à desservir la ville de Montréal et ses banlieues. La construction a débuté en 1961, et elle devrait être terminée en 1966. Ce métro est conçu d'après celui de Paris. Des conseillers techniques de la R.A.T.P. (Régie autonome des transports parisiens) ont collaboré avec le Département des travaux publics de la ville de Montréal pour en établir les plans. Toutes les formations lithologiques et pédologiques existant sous Montréal seront rencontrées au cours de la construction du métro.

Au cours de l'après-midi, les congressistes ont visité le site de l'Expo 67. L'Exposition de 1967 sera la première de son espèce en Amérique du Nord; elle est la première exposition mondiale de première catégorie autorisée par le Bureau international des expositions en Amérique du Nord; elle constituera un événement exceptionnel et mémorable, étant donné qu'elle coïncidera avec le premier centenaire de la confédération canadienne. Le thème de l'exposition universelle de 1967 sera "Terre des Hommes". Des nations du monde entier y célèbreront leur foi en l'homme, en ses réalisations, en ses aspirations et en sa destinée, par l'intermédiaire de pavillons consacrés à la science, à l'exploration, à la vie moderne, aux arts et à l'industrie. Les congressistes ont pu voir la construction de l'exposition battant son plein, et ils ont pu examiner des maquettes des pavillons proposés.

### MONTREAL CONSTRUCTION

Tour No. 13, Wednesday afternoon, September 15

The tour visited the Louis-Hippolyte Lafontaine Bridge-Tunnel complex near Boucherville on the south shore of the St. Lawrence River. When completed in 1966, this project—which is part of the Trans-Canada Highway system—will be nearly 4 miles long and capable of accommodating six lanes of road traffic. The complex consists of a tunnel—nearly a mile long and the largest prestressed structure in the world—which passes under the St. Lawrence River channel to Ile Charron, with a bridge from Ile Charron to the south shore of the river. The group was given a view of the construction in progress.

### CONSTRUCTION À MONTRÉAL

Excursion nº 13, mercredi 15 septembre dans l'après-midi

Les congressistes ont visité l'ensemble du pont-tunnel Louis-Hippolyte Lafontaine près de Boucherville, sur la rive sud du Saint-Laurent. Lorsqu'il sera terminé en 1966, cet ouvrage qui fait partie du réseau routier transcanadien mesurera environ 4 milles de longueur, et six voies de circulation y passeront. L'ensemble comprend un tunnel mesurant près d'un mille de long (c'est l'ouvrage en béton précontraint le plus grand au monde) qui passe sous le chenal du Saint-Laurent jusqu'a l'île Charron; un pont le prolonge entre l'île Charron et la rive sud du fleuve. Les congressistes ont pu examiner les travaux en cours.

### OTTAWA/SEAWAY

Tour No. 21, Saturday, September 11
Tour No. 22, Thursday, September 16

The tour travelled by chartered coach to Ottawa *via* the Trans-Canada Highway. A brief study stop was made at the Hawkesbury landslide, approximately 60 miles from Montreal. This slide, which involved half a million cubic yards of sand and clay, was apparently triggered by a small explosive charge innocently set off by workmen. The tour continued to Ottawa with a study stop at the eastern edge of the city. Several points of interest were indicated, including a 23-foot-high clay embankment placed over a 117-foot-thick compressible deposit which was instrumented to observe settlements.

A recently constructed sewage treatment plant provided an opportunity to examine some of the properties of Leda clay. The sewage pumping station involved an 80-foot-deep excavation in which large undisturbed block samples of soil were obtained for laboratory testing and comparison with tube samples.

The scar of a landslide, which probably occurred 200 to 300 years ago and can still be seen, was pointed out following the plant site visit. About 30 acres of a 90-foot-high bank flowed out over a fairly level plain, covering about 80 acres

### OTTAWA/LA VOIE MARITIME

Excursion nº 21, samedi 11 septembre
Excursion nº 22, jeudi 16 septembre

Le groupe est parti vers Ottawa, par autocar affrété, sur l'autoroute transcanadienne. Un bref arrêt d'études a permis aux congressistes d'examiner le glissement de terrain d'Hawkesbury, à environ 60 milles de Montréal. Ce glissement, qui touche un demi-million de verges cubes de sable et d'argile, a été semble-t-il déclenché involontairement par des ouvriers faisant détonner une petite charge explosive. Le groupe a ensuite continué vers Ottawa et s'est arrêté à la limite orientale de la ville pour une courte étude. On lui a montré plusieurs points intéressants, dont un remblai d'argile de 23 pieds de haut placé sur un lit de matériaux compressibles de 117 pieds d'épaisseur, qui a été muni d'instruments pour en mesurer le tassement.

La construction récente d'une usine d'épuration des eaux-vannes a fourni la possibilité d'étudier quelques-unes des propriétés de l'argile de la formation Léda. Pour ériger la station de pompage des eaux-vannes, il a fallu réaliser une excavation de 80 pieds de profondeur dans laquelle on a pu recueillir de gros échantillons massifs de sol intact en vue d'essais de laboratoire et de comparaison avec des échantillons de carottage.

to a depth of 20 feet. Approximately two million cubic yards of clay were involved.

Much of the city of Ottawa is underlain by the extra-sensitive Leda clay and this has caused many engineering and foundation problems. One example, which was seen on the tour, is the National Museum building constructed in 1910 and which has since undergone settlements up to 2 feet. A slight overconsolidation of the Leda clay in most areas allows the use of rafts and spread footings for buildings and bridges. Examples of such construction were also indicated in central Ottawa. Another characteristic of Leda clay is the large volume change associated with seasonal changes in water content. During dry summers large trees create a local demand for water which leads to local shrinkage and damage to shallow foundations. This characteristic was observed in central Ottawa.

The city of Ottawa has one of the oldest earth dams in North America. This dam can still be seen as part of the historic Rideau Canal system which provides a link between the Ottawa River and Lake Ontario. The Parliament Buildings of Canada were also visited.

The tour left Ottawa at about 1600 hours and travelled to Cornwall. The Cornwall Power generating plant was toured and a film shown illustrating construction of the dam. The tour returned to Montreal along the route of the St. Lawrence Seaway.

La trace d'un glissement de terrain qui s'est probablement produit il y a 200 ou 300 ans peut encore se voir et les congressistes l'ont aperçue après la visite à l'usine d'épuration des eaux. Environ 30 acres d'un banc de 90 pieds de hauteur se sont répandus sur un terrain relativement plat, recouvrant environ 80 acres sur une épaisseur de 20 pieds. Approximativement 2 millions de verges cubes d'argile ont été impliquées dans ce glissement.

Une grande partie du sous-sol de la ville d'Ottawa consiste en une argile de la formation de Léda très instable qui a causé de nombreuses difficultés de construction et de fondation. Un exemple, qui a été indiqué aux congressistes, est l'édifice du Musée national construit en 1910 et qui a subit depuis lors des tassements allant jusqu'à 2 pieds. Une légère consolidation supplémentaire de l'argile de la formation Léda permet dans la plupart des régions l'emploi de dalles flottantes et de semelles pour les bâtiments et les ponts. Des exemples d'une telle construction ont été montrés dans le centre d'Ottawa. De grands changements de volume dus à des variations saisonnières dans la teneur en eau sont une autre caractéristique de l'argile de la formation Léda. Au cours des mois secs de l'été les grands arbres absorbent beaucoup d'eau ce qui produit des contractions locales et endommage les fondations peu profondes. Les congressistes ont observé ces caractéristiques dans le centre d'Ottawa.

La ville d'Ottawa possède l'un des plus vieux barrages de terre en Amérique du Nord. On peut encore voir ce barrage qui fait partie du canal Rideau. Ce canal constitue un lien historique entre l'Outaouais et le lac Ontario. Le groupe a également visité les édifices du Parlement fédéral du Canada.

Le groupe a quitté Ottawa à environ quatre heures de l'après-midi pour se rendre à Cornwall. Les congressistes y ont visité la Centrale hydro-électrique et on leur a montré un film illustrant la construction du barrage. Le groupe retourna à Montréal par la route longeant la voie maritime du Saint-Laurent.

## ST. LAWRENCE/QUEBEC

### Tour No. 41, Sunday, September 12

The tour travelled by chartered aircraft to Quebec City. En route the plane flew at low altitude over the renowned landslide areas of Nicolet and St. Thuribe. For this purpose Fairchild 27 planes had been chartered to allow an unobstructed view from all windows.

Upon arrival at Quebec City, the group made a sightseeing tour of greater Quebec which lasted approximately four hours, including lunch, a stop at the celebrated Quebec Bridge, visits to the Citadel, the Parliament Buildings, the Laval University campus, and old Quebec. After some leisure time in Quebec, the group returned by the chartered aircraft to Montreal.

## LE SAINT-LAURENT À QUEBEC

### Excursion nº 41, dimanche 12 septembre

Les congressistes se sont rendus à Québec par avion nolisé. En cours de route l'avion survola à faible altitude les régions affectées par les célèbres glissements de terrain de Nicolet et de Saint-Thuribe. On avait affrété des avions Fairchild 27 dans ce but afin de permettre une bonne vision par les hublots.

Dès son arrivée à Québec, le groupe a entrepris une tournée du grand Québec en autocar qui a duré environ 4 heures, y compris le temps du repas, un arrêt au célèbre pont de Québec, une visite à la Citadelle, aux édifices du Parlement, à l'Université Laval et au vieux Québec. Après quelque temps de repos pris à Québec même, le groupe est retourné à Montréal par l'avion nolisé.

## NIAGARA FALLS

### Tour No. 51, Saturday, September 11

The tour travelled to Toronto on a regular scheduled Air Canada flight. The group then travelled by chartered coach to Niagara Falls *via* the Queen Elizabeth Way and the Burlington and Garden City Skyways.

Although only 35 miles long, the Niagara River is one of the greatest sources of hydro-electric power in the world. Its development has been carefully carried out with two objectives in mind: maximum use of the river's might for the efficient production of low-cost power, and the preservation

## NIAGARA FALLS

### Excursion nº 51, samedi 11 septembre

Les congressistes se sont envolés jusqu'à Toronto par l'avion normal d'Air Canada. Ils ont ensuite voyagé par autocar affrété jusqu'à Niagara Falls en empruntant le Queen Elizabeth Highway, le Burlington Skyway et le Garden City Skyway.

Quoiqu'il n'ait que 35 milles de longueur, le Niagara est l'une des plus grandes sources d'énergie hydroélectrique au monde. Sa mise en valeur a été soigneusement menée à bien en tenant compte de deux objectifs: l'utilisation maximale and enhancement of the beauty of the Falls. Three factors combine to make the Niagara River one of the most favourable rivers in the world for the production of electric power. These factors are the uniformity of its flow, the extent and concentration of its descent, and its proximity to markets.

A tour of this area afforded the opportunity of seeing at first hand two of the four generating stations on the Canadian side. Set at the base of the spectacular three-hundred-foot cliffs of the Niagara Gorge, eight miles downstream from the Horseshoe Falls, are the Sir Adam Beck-Niagara Generating Stations Nos. 1 and 2.

Construction of the Sir Adam Beck Generating Station No. 2 began in 1950 and first power was delivered in 1954. It has a capacity of 1,400,300 kilowatts and was built at a cost of 300 million dollars. The tremendous engineering problem involved included not only construction of the powerhouse itself and the upriver intakes, but two 5.5-mile, 50-foot diameter tunnels driven as deep as 300 feet under the city of Niagara Falls, a 2.25-mile open-cut canal, and a pumped-storage reservoir for the storage of large quantities of water for use during periods of peak power demand.

The Niagara Parks Commission maintains more than 3,000 acres of park extending along the length of the Niagara River from Lake Erie to Lake Ontario. The area features floral and shrubbery displays, rock gardens, lily ponds, terraces, and fountains that combine the great natural beauty of the area with man's skill in the arts of horticulture. The itinerary included a visit to the Seagram Tower which provided an unparalleled opportunity to view and photograph the beauty of the area. The group also visited Table Rock House for a close-up view of the Canadian Falls.

The tour returned by chartered coach to Toronto International Airport and then by a regular scheduled flight to Montreal.

de la puissance du cours d'eau pour obtenir une production efficace d'électricité à bon marché et la préservation et l'amélioration de la beauté des chutes. Trois facteurs concordent pour faire du Niagara l'une des rivières les plus favorables dans le monde pour la production d'énergie électrique. Ces facteurs sont l'uniformité de son régime, l'intensité et la concentration de sa chute et la proximité des marchés qu'il dessert.

La visite de cette région a permis de voir de près deux des quatre centrales installées du côté canadien. Les centrales n° 1 et 2 du complexe Sir Adam Beck sont situées à la base des falaises spectaculaires de 300 pieds de haut de la gorge du Niagara et à huit milles pieds en aval de la chute Horseshoe.

La construction de la centrale Sir Adam Beck n° 2 a commencé en 1950 et les premiers kilowatts ont été livrés en 1954. Elle a une puissance de 1 400 300 kilowatts et son coût de construction a atteint 300 000 000 de dollars. Un problème très complexe était posé non seulement par la construction de la centrale proprement dite et des prises d'eau en amont mais aussi par la construction de deux tunnels de 50 pieds de diamètre et de 5,5 milles de longueur creusés jusqu'à 300 pieds sous la ville de Niagara Falls, par un canal à l'air libre de 2,25 milles de long et par un réservoir d'emmagasinage de l'eau pompée afin d'avoir des réserves suffisantes pour les périodes de grande demande.

La Commission des parcs de Niagara entretient plus de 3 000 acres de terrain tout au long du Niagara depuis le lac Erié jusqu'au lac Ontario. On trouve sur ces terrains des arrangements floraux et des groupes de buissons à fleurs, des rocailles, des étangs fleuris, des terrasses et des fontaines qui ajoutent à la grande beauté naturelle de cette région la touche habile de l'horticulteur. L'itinéraire a inclus une visite de la tour Seagram qui a fourni une occasion unique de voir et de photographier cette magnifique région. Le groupe a également visité Table Rock House pour voir de près les chutes canadiennes.

Les congressistes sont retournés par autocar affrété jusqu'à l'aéroport international de Toronto et sont revenus à Montréal par le vol régulier.

## MANICOUAGAN

### Tour No. 61, Saturday, September 11

The tour left Montreal International Airport by chartered aircraft on Friday, September 10. An overnight stop was made at Baie Comeau. On Saturday morning, September 11, the group continued by chartered aircraft to the Manicouagan 5 Development.

The Manicouagan 5 Development forms a part of a large project which the Quebec Hydro-Electric Commission is undertaking on the Manicouagan and Outardes rivers in northeastern Quebec. These two rivers, which discharge into the St. Lawrence on its north shore within 10 miles of one another, and 200 miles downstream from Quebec City, will constitute one of the major sources of hydro-electric power in Canada. The project includes development of 6 million h.p. at 3 sites on the Manicouagan River, two sites on the Outardes River, and the extension of one existing plant on each river. It also includes the building of three storage reservoirs; two are relatively small, but the third, which is under construction as part of the Manicouagan Development, will rank among the larger in the world.

The Manicouagan 5 Development is situated above the fifth falls of the Manicouagan River, approximately 125 miles upstream. It comprises a power development whose installed capacity will be 1,760,000 h.p. under a 505-foot head, and a

## MANICOUAGAN

### Excursion n° 61, samedi 11 septembre

Les congressistes se sont envolés de l'aéroport international de Montréal par avion nolisé vendredi le 10 septembre. Ils s'arrêtèrent pour passer la nuit à Baie-Comeau. Le samedi matin, 11 septembre, le groupe a poursuivi son voyage par avion nolisé vers les réalisations en cours de Manicouagan 5.

L'aménagement de Manicouagan 5 fait partie d'un grand complexe que la Commission hydroélectrique de Québec érige actuellement sur les rivières Manicouagan et Outardes dans le nord-est du Québec. Ces deux rivières, qui se jettent du côté nord du Saint-Laurent à 10 milles l'une de l'autre et à 200 milles en aval de Québec, constituent l'une des principales sources d'énergie hydroélectrique au Canada. Ces projets comportent la mise en route d'installations d'une puissance de 6 millions de chevaux-vapeur à trois emplacements sur la rivière Manicouagan et à deux emplacements sur la rivière Outardes ainsi que l'agrandissement d'une centrale existant actuellement sur chaque rivière. Ils comprennent également la construction de trois réservoirs d'emmagasinage dont deux seront relativement petits et le troisième fera partie du complexe Manicouagan et comptera parmi les plus grands du monde.

L'aménagement de Manicouagan 5 est situé au-dessus de la cinquième chute de la rivière Manicouagan, à environ 125 concrete multiple-arch storage dam whose crest will be 4,000 feet long and 705 feet above the lowest point in its foundation. This dam will impound a reservoir containing 115 million acre-feet of water.

The foundation of the dam is high-strength gneisses and granitic rock of excellent quality. The dam comprises one main arch spanning the river, with buttresses 530 feet centre to centre, and 13 smaller arches spanning the rest of the valley, with buttresses at 250-foot centres. The crest of the dam will be straight and will accommodate a roadway 17 feet wide. The total volume of concrete in the dam will be 2,800,000 cubic yards; concreting was started in October, 1962, and is scheduled to be completed in the autumn of 1967.

After a technical visit of the dam site, the tour returned to Montreal by chartered aircraft late Saturday afternoon.

milles en amont de son embouchure. Il comprend une usine génératrice dont la puissance installée atteindra 1 760 000 chevaux-vapeur sous une chute de 505 pieds, et un barrage-réservoir en béton à voûtes multiples dont la crête aura 4 000 pieds de long et sera à 705 pieds au-dessus du point le plus bas de ses fondations. Ce barrage contiendra une quantité d'eau équivalente à 115 millions d'acres-pieds. (1 acre-pied = 1233 m.cu.)

Le barrage repose sur des gneiss fortement résistants et sur des roches granitiques d'excellente qualité. Le barrage comprend une voûte principale enjambant la rivière, des contreforts séparés par 530 pieds de centre à centre, et 13 voûtes plus petites qui traversent le reste de la vallée avec des contreforts séparés de 250 pieds de centre à centre. La crête du barrage sera droite et portera une route d'un peu plus de 17 pieds de large; le volume total du béton dans le barrage sera de 2 800 000 verges cubes. Le bétonnage a commencé en octobre 1962 et on prévoit qu'il sera terminé à l'automne de 1967.

Après une visite technique à l'emplacement du barrage, les congressistes sont retournés à Montréal par avion affrété à la fin de l'après-midi de samedi.

### TRANS-CANADA STUDY TOUR

Wednesday, September 15–Thursday, September 23

The tour group travelled to Toronto by regular scheduled flight arriving in the late Wednesday afternoon.

*Thursday, September 16—Toronto*

The tour visited Toronto's new City Hall, the subway under construction, and the Macdonald-Cartier Freeway.

Toronto's new City Hall was conceived in an international competition in which 530 architects from 42 countries were represented. The Civic Square, which is the setting for the new building, is the largest undertaken by any city in the last three generations. Originally designed by the late Viljo Rewell of Finland, the City Hall building consists of east and west towers which rise to heights of 325 and 260 feet respectively, forming an imposing edifice which encloses a dome-shaped council chamber 230,000 square feet in area supported on one central column. The project was started in the fall of 1961 and the official opening of the Square was in the week of September 13, 1965.

The tour continued to the Toronto Transit Commission subway. A long-term programme of subway construction has been under way in Toronto since 1945. The present major expansion is the east–west subway, located just north of Bloor Street. For the most part, it is of cut-and-cover construction although tunnels under major railway lines are under construction. A variety of soils from rock-hard silty tills to wet saturated stratified silts have been encountered. The problems associated with earth pressures on temporary shoring and strutting, and the requirements to ensure stability of adjacent buildings, are of considerable interest to geotechnical engineers. There was ample opportunity to examine the soils.

The tour continued to the Macdonald-Cartier Freeway (Highway 401). The tremendous growth of traffic on this section of Highway 401 has defied all rational means of predicting traffic growth. After an extensive study of the present and anticipated future traffic volume, a comprehensive collector distribution system was conceived which, when completed, will be the largest of its kind in the world. A

### VOYAGE D'ÉTUDE TRANSCANADIEN

mercredi 15 septembre—jeudi 23 septembre

Les congressistes se sont rendus à Toronto par le vol normal arrivant à la fin de l'après-midi.

*Jeudi 16 septembre—Toronto*

Les congressistes ont visité le nouvel Hôtel de Ville de Toronto, la section du métro en construction et l'autoroute Macdonald-Cartier.

Le nouvel Hôtel de Ville de Toronto a été conçu à l'occasion d'un concours international auquel 530 architectes de 42 nations avaient participé. Le Civic Square, qui constitue l'emplacement où se trouve le nouvel édifice, est la plus importante réalisation depuis trois générations dans n'importe quelle ville. Le bâtiment a été conçu originellement par Viljo Rewell de Finlande maintenant décédé; le bâtiment comprend une tour est et une tour ouest qui s'élèvent à une hauteur de 325 et de 260 pieds respectivement, formant un édifice imposant qui contient une salle de conseil municipal en forme de dôme lequel couvre une surface de 230 000 pieds carrés et qui est soutenu par une colonne centrale. Les travaux ont débuté à l'automne de 1961 et l'ouverture officielle du Civic Centre était fixée à la semaine du 13 septembre 1965.

Le groupe a ensuite visité le métro de la Toronto Transit Commission. Un programme à long terme pour la construction d'un métro à Toronto se poursuit depuis 1945. L'importante extension en cours d'exécution est la ligne de métro est-ouest, située immédiatement au nord de la rue Bloor. La plus grande partie de la nouvelle ligne a été construite à ciel ouvert et recouverte, bien que des tunnels soient en construction sous d'importantes lignes de chemin de fer. Les constructeurs ont rencontré des sols très variés allant de la moraine de fond glaciaire dure comme le roc jusqu'à des lits de limons stratifiés imprégnés d'eau. Les questions relatives à la pression du sol sur les dispositifs temporaires d'étançonnement et les conditions exigées pour assurer la stabilité des bâtiments adjacents présentent un intérêt considérable pour les ingénieurs géotechniciens. Les congressistes ont eu amplement le temps d'examiner les divers sols.


Route of Trans-Canada Study Tour

twelve basic lane section was chosen with special design solutions and extra lanes in the vicinity of interchanges. The construction of the 20-mile section was started in 1963 and should be completed by 1971. The visit to this project included the viewing of a scale model with a short explanatory talk given by a representative of the Department of Highways of Ontario and then a trip along portions of the highway under construction. This included a look at the Spadina Interchange (Interchange No. 51) which is believed to be the largest and most complicated interchange under construction in Canada.

Les congressistes ont continué leur visite par l'autoroute Macdonald-Cartier (Highway 401). L'extraordinaire intensification de la circulation dans cette section de l'autoroute 401 a mis en échec tous les moyens rationnels dont on dispose pour prédire le développement de la circulation routière. Après une étude approfondie du volume actuel et prévu de la circulation, un vaste réseau routier a été conçu qui, lorsqu'il sera terminé, sera le plus grand du genre dans le monde. Un tronçon de base comportant douze voies a été choisi et comporte des traits de conception très particuliers et des voies supplémentaires aux abords des raccordements. La construction de ce tronçon de 20 milles de long a commencé en 1963 et devrait être terminée en 1971. La visite de ces travaux a débuté par l'examen d'une maquette et par un court exposé donné par un représentant du Ministère de la voirie de l'Ontario et se continua par une excursion tout au long des tronçons de l'autoroute en construction. Les congressistes ont pu apercevoir le raccordement de Spadina (Interchange No. 51) qu'on croît être le raccordement routier le plus complexe et le plus grand en construction au Canada.

*Friday, September 17—Winnipeg*

The tour made several technical visits to various points of interest in and around Winnipeg. The city is located in the basin of the former glacial Lake Agassiz, which covered a large portion of Manitoba near the end of the last ice age. Lacustrine deposits some 40 to 60 feet deep are found over glacial till or limestone bedrock. Most of these deposits consist of laminated clays of high plasticity and low sensitivity, and they are subject to large volume changes by drying or wetting.

Because of relatively flat terrain and adverse hydrological conditions, the metropolitan area of Winnipeg, having a population of about 500,000, has been subjected to a number of major floods by its two main rivers, the Red and the Assiniboine. To alleviate flooding conditions, construction is under way on a 30-mile-long floodway designed to have a capacity of 60,000 c.f.s. The top width is approximately 1,000 feet and the depth will vary between 25 and 75 feet. The magnitude of this work is realized when it is noted that approximately 100,000,000 cubic yards of excavation will be required, and that a large number of crossings must be built for major highways, railroads, water supply lines, and other utilities. The main soil mechanics problem was the selection of suitable side slopes to assure long-term stability.

The tour visited key points on the floodway project. Visitors also saw a number of riverbanks where active sliding over a number of years has endangered property. The volume changing properties of the lacustrine clays have resulted in the development of foundation designs to resist or to accommodate the movement. Visits were made to construction sites where caissons drilled by auger were being installed.

Winnipeg is also the administrative centre of many hydroelectric developments in the northern part of Manitoba. A lecture was given on some aspects of these projects including construction on permafrost and extensive grouting of fissured limestone.

*Vendredi 17 septembre—Winnipeg*

Les congressistes ont effectué plusieurs visites techniques à divers endroits intéressants dans la région de Winnipeg. Cette ville est située dans le bassin de l'ancien lac glaciaire Agassiz qui recouvrait une grande partie du Manitoba vers la fin de la dernière période glaciaire. Des dépôts lacustres de 40 à 60 pieds d'épaisseur reposent au-dessus des moraines glaciaires ou de la roche de fond calcaire. La plupart de ces dépôts consistent en argile feuilletée à haute plasticité, à faible sensibilité et sont sujets à de grands changements de volume par séchage et humidification.

La zone métropolitaine de Winnipeg, qui a une population d'environ 500 000 âmes, a subi un certain nombre d'inondations importantes, causées par ses deux rivières principales, la Rouge et l'Assiniboine, car la ville est bâtie sur des terrains relativement plats où les conditions hydrologiques ne sont pas favorables. Pour faire face à ces dangers d'inondation, on construit actuellement un canal de dérivation de 30 milles de long conçu pour évacuer 60 000 pied cubes d'eau à la seconde. Sa largeur au sommet atteint environ 1 000 pieds et sa profondeur variera de 25 à 75 pieds. On peut se rendre compte de l'importance de ce travail lorsque l'on constate qu'environ 100 000 000 de verges cubes seront extraites et qu'un grand nombre de voies de passages devront être prévues pour les autoroutes, les voies de chemin de fer, les conduites d'approvisionnement d'eau et autres services d'utilité publique. Le principal problème de mécanique des sols a été posé par le choix de la pente appropriée des berges en vue d'assurer une stabilité à long terme.

Le groupe a visité les points stratégiques des travaux du canal de dérivation. Il a aussi examiné un certain nombre de berges où des glissements actifs ont menacé les propriétés au cours d'un certain nombre d'années. Le fait que les argiles lacustres aient la propriété de changer de volume a entraîné la mise au point de types de fondations aptes à résister ou à s'accommoder aux mouvements du sol. Le groupe a ensuite visité des chantiers de construction où des caissons sont mis en place au moyen de tarières.

Winnipeg est également le centre administratif d'un grand nombre de réalisations hydroélectriques dans la partie nord du Manitoba. Un conférencier a expliqué quelques aspects de ces entreprises y compris les techniques de construction sur le pergélisol et l'important jointoiement qui est nécessaire à la consolidation du calcaire fissuré.

*Saturday, September 18—Saskatoon*

The tour visited the South Saskatchewan River Dam, travelling to the site on the east side of the river. Travel was through typical mixed farming and grain farming areas. Stops were made to observe interesting geological features, shelter belts planted to conserve moisture and control erosion, an Experimental Irrigation Farm, and other points of interest. The South Saskatchewan River Development is a large, multi-purpose project to provide irrigation, hydroelectric power, flood control, recreation, and water supply for an agricultural area in central Saskatchewan. The project is being financed jointly by the federal government and the Province of Saskatchewan.

The key structure is an earthfill dam and appurtenant works located on the South Saskatchewan River about 80 miles south of Saskatoon. This dam, which is the largest earthfill dam in Canada, contains approximately 100 million cubic yards of material and creates a reservoir with a total capacity of 8 million acre-feet. The main embankment is 210 feet in height and is located partly on river sand and partly on a soft clay-shale known as the Bearpaw Shale. A complete cut-off has not been made through the river sand in the foundation; seepage will be controlled by an upstream blanket, downstream filters, and relief wells. The Bearpaw Shale, which outcrops along the sides of the valley, shows definite signs of old slides and instability, which have resulted in stability problems on the abutments. The tunnels, spillway, and powerhouse are also in the clay-shale. The clay-shale is of Upper Cretaceous age and has a pronounced tendency to swell after removal of load or upon saturation.

The construction of the dam was nearing completion, but at the time of the visit, extensive earthwork operations were underway. This involves placing materials at rates of up to 80,000 yards per day to complete the main embankment. In addition, construction of a reinforced concrete chute-type spillway was taking place.

The group returned to Saskatoon along the west side of the river.

*Samedi 18 septembre—Saskatoon*

Le groupe a visité le barrage de la rivière Saskatchewan-sud après avoir suivi la rive est de ce cours d'eau. Le chemin passe à travers des régions typiques de cultures mixtes et de cultures de céréales. Les congressistes se sont arrêtés pour observer d'intéressantes particularités géologiques, les plantations destinées à conserver l'humidité et à empêcher l'érosion, une ferme d'irrigation expérimentale et d'autres lieux intéressants. Le South Saskatchewan River Development est une grande entreprise qui a pour but de faciliter l'irrigation, de produire de l'énergie hydroélectrique, de maîtriser les inondations, de fournir des parcs de délassement et d'approvisionner en eau la région agricole du centre de la Saskatchewan. L'entreprise est financée conjointement par le gouvernement fédéral et la province de la Saskatchewan.

L'ouvrage clé comprend un barrage de terre et des ouvrages annexes situés sur la rivière Saskatchewan-sud, à environ 80 miles au sud de Saskatoon. Ce barrage, qui est le plus grand barrage de terre au Canada, contient approximativement 100 millions de verges cubes de matériaux et il constitute un réservoir ayant une capacité équivalente à 8 millions d'acres-pieds d'eau. Le remblai principal atteint 210 pieds de hauteur et il repose en partie sur du sable de rivière et en partie sur un schiste argileux tendre connu sous le nom de schiste de la formation Bearpaw. Les fondations n'apportent pas une étanchéité complète; un écran en amont, des filtres en aval et des puits de décharge empêcheront les infiltrations. Le schiste de la formation de Bearpaw qui apparaît le long des côtés de la vallée, montre des signes visibles d'anciens glissements et révèle ainsi son instabilité, ce qui a posé des problèmes de stabilité concernant les butées. Les tunnels, le déversoir et la centrale reposent également sur le schiste argileux. Ce matériau a été déposé à l'époque du crétacé ancien et il possède une forte tendance à gonfler lorsque la charge qui le supporte est enlevée ou lorsqu'il est saturé d'eau.

La construction du barrage était presque terminée, mais au moment où les congressistes l'ont visitée, d'importants travaux de remblayage étaient en cours. Ces opérations comprennent la mise en place de matériaux au rythme de plus de 80 000 verges cubes par jour pour compléter le remblai principal. En outre, la construction d'une forme de déversoir en béton armé était en cours.

Le groupe retourna à Saskatoon par la rive ouest de la rivière.

*Sunday, September 19—Edmonton*

The tour visited the Big Bend Dam site on the Brazeau River, approximately 130 miles southwest of Edmonton. The travelling time to the site was approximately 2½ hours through typical farming country and timbered foothills with the Rocky Mountains in the distance.

The Brazeau River, one of the main tributaries of the North Saskatchewan River, rises on the eastern slopes of the Rocky Mountains. The Big Bend site is the first to be developed on the River for the purpose of producing hydroelectric power. The project also provides regulation of the minimum winter flow of the North Saskatchewan River at Edmonton.

The project will be producing power by September, 1965, and all earthwork completed. The main dam is a rolled earthfill, 200 feet in height, with provision for increasing the height to 225 feet. A unique pump-turbine of 3,500 c.f.s. capacity pumps the stored water to a canal twelve miles long leading to the intake for the powerhouse, where the head developed is 400 feet. The development is designed for an

*Dimanche 19 septembre—Edmonton*

Les congressistes ont visité l'emplacement du barrage Big Bend sur la rivière Brazeau, à environ 130 milles au sud-ouest d'Edmonton. L'aller a pris environ 2 heures et demie, le chemin passe à travers une région agricole typique et parmi des collines boisées tandis que les Montagnes Rocheuses se profilent à l'arrière-plan.

La rivière Brazeau, l'un des principaux affluents de la rivière Saskatchewan-nord, prend sa source sur les pentes orientales des Montagnes Rocheuses. Le barrage de Big Bend sera le premier à être construit sur la rivière pour la production de l'énergie hydroélectrique. Les travaux ont également pour but de régulariser le débit minimal de la rivière Saskatchewan-nord à Edmonton en hiver.

La nouvelle centrale produira de l'électricité en septembre 1965 et tous les travaux de remblayage seront alors terminés. Le barrage principal est constitué de terre compactée et mesure 200 pieds de hauteur; il pourra être exhaussé jusqu'à 225 pieds. Une pompe-turbine spéciale d'une puissance de 3 500 pieds cubes par seconde pompe l'eau emmagasinée ultimate installation of one million horsepower. The development is owned by the Calgary Power Co. Ltd.

The Brazeau River runs in a narrow cut through Cretaceous shales and sandstones. The main dam is a zoned section with an impervious core of glacial clay-till and pervious sections of river gravel. The canal embankment is built of rolled glacial clay-till on a foundation consisting of till, highly plastic clay, and peat.

The tour returned to Edmonton, passing through the Leduc Oilfield.

A few tour members preferred a more relaxed day, and an alternative tour of the general geology and soils in the Edmonton area was arranged. A tour of Edmonton and vicinity was made to view typical Pleistocene and Cretaceous deposits, including an instrumented slide area in the North Saskatchewan River Valley. The tour included a portion of the Leduc Oilfield and the Edmonton Refinery Area.

vers un canal long de 12 milles conduisant à la prise d'eau de la centrale, où la hauteur de chute atteint 400 pieds. Le projet est conçu en vue d'une production maximale d'un million de chevaux-vapeur. L'aménagement est la propriété de la Calgary Power Co. Ltd.

La rivière Brazeau coule dans un couloir étroit à travers des schistes et des grès du crétacé. La section du barrage principal comprend un noyau imperméable consistant en moraine et en argile glaciaire recouverte de gravier de rivière perméable. Le remblai du canal est constitué par des dépôts d'argile glaciaire et de moraine compactée reposant sur des fondations de moraine, d'argile fortement plastique et de tourbe.

Le groupe retourna ensuite à Edmonton en passant par les champs pétrolifères Leduc.

Un certain nombre de congressistes ont préféré passer une journée plus tranquille, et ont fait une tournée d'études de la géologie générale et des sols dans la région d'Edmonton. Ils y examinèrent des formations typiques du pléistocène et du crétacé, y compris une zone de glissements munie d'instrument dans la vallée de la rivière Saskatchewan-nord. Les congressistes visitèrent également une partie du champ pétrolifère Leduc et la région des raffineries d'Edmonton.

*Monday, September 20—Hudson Hope*

The tour travelled by chartered aircraft to Hudson Hope, and from there by coach to the Portage Mountain Dam. A tour was made of the dam fill, borrow pit, and materials processing plant. The Portage Mountain Dam is the first and major stage in developing the power potential of the upper Peace River in north central British Columbia. Runoff water from over 27,000 square miles will be trapped behind the dam to form a reservoir covering 680 square miles—becoming the largest lake in the province. The underground powerhouse will have an ultimate capacity of 2,300,000 kilowatts.

The dam site is located in a steep rock-walled valley known as the Peace River Canyon, having rock cliffs that rise about 150 feet above water level. The rock consists of nearly horizontal strata of massive sandstone and shale, with a few thin seams of coal and one 7 feet thick. The earth dam, containing 60 million cubic yards, will be a zoned, rolled gravel fill structure with a tightly compacted core of well-graded silty sand, obtained from glacial moraine ridges 4 miles from the site. The dam will be 600 feet above bedrock in the river bottom, ½ mile wide, stretching 1¼ miles across the Peace River Valley. A grout curtain will seal bedrock cracks and fissures.

A 66-inch conveyor belt nearly three miles long, one of the longest in the world, carries 12,000 tons of material per hour from the moraine areas to the separation plant near the dam. Here the material is screened, washed, and separated, then recombined as required for placing in the various zones of the dam. The processing plant of the most modern design is the largest ever built.

*Lundi 20 septembre—Hudson Hope*

Le groupe s'est envolé par avion nolisé jusqu'à Hudson Hope, et de là il a voyagé par autocar jusqu'au barrage de Portage Mountain. Les congressistes ont visité les travaux de remblayage du barrage, l'excavation d'où sont tirés les matériaux, et l'usine de traitement de ces matériaux. Le barrage de Portage Mountain est la première et la plus importante étape de la mise en valeur de la puissance hydroélectrique de la partie supérieure de la rivière de la Paix dans le centre-nord de la Colombie Britannique. L'eau provenant du bassin hydrographique de plus de 27 000 milles carrés sera captée derrière le barrage et formera un réservoir d'une superficie de 680 milles carrés, soit le plus grand lac de la province. La centrale souterraine aura une puissance maximale de 2 300 000 kilowatts.

Le barrage est situé dans une profonde vallée rocheuse que l'on appelle le Peace River Canyon. On y trouve des falaises rocheuses qui s'élèvent à environ 150 pieds au-dessus du niveau de l'eau. La roche repose en strates presque horizontales et consiste en grès massif et en schiste argileux, entrecoupés de quelque minces filons de charbon; un de ces derniers atteint toutefois 7 pieds d'épaisseur. Le barrage de terre qui contient 60 millions de verges cubes de matériaux aura une section comprenant une zone centrale fortement compactée de sable limoneux bien calibré extrait des collines de moraine glaciaire situées à quatre milles de l'emplacement du barrage; du gravier tassé reposera au-dessus de cette zone compactée. Le barrage sera situé à 600 pieds au-dessus de la roche de fond gisant sous le lit de la rivière; il aura un demi-mille de largeur et s'étendra sur 1 mille et quart à travers la vallée du Peace. Un voile d'étanchéité scellera les fissures du fond rocheux.

Une bande transporteuse de 66 pouces de large et d'environ 3 milles de long, l'une des plus grandes au monde, transporte 12 000 tonnes de matériaux à l'heure des excavations d'où la moraine est extraite jusqu'à l'usine de triage située près du barrage. Les matériaux y sont criblés, lavés et classifiés, puis recombinés selon les besoins des diverses zones du barrage. L'usine de traitement est de conception très moderne et la plus grande jamais construite.

*Tuesday, September 21—Columbia River Power Projects*

The tour travelled by chartered coach to the Duncan Dam, through some of the finest mountain scenery in Canada.

The Columbia is the fourth largest river in North America. Rising in the Rocky Mountains the river first flows northward, then reverses its direction, crossing the boundary between Canada and the United States to enter the Pacific Ocean near Portland, Oregon. During a passage of 1,220 miles, 480 in Canada and 740 in the United States, the river falls 2,650 feet. The Columbia River basin has a drainage area of 259,000 square miles and a power potential of the order of 40 million kilowatts. Optimum development of the Columbia River basin requires that major storages be provided in Canada—with generating capacity installed progressively at the dam sites as the load demand grows—and that generating capacity be added at existing downstream plants in the United States to take advantage of the storage and flow regulation. Under the Columbia Treaty, three Canadian sites have been selected for development: Duncan Dam—height–120 feet, crest length–2,525 feet, storage–1.4 million acre-feet; Arrow Dam—height–170 feet, crest length–2,750 feet, storage–7.1 million acre-feet; Mica Dam—height–640 feet, crest length–2,540 feet, storage–12 million acre-feet. Two of the dam sites were visited during the tour.

The Duncan Lake Storage Dam is being developed on the Duncan River, a tributary of the Columbia. The dam site is located a few thousand feet upstream of the confluence of the Lardeau and Duncan rivers. Bedrock is exposed on the abutments of the dam site but in common with many other river valleys in British Columbia, the river bed consists of extensive beds of compressible sands, silts, and gravels, the maximum depth being in excess of 1,200 feet. The earth embankment under construction will have flat side slopes varying from 8 : 1 at the base to 3 : 1 at the crest. A total of 7 million cubic yards of fill will be required. Due to the compressibility of the foundation materials, settlements of 10 to 14 feet are anticipated, mainly during construction.

*Wednesday, September 22*

The tour travelled by chartered coach to the Arrow Dam *via* a route beside the Kootenay River.

The Arrow Lakes Dam is located in the Castlegar Narrows, approximately 20 miles from the International Boundary. The riverbed is typical of the buried valleys of the Canadian Cordillera in that the bedrock is overlain by some 500 feet of overburden consisting chiefly of glacial débris. However, advantage is taken of a rock ledge, which extends across the major portion of the width of the valley at the dam site to provide a foundation for the concrete components of the dam, comprising the low level discharge ports and sluices. The dam is arranged to allow for future con-

*Mardi 21 septembre—Aménagements hydroélectriques de la rivière Columbia*

Les congressistes ont voyagé par autocar affrété jusqu'au barrage Duncan, en traversant une des régions montagneuses les plus pittoresques du Canada.

Le Columbia est le quatrième des plus grands fleuves de l'Amérique du Nord. Il prend sa source dans les Montagnes Rocheuses de Colombie Britannique, s'écoule tout d'abord vers le nord, renverse ensuite son cours et franchit la frontière entre le Canada et les États-Unis pour se jeter dans l'océan Pacifique près de Portland en Orégon. Il parcourt en tout 1 220 milles, dont 480 au Canada et 740 aux États-Unis et sa dénivellation totale atteint 2 650 pieds. Le bassin hydrographique du Columbia comprend une superficie de 259 000 milles carrés et ses possibilités de production d'énergie hydroélectrique atteignent environ 40 millions de kilowatts. Un développement optimal du bassin hydrographique du fleuve Columbia exige que d'importantes réserves soient constituées au Canada, les possibilités de production étant mises en route progressivement au barrage au fur et à mesure que la demande augmentera, et qu'en aval, aux États-Unis, les centrales hydroélectriques soient agrandies pour tirer profit de l'emmagasinage d'eau et de la régularisation du débit. Aux termes du traité du Columbia, trois emplacements ont été choisis au Canada pour les ouvrages: le barrage Duncan d'une hauteur de 120 pieds, d'une longueur de crête de 2 525 pieds, contenant l'équivalent de 1.4 million d'acres-pieds d'eau; le barrage Arrow d'une hauteur de 170 pieds, d'une longueur de crête de 2 750 pieds et d'une capacité équivalente à 7.1 million d'acres-pieds d'eau; le barrage Mica d'une hauteur de 640 pieds, d'une longueur de crête de 2 540 pieds, d'une capacité d'emmagasinage équivalente à 12 million d'acres-pieds d'eau. Deux des emplacements de ces barrages ont été visités au cours de l'excursion.

Le barrage-réservoir du lac Duncan est en cours de construction sur la rivière Duncan, un affluent du Columbia. L'emplacement du barrage est situé à quelques milliers de pieds en amont du confluent des rivières Lardeau et Duncan. La roche de fond apparaît à l'emplacement des culées du barrage, mais de même que dans un grand nombre d'autres vallées fluviales de la Colombie Britannique, le lit de la rivière comprend d'importantes couches de sable compressible, de limon et de gravier, dont l'épaisseur maximale atteint au delà de 1 200 pieds. Le remblai de terre actuellement en construction aura des pentes douces d'un coefficient d'étalement variant de 8 pour un à la base jusqu'à 3 pour un au sommet. Un total de 7 millions de verges cubes de matériaux seront nécessaires. On prévoit qu'il se produira des tassements allant de 10 à 14 pieds principalement au cours de la construction, en raison de la compressibilité de ces matériaux.

*Mercredi 22 septembre*

Le groupe s'est rendu par autocar affrété jusqu'au barrage Arrow en suivant une route le long de la rivière Kootenay.

Le barrage des lacs Arrow est situé dans les défilés appelés Castlegar Narrows, à environ 20 milles de la frontière américaine. Le lit de la rivière est typique des vallées enfouies de la Cordillère canadienne car la roche de fond est recouverte d'une épaisseur d'environ 500 pieds de matériaux d'origine principalement glaciaire. Cependant, on a tiré profit de l'existence d'une saillie rocheuse qui traverse la plus grande partie de la vallée à l'emplacement du barrage pour servir de fondation aux ouvrages bétonnés, y compris les installations d'évacuation de fond et les canaux de décharge. Le struction of a powerhouse. Abutting the concrete works, the present river channel will be traversed by an earthfill embankment. The lower portions, to the normal water surface, are being built "in the wet" upon which the upper portions will be of standard compacted fill construction. An important feature of the dam will be an upstream impervious blanket extending some 2,200 feet from the dam. The core of the dam is integral with the impervious layer of the blanket.

*Thursday, September 23—Vancouver*

The tour travelled by chartered coach *via* Stanley Park Drive and the First Narrows Bridge to Seymour Falls Dam in the Coast Range mountains of British Columbia, 11 miles north of the city of Vancouver. The dam has a total crest length of 1,510 feet. The eastern half is a slab and buttress structure with overflow spillway supported on bedrock. The western half is an earthfill structure supported on sediments.

The height of the first dam built at the site in 1928 was limited to 22 feet because of the pervious foundation. Using modern advances in soil mechanics, a reappraisal indicated that a higher dam could be constructed safely and economically, provided that the design included upstream impervious blankets to reduce the leakage to tolerable limits, measures to accommodate large settlements, and drainage facilities to control the substantial seepage flows. The dam was completed to its present height of 88 feet above stream bed in 1960, with design provisions for an ultimate height of 145 feet.

The tour then travelled *via* the Second Narrows Bridge to the Port Mann Freeway. The Port Mann Freeway is a portion of the Trans-Canada Highway extending from the boundary of the city of Vancouver for a distance of 12 miles to the Fraser River in the lower mainland of British Columbia. Four miles of the Freeway traverse peat and very soft sensitive silty-clay areas. Six Freeway interchanges are located partly or wholly on peat soil. The maximum depth of peat and silty clay was 75 feet, and the maximum depth of peat was 30 feet. Construction of the Freeway grade through these areas required the erection of pre-loaded embankments. Sawdust and other lightweight fill were used extensively to reduce embankment weights.

During lunch a 35-minute film was shown on the construction of the Port Mann Bridge. Spanning the Fraser River near Vancouver, it comprises a main arch of 1,200 feet flanked by side spans of 360 feet. It is the first major bridge in North America of orthotropic deck design. Low-lying land on either side of the main arch, together with high clearances, dictated the use of long approaches. The over-all length of the bridge from abutment to abutment is 6,870 feet. Of special interest are the main pier foundations. Soil investigations indicated that under these piers there would be 50 feet of soft silty clay and peat overlying 50 feet of sand. Below this was 100 feet of sensitive clay overlying hard till. To accommodate these soil conditions, 24-inch-diameter steel pipe piles coated with asphalt were placed in pre-bored holes and driven into the hard material at 200 foot depth. The piles carry a working load of 125–150 tons. The horizontal loads are taken in the sand layer at 50 foot depth, transfer being through a specially designed ring beam surrounding the pile cap.

The bridge has recently received a Canadian Design Award for noteworthy achievements in the creative use of structural steel.

The tour travelled along the Freeway with stops for

barrage est disposé en prévision de la construction d'une centrale. Le chenal actuel de la rivière, attenant aux ouvrages de béton, sera barré par un remblai de terre. Les parties inférieures au niveau normal de la rivière sont élevées sous l'eau. Les parties supérieures reposeront au-dessus et seront d'une construction normale à remblayage compacté. Une caractéristique importante du barrage sera un rideau imperméable en amont s'étendant jusqu'à quelques 2 200 pieds du barrage. Le noyau du barrage fera corps avec la couche imperméable du rideau.

*Jeudi 23 septembre—Vancouver*

Les congressistes sont partis par autocar affrété jusqu'au barrage de Seymour Falls dans les chaînes de montagnes côtières de la Colombie britannique, à 11 milles au nord de Vancouver. Ils sont passés par la promenade de Stanley Park et par le pont First Narrows. Ce barrage est d'une longueur totale à la crête de 1 510 pieds. La partie est consiste en une structure à contreforts à dalle plane, le déversoir reposant sur la roche de fond. La partie ouest consiste en un ouvrage de terre reposant sur des sédiments.

La hauteur du premier barrage construit sur cet emplacement en 1928 était limitée à 22 pieds en raison de la perméabilité des fondations. Grâce au progrès accompli en mécanique des sols, une nouvelle étude a montré qu'un barrage plus élevé pouvait être construit en toute sécurité et de façon économique, à condition que le tracé comprenne: des rideaux imperméables en amont pour réduire les fuites à des limites acceptables; des précautions pour tenir compte de la possibilité de grands tassements et des installations de drainage pour venir à bout des importantes infiltrations. Le barrage a été élevé à sa hauteur actuelle de 88 pieds au-dessus du lit de la rivière en 1960, et selon les plans il devrait atteindre éventuellement une hauteur de 145 pieds.

Le groupe a ensuite emprunté le pont Second Narrows pour parvenir Port Mann Freeway. Le Port Mann Freeway fait partie de l'autoroute transcanadienne. Il s'étend depuis les limites de Vancouver sur une distance de 12 milles jusqu'à la rivière Fraser dans la partie basse de la Colombie britannique. Quatre milles du Port Mann Freeway traversent des zones de tourbe et des zones d'argile limoneuse très molle et très sensible à la surcharge. Six raccordements de cette autoroute sont situés entièrement ou en partie seulement sur du sol tourbeux. L'épaisseur maximale de la couche de tourbe et de la couche d'argile limoneuse atteint 75 pieds; l'épaisseur maximale de la couche de tourbe seule atteint 30 pieds. La construction des rampes de l'autoroute au travers de ces régions a exigé l'érection de remblais préchargés. On a eu recours à de la sciure de bois et à d'autres matériaux légers de remblayage pour réduire le poids des remblais.

Pendant le repas, les congressistes ont vu un film d'une durée de 35 minutes concernant la construction du pont Port Mann. Ce pont qui enjambe le Fraser près de Vancouver comprend une arche principale d'une portée de 1 200 pieds prolongée de chaque côté par des travées de 360 pieds. C'est le premier grand pont en Amérique du Nord conçu pour que ses résistances soient orthogonalement anisotropes. L'existence de terrains en contrebas de chaque côté de l'arche principale, et de dégagements élevés, ont nécessité l'installation de longues approches. La longueur totale du pont d'une culée à l'autre est de 6 870 pieds. Les fondations des piliers principaux sont particulièrement intéressantes. Les études du sol effectuées ont indiqué que sous ces piliers il y aurait une épaisseur de 50 pieds d'argile limoneuse molle et de tourbe reposant sur 50 pieds de sable. En-dessous de cet ensemble se trouve une couche d'une épaisseur de 100 pieds d'une argile technical discussions at points of interest on the Freeway and at the Bridge. The tour returned to Vancouver *via* the Fraser-Delta Thruway and the Deas Island Tunnel.

sensible recouvrant des moraines durcies. Pour surmonter ces conditions géotechniques, il a fallu employer des tuyaux d'acier de 24 pouces de diamètre recouverts d'asphalte, qu'on a enfoncés dans des trous forés à l'avance et qu'on a forcés dans la couche de moraine durcie jusqu'à une profondeur de 200 pieds. Les pieux supportent une charge utile allant de 125 à 150 tonnes. Les efforts horizontaux sont transmis à la couche de sable à 50 pieds de profondeur, le transfert étant effectué par une poutre annulaire spécialement conçue et entourant la tête des pieux.

Un Canadian Design Award a été récemment accordé pour ce pont qui est une réalisation remarquable dans l'utilisation habile de l'acier de construction.

Les congressistes ont pris l'autoroute et se sont arrêtés pour certaines discussions techniques à des endroits intéressants tout au long de l'autoroute et au pont. Le groupe est revenu à Vancouver par l'autoroute Fraser-Delta et le tunnel Deas Island.

*Closing Banquet*

The Trans-Canada Tour concluded with a reception and dinner at the Engineers' Club in Vancouver.

*Dîner de clôture*

Le voyage transcanadien s'est terminé par une réception et un dîner à l'Engineers' Club de Vancouver.

### LADIES' TOUR L1—OTTAWA

Thursday, September 9

The tour travelled to Ottawa along the fur trade route of the Trans-Canada Highway. The day was spent touring the city along scenic driveways following the rivers and canal through residential areas and parks with stops at vantage points and visits to the Eskimo exhibit at the National Museum and to Parliament Hill. Some free time was available for visiting the Canadian art exhibit at the National Gallery or for shopping on the Mall.

### EXCURSION POUR LES DAMES L1—OTTAWA

Jeudi 9 septembre

Le groupe s'est rendu à Ottawa en suivant l'ancien itinéraire du commerce des fourrures que longe aujourd'hui la Transcanadienne. Les congressistes ont passé la journée à visiter la ville en circulant le long des promenades pittoresques qui longent les rivières et le canal et passent par des zones domiciliaires et des parcs. Ils se sont arrêtés pour admirer certains panoramas, ont visité l'Exposition d'art esquimau au Musée national et se sont rendus à la Colline du Parlement. Quelque temps libre avait été prévu pour la visite de l'Exposition d'art canadien à la Galerie nationale ou pour faire ses emplettes sur le Mail.

### LADIES' TOUR L2—UPPER CANADA VILLAGE

Thursday, September 9

The tour proceeded *via* Cornwall to Upper Canada Village and Crysler Park near Morrisburg, Ontario. Upper Canada Village can be likened to the folk museums in the Scandinavian countries and is a faithful representation of life in pioneer times in Canada. Among the things seen were a blockhouse, church, hotel, sawmill, bakery, blanket mill, old schoolhouse and master's residence, quilting, weaving, spinning, flax growing, etc.

### EXCURSION POUR LES DAMES L2—VILLAGE DU HAUT-CANADA

Jeudi 9 septembre

Le groupe s'est dirigé vers le Village du Haut-Canada et le parc Crysler situé près de Morrisburg en Ontario en passant par Cornwall. On peut comparer le Village du Haut-Canada aux musées folkloriques des pays scandinaves. Ils représentent fidèlement la vie que menaient les pionniers du Canada. Ils ont pu voir parmi autres choses intéressantes une maison fortifiée, un presbytère, une scierie, une boulangerie, une fabrique de couvertures, une vieille école et la résidence du maître, et ont pu s'intéresser au rembourrage, au tissage, au filage, à la culture du lin, etc.

### LADIES' TOUR L3—LAURENTIANS

Tuesday, September 14

A short trip to the Laurentians was made. Here, among the oldest hills in Canada, are some of the loveliest vacation resorts in the region. In winter, almost every slope is alive with skiers. Bright, hot days followed by cool nights, plus a generous sprinkling of both large and small lakes, make it ideal for summer vacationers. In autumn, many thousands of people are drawn from the city just to view the extraordinarily colourful foliage. Buses took the ladies to Ste. Adele which is about 50 miles from Montreal, and on the return trip stopped at the Mont Gabriel Lodge for luncheon.

### EXCURSION POUR LES DAMES L3—LES LAURENTIDES

Mardi 14 septembre

Le groupe a fait une courte excursion dans les Laurentides. Ces chaînes de montagnes sont parmi les plus anciennes du Canada, et elles constituent un endroit rêvé pour les vacances dans la région. En hiver, presque chaque pente des Laurentides fourmille de skieurs. Des journées chaudes et ensoleillées suivies de nuits vraiment fraîches et de nombreux lacs grands et petits font des Laurentides un lieu idéal pour les estivants. En automne, des milliers de gens viennent de Montréal et d'ailleurs pour voir l'apothéose des érables rougissants. Des autocars ont amenés les dames à Sainte-Adèle, village qui se trouve à environ 50 milles de Montréal, et au retour ils se sont arrêtés à l'auberge Mont-Gabriel pour le déjeuner.

# Minutes of the Executive Committee Meetings

# Procès-verbal des réunions du Comité exécutif

ATTENDANCE AND COUNTRIES REPRESENTED

*President*: A. CASAGRANDE
*Past President*: A. W. SKEMPTON
*Secretary*: A. MCDONALD
*Vice-Presidents*
Africa: R. L. MITCHELL
Australia: G. D. AITCHISON
Europe: L. BJERRUM
North America: L. ZEEVAERT
South America: A. J. DA COSTA NUNES
*Delegates*
Argentina: E. NUÑEZ
O. MORETTO
Austria: H. BOROWICKA
Belgium: V. ROISIN
Brazil: M. VARGAS
Bulgaria: G. STEFANOFF
Canada: R. PETERSON
C. B. CRAWFORD (Organizing Committee)
Colombia: T. SHUK
Czechoslovakia: A. MYSLIVEC
Denmark: J. BRINCH HANSEN
France: R. E. E. PELTIER
Germany: H. W. KOENIG
Hungary: C. SZÉCHY
India: I. C. DOS M. PAIS-CUDDOU
Israel: J. G. ZEITLEN
Italy: G. MORALDI
Japan: T. MOGAMI
Mexico: L. RAMÍREZ DE ARELLANO
Netherlands: C. VAN DER VEEN
Norway: N. JANBU
Peru: J. TONG MATOS
Portugal: U. NASCIMENTO
Republic of South Africa: B. A. KANTEY
Rhodesia: A. D. HARRIS
Spain: J. A. J. SALAS
Sweden: R. LUNDSTRÖM
Switzerland: C. SCHAERER
Turkey: H. PEYNIRCIOĞLU
U.S.S.R.: N. A. TSYTOVICH
United Kingdom: A. W. BISHOP
U.S.A.: B. MCCLELLAND
Venezuela: H. PEREZ LA SALVIA
Yugoslavia: P. ANAGNOSTI

MEETINGS WERE HELD

Tuesday, Sept. 7, 1965, 9:00 A.M. to 6:00 P.M.
(with a break of one hour for lunch)

MEMBRES PRÉSENTS ET PAYS REPRÉSENTÉS

*Président*: A. CASAGRANDE
*Ancien président*: A. W. SKEMPTON
*Secrétaire*: A. MCDONALD
*Vice-présidents*
Afrique: R. L. MITCHELL
Amérique du Nord: L. ZEEVAERT
Amérique du Sud: A. J. DA COSTA NUNES
Australie: G. D. AITCHISON
Europe: L. BJERRUM
*Délégués*
Allemagne: H. W. KOENIG
Argentine: E. NUÑEZ
O. MORETTO
Autriche: H. BOROWICKA
Belgique: V. ROISIN
Brésil: M. VARGAS
Bulgarie: G. STEFANOFF
Canada: R. PETERSON
C. B. CRAWFORD (Comité d'organisation)
Colombie: T. SHUK
Danemark: J. BRINCH HANSEN
Espagne: J. A. J. SALAS
E.U. d'Amérique: B. MCCLELLAND
France: R. E. E. PELTIER
Hongrie: C. SZÉCHY
Inde: I. C. DOS M. PAIS-CUDDOU
Israël: J. G. ZEITLEN
Italie: G. MORALDI
Japon: T. MOGAMI
Mexique: L. RAMÍREZ DE ARELLANO
Norvège: N. JANBU
Pays-Bas: C. VAN DER VEEN
Pérou: J. TONG MATOS
Portugal: U. NASCIMENTO
République de l'Afrique du Sud: B. A. KANTEY
Rhodésie: A. D. HARRIS
Royaume-Uni: A. W. BISHOP
Suède: R. LUNDSTRÖM
Suisse: C. SCHAERER
Tchécoslovaquie: A. MYSLIVEC
Turquie: H. PEYNIRCIOĞLU
U.R.S.S.: N. A. TSYTOVICH
Vénézuela: H. PEREZ LA SALVIA
Yougoslavie: P. ANAGNOSTI

LES RÉUNIONS SE SONT TENUES AUX DATES SUIVANTES

mardi, 7 septembre 1965, de 9 h du matin à 6 h du soir
(y compris une interruption d'une heure pour le repas);

Wednesday, Sept. 8, 1965, 9:00 A.M. to 10:30 A.M.
Thursday, Sept. 9, 1965, 5:30 P.M. to 8:30 P.M.
Monday, Sept. 13, 1965, 7:30 P.M. to 10:30 P.M.
Wednesday, Sept. 15, 1965, 9:00 A.M. to 10:00 A.M.

MEMBERSHIP

The Secretary reported that the membership has increased by more than 3,000 since the Fifth Conference and now stands at approximately 7,700; and that the Morocco Society was admitted to membership by letter vote. The Executive Committee then voted to accept the applications for membership of the National Societies of Ecuador and Peru. There are now 41 member countries.

RELATIONS WITH THE INTERNATIONAL UNION OF TECHNICAL ASSOCIATIONS (I.U.T.A.)

The Secretary reported that since the last conference assistance was received from the I.U.T.A. as follows: 1962—$700; 1963—$900; 1964—$700. No information was received about the request made for financial assistance for publication of the *Proceedings* of the Sixth Conference, and a cable received during the meeting stated that the matter would not be considered again until early 1966. An assurance was given that the subventions for work already in hand would be continued.

AMENDMENTS TO STATUTES

The following paragraphs contain a summary of the discussions on proposed changes in the Statutes and the amendments thereto agreed upon. The complete, amended Statutes are included in Appendix I.

*Statute I*

Suggestions had been received that the name of the Society should be amended. After a long discussion it was agreed that the name should remain as at present, but that the word "for" should be substituted for "of." If so desired, the last three words of the name could be printed in smaller letters.

*Statute I (2)*

It was agreed that this should be amended to read: "The aim of the Society is the promotion of international cooperation among engineers and scientists for the advancement of knowledge in the field of soil mechanics and its practical applications, and in the civil engineering applications of geology, and of rock, snow, and ice mechanics."

*Statute I (2)a*

It was agreed that this should be amended to read: "periodically holding international conferences and encouraging regional conferences and joint sessions or meetings with other international or national societies having common interests in one or more areas of geotechnical sciences."

*Statute III (10)b*

It was agreed that the words "Honorary President" be omitted.

*Statute III (10)c*

A proposal that Europe should have more than one vice-president was not accepted.

mercredi, 8 septembre 1965, de 9 h à 10 h 30 du matin;
jeudi, 9 septembre 1965, de 5 h 30 à 8 h 30 du soir;
lundi, 13 septembre 1965, de 7 h 30 à 10 h 30 du soir;
et mercredi 15 septembre 1965, de 9 h à 10 h du matin.

SOCIÉTARIAT

Le Secrétaire a relaté que le nombre des membres s'est accru de plus de 3 000 depuis le V[e] Congrès et atteint maintenant le chiffre d'environ 7 700, et que la Société marocaine a été admise comme membre par vote épistolaire. Le Comité exécutif a ensuite voté à propos des demandes d'affiliation des Sociétés nationales du Pérou et de l'Equateur, et les a acceptées. Quarante et une nations sont maintenant membres.

RELATIONS AVEC L'UNION DES ASSOCIATIONS TECHNIQUES INTERNATIONALES (U.A.T.I.)

Le Secrétaire a relaté que l'U.A.T.I. a accordé les subventions suivantes, à dater du dernier congrès: en 1962: 700 dollars; en 1963: 900 dollars; en 1964: 700 dollars. Aucun renseignement n'a été reçu à propos de la demande d'aide financière à la publication des *Comptes Rendus* des séances du VI[e] Congrès, et un câblogramme reçu au cours de ce dernier déclarait que la question ne serait pas reprise en considération avant le début de 1966. L'U.A.T.I. a donné l'assurance que les subventions pour les travaux en cours seraient maintenues.

MODIFICATIONS AUX STATUTS

Les alinéas suivants contiennent un résumé des débats à propos des modifications proposées aux statuts, et de celles qui ont été acceptées. Les statuts modifiés figurent au complet à l'appendice I.

*Statut I*

Il a été proposé de changer le nom de la Société. Après un long débat, le Comité a retenu le nom actuel, compte tenu que le mot "for" serait substitué au mot "of" et que les trois derniers mots du titre pourraient être imprimés en minuscules.

*Statut I (2)*

Le Comité a décidé de modifier ce paragraphe comme suit: "L'objectif de la Société est de promouvoir la collaboration internationale entre les ingénieurs et entre les hommes de science dans le but de faire progresser la connaissance du domaine de la mécanique des sols et de ses applications pratiques, ainsi que les applications de la géologie, de la mécanique des roches, de la neige et de la glace en génie civil."

*Statut I (2)a*

Le Comité a décidé de modifier ce paragraphe comme suit: ". . . tient périodiquement des congrès internationaux et encourage la tenue de colloques régionaux et de séances communes, ou de rencontres, avec les autres associations internationales ou nationales ayant un intérêt similaire dans un ou plusieurs domaines des sciences géotechniques."

*Statut III (10)b*

Il a été convenu d'omettre l'expression "Président honoraire."

*Statut III (10)c*

Le Comité n'a pas accepté une proposition accordant plus d'un vice-président à l'Europe.

*Statute III (10)d*

The second sentence in this paragraph was amended to read: "The President shall be nominated by the outgoing President and Past Presidents and recommended to the Executive Committee for election. In the event of the resignation or death of the President, a new President shall be nominated by the Past Presidents and recommended to the Executive Committee for election for the unexpired term of office."

The third sentence in this paragraph was amended to read: "The Vice-Presidents shall be nominated by the National Societies and by the retiring Vice-Presidents of the regions which they represent, and recommended to the Executive Committee for election."

### OFFICIAL LANGUAGES

The question of the official languages received careful attention in the written answers which were submitted by the National Societies before this Conference, and it was also thoroughly discussed in the Executive Committee meetings. Although a majority favoured use of a single language, it was agreed to continue study of this question and to defer a decision until the next International Conference.

### PROCEEDINGS OF INTERNATIONAL CONFERENCES

Agreement was reached on the following points:

1. Informative abstracts of about 200 to 500 words in length, including essential figures, should be prepared by the authors in the language of the paper, i.e., English or French. Well in advance of the conference they should be sent by the Organizing Committee to all National Societies who will, if they so desire, translate them into their own languages and distribute them to their members as early as possible and at their own cost.
2. All papers should have a short synopsis in the language of the paper, which will be printed with the paper itself.
3. In the final volume there should appear, in English, French, Russian, German, and Spanish, a complete list of titles of all papers in all volumes with their respective page references.
4. It was recommended that all papers should end with "conclusions," but that implementation should be left to the discretion of the Organizing Committee.

### SIMULTANEOUS TRANSLATION AT INTERNATIONAL CONFERENCES

To ensure successful simultaneous translation it was suggested (1) that interpreters should be familiar with the terminology of the subject being discussed, and (2) that if contributions were read during the discussion, copies of the notes should be given to the interpreters beforehand.

### REGIONAL AND NATIONAL CONFERENCES

1. It was noted that regional conferences are inevitably of an international nature, but that the scope is usually more restricted than that of the international conferences.
2. To avoid conflicts, it was recommended that the President, the Vice-Presidents, and the Secretary be informed, without delay, of proposals to hold regional or national conferences.
3. It was emphasized that the titles of the proceedings of

*Statut III (10)d*

La deuxième phrase de ce paragraphe a été modifiée comme suit: "Le Président sortant et les anciens Présidents présenteront le candidat au poste de président et recommanderont son élection par le Comité exécutif. En cas de démission ou de décès du Président, les anciens Présidents présenteront un candidat au poste de président et recommanderont son élection par le Comité exécutif pour le temps qui reste à courir sur le mandat précédent."

La troisième phrase de ce paragraphe a été modifiée, et se lira ainsi: "Les candidats aux vice-présidences seront proposés par les Sociétés nationales et par les Vice-présidents sortants des régions qu'elles représentent et l'élection de ces candidats sera recommandée au Comité exécutif."

### LANGUES OFFICIELLES

La question des langues officielles a été soigneusement exposée dans les réponses écrites soumises, avant le congrès, par les Sociétés nationales, et elle a été également débattue au cours des réunions du Comité excutif. Bien qu'il se soit trouvé une majorité pour recommander l'emploi d'une seule langue, le Comité a décidé de poursuivre l'étude de cette question et de renvoyer la décision à l'époque du prochain congrès international.

### COMPTES RENDUS DES CONGRÈS INTERNATIONAUX

Le Comité s'est mis d'accord sur les points suivants:

1° Les auteurs de mémoires scientifiques devraient en préparer une analyse contenant 200 à 500 mots dans la langue du mémoire (c'est-à-dire en français ou en anglais) ainsi que les figures essentielles, et le Comité d'organisation devrait envoyer ces analyses bien avant le congrès à toutes les Sociétés nationales. Ces dernières les feraient traduire le cas échéant dans leur propre langue puis en distribueraient à leurs frais les traductions à leurs membres aussitôt que possible.

2° Tous les mémoires devraient être accompagnés d'un sommaire dans la même langue. Ce sommaire serait imprimé en même temps que le mémoire.

3° Un répertoire complet de tous les mémoires contenus dans tous les volumes, avec leurs renvois respectifs, devrait figurer en anglais, français, russe, allemand et espagnol dans le dernier volume.

4° Le Comité a recommandé que tous les mémoires finissent par un paragraphe de conclusions. La mise en œuvre de cette recommandation serait toutefois laissée à la discrétion du Comité d'organisation.

### INTERPRÉTATION SIMULTANÉE DANS LES CONGRÈS INTERNATIONAUX

Pour assurer que l'interprétation simultanée soit réalisée avec succès, le Comité recommande que les interprètes soient: 1° au courant de la terminologie du sujet traité, 2° que les interprètes aient en mains, d'avance, le texte des communications qui doivent être lues au cours des débats.

### COLLOQUES RÉGIONAUX ET NATIONAUX

1° Le Comité a pris note du fait que les colloques régionaux sont inévitablement d'intérêt international, mais que le domaine traité est habituellement plus étroit que ceux des congrès internationaux.

2° En vue d'éviter les heurts, le Comité recommande que le Président, les Vice-présidents et le Secrétaire soient mis au courant sans retard des propositions de tenue de colloque régional ou national.

regional conferences must not conflict with the titles oi the International Conference *Proceedings*.

ADVISORY COMMITTEE

It was agreed that an Advisory Committee, consisting of the President, the Vice-Presidents and the Past Presidents, should guide the Organizing Committees of future international conferences. In addition, several items on the agenda were referred by the Executive Committee to this Advisory Committee for further study.

FINANCE

The Executive Committee reviewed the statement of accounts submitted by the Secretary covering the four years since the last Conference. The Committee concluded that the International Society was working with insufficient funds. Printing of the membership lists is at present the principal item of expenditure and costs are continually increasing. It was agreed that the membership fees should be increased, effective January 1, 1966, as follows to cover all reasonable costs so far as can be foreseen (present rates in brackets): \$25.00 per National Committee (\$15.00); \$0.75 per individual member (\$0.25)

MEMBERSHIP LISTS

It was agreed (1) that it would suffice if these were brought up to date and printed approximately twelve months before each conference; and (2) that each National Committee should prepare its own list of members on a standard format which would be reproduced and bound by the International Society. It was recommended that all names and addresses should be in Roman letters. The U.S.S.R. delegate stated that he could see no difficulty in complying with this recommendation. It was recommended that the permanent address of the Secretary of each National Society should be included.

SUBCOMMITTEE ON CLASSIFICATION OF GEOTECHNICAL LITERATURE

Mr. Flodin reported on the work of the Subcommittee and stated that he would be prepared to receive suggestions up to the first of January 1966. The Subcommittee was re-elected until the work is completed, which should be about July, 1966. Mr. Flodin then outlined a proposal by the Swedish Geotechnical Institute to publish Geotechnical Literature Abstracts. A new subcommittee was appointed to study and implement this proposal, with the following membership: Professor Casagrande, Dr. Cooling, Dr. Petermann, Mr. Karst, and Dr. Broms (chairman). Mr. Flodin asked that a member, knowledgeable in the subject, should be appointed by each National Committee to assist in the work of this new Subcommittee.

The Executive Committee thanked Mr. Flodin for the work which he and the Subcommittee on Geotechnical Literature Classification had carried out.

SUBCOMMITTEE ON DEFINITIONS

Professor Kérisel submitted a list of definitions and symbols. After considerable discussion the Executive Committee recommended (1) that the symbols should conform to those adopted at the Paris Conference, and (2) that Professor Kérisel should co-operate with Mr. C. Shaerer for the pur-

3° Le Comité a souligné que les titres des publications issues des colloques régionaux ne doivent pas pouvoir être confondus avec le titre des *Compte Rendus* du Congrès international.

COMITÉ CONSULTATIF

Il a été convenu qu'un Comité consultatif comprenant le Président, les Vice-présidents et les anciens Présidents devrait conseiller les Comités d'organisation des futurs congrès internationaux. En outre, le Comité exécutif a saisi le Comité consultatif de diverses questions à l'ordre du jour pour étude subséquente.

QUESTIONS FINANCIÈRES

Le Comité exécutif a étudié l'état de compte soumis par le Secrétaire et se rapportant aux quatre années depuis le dernier congrès. Le Comité a conclu que la Société internationale fonctionne avec des fonds insuffisants. L'impression de la liste des membres constitue actuellement le principal chef de dépenses et le coût en croît continuellement. Il a été convenu que les cotisations de membres seraient augmentées à dater du 1[er] janvier 1966, pour couvrir toutes les dépenses raisonnables prévisibles, selon le barème suivant (le taux actuel est entre parenthèses): 25 dollars par Comité national (15 dollars); 75¢ par membre individuel (25¢).

LISTES DES MEMBRES

Le Comité a convenu: 1° qu'il suffirait que ces dernières soient mises à jour et imprimées environ douze mois avant chaque congrès, et 2° que chaque Comité national devrait préparer sa propre liste de membres sur des feuilles de format normalisé qui seraient reproduites, et dont l'ensemble serait relié par les soins de l'Association internationale. Le Comité recommande que tous les noms et adresses soient écrits en caractères latins. Le délégué de l'U.S.S.R. a déclaré qu'il ne prévoyait aucune difficulté dans l'application de cette recommandation. Le Comité également recommandé que l'adresse permanente du secrétaire de chaque association nationale figure dans la liste.

SOUS-COMITÉ DE CLASSIFICATION DE LA DOCUMENTATION RELATIVE AUX SCIENCES DU SOL

M. Flodin a rendu compte du travail du Sous-comité et a fait savoir qu'il serait prêt à recevoir des propositions jusqu'au 1[er] janvier 1966. Le Sous-comité a été réélu pour une période lui permettant de terminer son travail, soit jusqu'aux environs de juillet 1966. M. Flodin a ensuite exposé à grands traits une proposition de l'Institut suédois de géotechnique concernant la publication de Bulletins analytiques de la documentation géotechnique. Un nouveau sous-comité a été désigné pour étudier cette proposition et la mettre en œuvre. Les membres de ce Sous-comité seront les suivants: M. le professeur Casagrande, M. Karst, et MM. Cooling, Peterman, et M. Broms (président), D[r] ès Sc. M. Flodin a demandé que chaque Comité national désigne un membre bien informé du sujet pour aider le Sous-comité dans son travail. Le Comité exécutif a remercié M. Flodin pour le travail qu'il a accompli avec le Sous-comité de classification de la documentation géotechnique.

SOUS-COMITÉ DES DÉFINITIONS

Le professeur Kérisel a soumis une liste de définitions et de symboles. Après un long débat, le Comité exécutif a recommandé: 1° que les symboles soient établis conformément à ceux qui ont été adoptés au Congrès de Paris, et 2° que le professeur Kérisel collabore avec M. C. Schaerer en pose of publishing the List of Definitions and Symbols in the new edition of the *Dictionary of Soil Mechanics Terms* which is in preparation. The Executive Committee thanked Professor Kérisel and the members of the Subcommittee for their efforts and requested that they continue until the List of Definitions and Symbols is published in the *Dictionary*.

SUBCOMMITTEE ON STATIC AND DYNAMIC PENETRATION TEST METHODS

Professor Vargas reported. Because of wide divergence of opinions among members of this Subcommittee, it was recommended that its work be compiled in several separate reports, to represent the various viewpoints, and that these reports be published in the A.S.C.E. *Proceedings*, *Géotechnique*, or other appropriate journals. The Executive Committee expressed their thanks to Professor Vargas and the Subcommittee for their work, and as their particular task has now been completed, the Subcommittee was dissolved. The European National Committees expressed a desire to continue the work on a regional basis. It was agreed to establish a European Subcommittee with Dr. Zweck as Chairman; he will propose additional Committee members on the advice of the European National Committees.

SUBCOMMITTEE ON PROBLEMS AND PRACTICES OF SOIL SAMPLING

The Chairman of the Subcommittee, Dr. Kallstenius, reported on the work of the Subcommittee. The Executive Committee suggested that the Subcommittee should prepare a summary report on the current status of undisturbed soil sampling in the countries which contributed to the work of the Subcommittee. Appendix II contains this summary report. The Executive Committee expressed its appreciation to Dr. Kallstenius and the members of his Subcommittee for their efforts and learned with regret that he could not continue to serve on the Subcommittee. Dr. Aitchison was appointed Chairman, and Dr. Broms will replace Dr. Kallstenius.

SUBCOMMITTEE ON VOCABULARY OF SOIL MECHANICS TERMS

Mr. C. Schaerer reported on the progress of the work on the revised edition of the *Dictionary* which is expanded to include also Italian and Russian. He accepted the recommendation by the Executive Committee that the List of Definitions and Symbols which is being prepared by Professor Kérisel and his Subcommittee be published in the *Dictionary*. The Executive Committee thanked Mr. Schaerer and his Subcommittee for their efforts.

SEVENTH INTERNATIONAL CONFERENCE

Invitations were originally received from Australia and Germany. Immediately prior to the meetings of the Executive Committee invitations were also received from India and Mexico. During the Executive Committee meeting on September 13 a majority of members voted in favour of holding the 1969 Conference in Mexico.

At the conclusion of the final meeting of the Executive Committee, the question of whether the Secretariat should be established permanently in London, at the Institution of Civil Engineers was discussed. Because of lack of time, the President suggested that the incoming President might wish to pursue this question by correspondence with the members of

vue de publier la Liste des définitions et des symboles dans la nouvelle édition du *Dictionnaire des Termes de la Mécanique des Sols*, en cours de préparation. Le Comité exécutif a remercié le professeur Kérisel et les membres du Sous-comité pour les efforts accomplis et a demandé qu'ils persévèrent jusqu'à la publication de la Liste des symboles et définitions dans le *Dictionnaire*.

SOUS-COMITÉ DES MÉTHODES D'ESSAIS PAR PÉNÉTRATION STATIQUE ET DYNAMIQUE

Le professeur Vargas a présenté son compte rendu. En raison des fortes divergences d'opinion entre les membres de ce Sous-comité, on a recommandé que ses travaux soient décrits dans plusieurs exposés séparés en vue de représenter les différents points de vue, et que ces exposés soient publiés dans A.S.C.E. *Proceedings*, *Géotechnique* ou toute autre revue scientifique appropriée. Le Comité exécutif a exprimé ses remerciements au professeur Vargas et au Sous-comité pour le travail accompli, et comme leur tâche est achevée, le Sous-comité a été dissous. Les Comités nationaux d'Europe ont exprimé le désir de continuer le travail sur une base régionale. Il a été convenu d'établir un Sous-comité européen dont M. Zweck serait président et proposerait la nomination de nouveaux membres sur la recommandation des Comités nationaux d'Europe.

SOUS-COMITÉ DES MÉTHODES D'ÉCHANTILLONNAGE ET QUESTIONS CONNEXES

Le Président du Sous-comité, M. Kallstenius, D^r^ ès Sc., a présenté son compte rendu des travaux du Sous-comité. Le Comité exécutif propose que le Sous-comité prépare un exposé sommaire de l'état actuel des méthodes de prélèvement de sol non perturbé dans les pays qui ont contribué aux travaux du Sous-comité. L'appendice II contient cet exposé sommaire. Le Comité exécutif a exprimé ses remerciements à M. Kallstenius et aux membres de son Sous-comité pour les efforts accomplis, et a appris avec regret que M. Kallstenius ne pourrait continuer à faire partie du Sous-comité. M. Aitchison, D^r^ ès Sc., a été nommé Président, et M. Broms, D^r^ ès Sc., remplacera M. Kallstenius.

SOUS-COMITÉ DU VOCABULAIRE DE LA MÉCANIQUE DES SOLS

M. C. Schaerer a présenté son compte rendu des progrès accomplis au sujet de l'édition révisée du *Dictionnaire*, lequel sera étendu et comprendra également les termes italiens et russes. M. Schaerer a accepté la recommandation présentée par le Comité exécutif, à l'effet que la Liste des définitions et des symboles en cours de préparation par le professeur Kérisel et son Sous-comité soit publiée dans le *Dictionnaire*. Le Comité exécutif a remercié M. Schaerer et son Sous-comité pour les efforts accomplis.

SEPTIÈME CONGRÈS INTERNATIONAL

Des invitations avaient été reçues précédemment de la part de l'Australie et de l'Allemagne. Juste avant la réunion du Comité exécutif, l'Inde et le Mexique ont également fait parvenir leur invitation. Au cours de la réunion du Comité exécutif du 13 septembre, les membres ont opté en majorité pour le Mexique comme siège du Congrès de 1969.

A la fin de sa dernière réunion, le Comité exécutif a débattu la question de l'établissement permanent du secrétariat à l'Institution of Civil Engineers, à Londres. En raison du manque de temps, le Président a déclaré que le Président entrant pourrait poursuivre l'étude de cette question par correspondance avec les membres du Comité exécutif, et the Executive Committee; and that in accordance with the Statutes the incoming President would appoint a Secretary for the period of his term in office.

### ELECTION OF OFFICERS

The following officers were elected:

*President*: L. BJERRUM

*Vice-Presidents*

Africa: B. A. KANTEY, South Africa
Asia: J. G. ZEITLEN, Israel
Australasia: D. H. TROLLOPE, Australia
Europe: J. BRINCH HANSEN, Denmark
North America: W. J. TURNBULL, U.S.A.
South America: O. MORETTO, Argentina

qu'en accord avec les statuts il pourrait désigner une secrétaire pour la durée de son mandat.

### ÉLECTION DES MEMBRES DU BUREAU

Les membres du bureau suivants ont été élus:

*Président*: L. Bjerrum

*Vice-présidents*

Afrique: B. A. Kantey, Afrique du Sud
Amérique du Nord: W. J. Turnbull, E.U.A.
Amérique du Sud: O. Moretto, Argentine
Asie: J. G. Zeitlen, Israël
Australie: D. H. Trollope, Australie
Europe: J. Brinch Hansen, Danemark

# Appendix I Statutes of the International Society for Soil Mechanics and Foundation Engineering

# Appendice I Statuts de la Société Internationale de Mécanique des Sols et des Travaux de Fondations

AS AMENDED IN MONTREAL, SEPTEMBER 1965
REVISÉ À MONTRÉAL, SEPTEMBRE 1965

## I. NAME, AIM, HEADQUARTERS AND OFFICIAL LANGUAGES OF THE SOCIETY

1. The name of the Society is: International Society for Soil Mechanics and Foundation Engineering; in French: Société Internationale de Mécanique des Sols et des Travaux de Fondations.

2. The aim of the Society is the promotion of international co-operation among engineers and scientists for the advancement of knowledge in the field of soil mechanics and its practical applications, and in the civil engineering applications of geology, and of rock, snow, and ice mechanics.

The International Society ensures this co-operation by:

(*a*) periodically holding international conferences and encouraging regional conferences and joint sessions or meetings with other international or national societies having common interests in one or more areas of geotechnical sciences;
(*b*) creating permanent Research Committees;
(*c*) publishing a list of members approximately one year before each international conference;
(*d*) promoting the publication of abstracts.

3. The official languages of the Society are English and French.

## II. MEMBERSHIP, NATIONAL ORGANIZATIONS, CONTRIBUTIONS

4. The International Society is composed of National Societies. The National Societies may be affiliated to existing Engineering Societies. The National Societies shall be governed by the rules stated in Articles 6, 7, 8.

The application of a new national society for membership must be submitted to the Executive Committee of the International Society who have the right to accept or reject it.

Should the Society belong to a country in good standing represented on the Executive Committee at the Fourth International Conference of Soil Mechanics and Foundation Engineering it shall be automatically admitted.

5. Each individual or collective member of a National Society is automatically a member of the International Society. In countries where no National Society exists the resident shall apply for admission to a National Society of his choice willing to accept his application.

## I. NOM, BUT, SIÈGE ET LANGUES OFFICIELLES DE LA SOCIÉTÉ

1° Le nom de la Société est Société Internationale de Mécanique des Sols et des Travaux de Fondations; en anglais: International Society for Soil Mechanics and Foundation Engineering.

2° L'objectif de la Société est de promouvoir la collaboration internationale entre les ingénieurs et entre les hommes de science dans le but de faire progresser la connaissance du domaine de la mécanique des sols et de ses applications pratiques, ainsi que les applications de la géologie, de la mécanique des roches, de la neige et de la glace en génie civil.

Pour assurer cette collaboration, la Société Internationale:

(*a*) tient périodiquement des congrès internationaux, et encourage la tenue de colloques régionaux et de séances communes, ou de rencontres, avec les autres associations internationales ou nationales ayant un intérêt similaire dans un ou plusieurs domaines des sciences géotechniques;
(*b*) crée des Commissions permanentes d'étude;
(*c*) publie une liste de ses membres un an, à peu près, avant chaque congrès international;
(*d*) encourage la publication de résumés.

3° Les langues officielles de la Société sont l'anglais et le français.

## II. MEMBRES, ORGANISATIONS NATIONALES, COTISATIONS

4° La Société Internationale est composée de Sociétés nationales. Les Sociétés nationales peuvent être affiliées à des sociétés d'ingénieurs déjà existantes. Les Sociétés nationales sont soumises aux règles fixées aux articles 7, 8 et 9.

La demande d'admission d'une nouvelle société est soumise au Comité exécutif de la Société Internationale qui a le droit de l'accepter ou de la rejeter.

Si la société appartient à un pays remplissant les conditions requises par les statuts et déjà représenté au Comité exécutif du Quatrième Congrès International de Mécanique des Sols et des Travaux de Fondations, elle est admise automatiquement.

5° Chaque membre individuel ou collectif d'une Société nationale est automatiquement membre de la Société Internationale. Dans les pays n'ayant pas de Société nationale le requérant sollicitera son admission auprès d'une Société nationale de son choix disposée à accepter sa demande.

6. Annual contributions, individual and collective, shall be collected by the National Societies. The National Societies shall pay their annual contributions to the International Society. The amount and the date of payment of the latter contributions shall be fixed by the Executive Committee.

7. To fulfil the obligations necessary for its admission to the International Society a National Society must send to the Secretary of the International Society:
(*a*) its statutes, in duplicate;
(*b*) the names, addresses, and occupations of its members, in duplicate;
(*c*) the contributions for the current year.

8. Each year, at a date fixed by the Executive Committee, the National Society shall send to the Secretary of the International Society:
(*a*) the amount of its contribution as stated by Article 6.
It shall send further, in duplicate, and at the same date:
(*b*) copies of its complete statutes if they have been modified during the current year;
(*c*) the current list of its members, their occupations and addresses.

III. MANAGEMENT OF THE SOCIETY

9. The management of the Society shall be vested in the Executive Committee.

10. The Executive Committee is composed of:
(*a*) the President;
(*b*) the Past Presidents;
(*c*) 1 Vice-President for Europe (Turkey to be considered as a European member)
1 Vice-President for Asia
1 Vice-President for Africa
1 Vice-President for North America
1 Vice-President for South America
1 Vice-President for Australasia;
(*d*) one delegate from each National Society in good standing.

The President shall be nominated by the outgoing President and Past Presidents and recommended to the Executive Committee for election. In the event of the resignation or death of the President, a new President shall be nominated by the Past Presidents and recommended to the Executive Committee for election for the unexpired term of office.

The Vice-Presidents shall be nominated by the National Societies and by the retiring Vice-Presidents of the regions which they represent, and recommended to the Executive Committee for election. Their mandate shall expire after each International Conference. They shall be eligible for re-election.

11. The Secretary of the International Society shall be appointed by the President.

The Secretary shall be a non-voting member of the Executive Committee.

12. Voting shall be decided by a simple majority. The President shall have a casting vote. The Executive Committee will hold its meetings during the Conferences; between these, the business of the International Society will be transacted by correspondence.

The Executive Committee cannot take decisions unless more than 50 per cent of its members participate in the vote. Votes by correspondence shall be admitted. Voting shall be decided by a simple majority.

6° Les cotisations annuelles, individuelles et collectives, sont encaissées par les Sociétés nationales. Les Sociétés nationales versent leurs cotisations annuelles à la Société Internationale. Le montant et la date de versement de ces cotisations sont fixés par le Comité exécutif.

7° Pour remplir les conditions nécessaires à son admission à la Société Internationale, une Société nationale devra envoyer au Secrétariat de la Société Internationale:
(*a*) ses statuts, en double;
(*b*) les noms, adresses et indication de l'activité de ses membres, en double;
(*c*) la cotisation pour l'année courante.

8° Chaque année à la date fixée par le Comité exécutif, la Société nationale versera au Secrétariat de la Société Internationale:
(*a*) la cotisation fixée à l'article 6.
En outre elle enverra en double exemplaire et à la même date:
(*b*) un exemplaire complet de ses statuts si ceux-ci ont été modifiés pendant l'année en cours;
(*c*) la liste mise à jour de ses membres, de leurs activités et de leurs adresses.

III. DIRECTION DE LA SOCIÉTÉ

9° La direction de la Société est confiée au Comité exécutif.

10° Le Comité exécutif comprend:
(*a*) le Président;
(*b*) les anciens Présidents;
(*c*) 1 Vice-président pour l'Europe (la Turquie fait partie de l'Europe)
1 Vice-président pour l'Asie
1 Vice-président pour l'Afrique
1 Vice-président pour l'Amérique du Nord
1 Vice-président pour l'Amérique du Sud
1 Vice-président pour l'Australasie;
(*d*) un délégué par Société nationale remplissant les conditions prévues par les Statuts.

Le président sortant et les anciens Présidents présenteront le candidat au poste de président et recommanderont son élection par le Comité exécutif. En cas de démission ou de décès du Président, les anciens Présidents présenteront un candidat au poste de président et recommanderont son élection par le Comité exécutif pour le temps qui reste à courir sur le mandat précédent.

Les candidats aux vice-présidences seront proposés par les sociétés nationales et par les Vice-présidents sortants des régions qu'elles représentent et l'élection de ces candidats sera recommandée au Comité exécutif. Leur mandat cesse au terme de chaque Congrès International. Ils sont rééligibles.

11° Le Secrétaire de la Société Internationale est désigné par le Président.

Le Secrétaire est membre du Comité exécutif mais ne participe pas aux votes.

12° Les décisions par vote seront prises à la majorité simple. En cas d'égalité du nombre des voix, le Président décide. Le Comité exécutif tient ses séances durant les Congrès; entre ceux-ci il règle les affaires de la Société Internationale par correspondance.

Le Comité exécutif ne peut prendre des décisions que si 50 pour cent au moins de ses membres participent au vote. Le vote par correspondance est admis. Les décisions seront prises à la majorité simple.

13. The applications of the inviting countries for the next conference shall be submitted to the Secretary before the opening of the Conference.

The agenda of the work of the Executive Committee shall be drawn up by the President and must be sent to the National Societies at least one month before the opening of the Conference.

IV. LIST OF MEMBERS

14. At the given date (Article 8) each National Society shall send to the Secretary the current list of its members, their occupations and addresses.

The Secretary shall publish a List of Members on the basis of these lists and shall send copies to the National Societies approximately one year before each International Conference.

V. INTERNATIONAL CONFERENCES

15. Generally, the International Conferences shall be held at intervals of 4-5 years; time and place shall be fixed by the Executive Committee on the basis of the invitations submitted by the National Societies.

16. The National Society of the country in which the Conference meets shall be responsible for the organization as foreseen by Article 17. To this end the National Society shall appoint an Organizing Committee of which the President and Secretary are *ex officio* members.

17. At least 18 months before the opening of the Conference this Organizing Committee shall request all National Societies to submit to it the papers submitted by their members. These shall be allotted to the sections selected by the Organizing Committee. The Organizing Committee shall nominate a General Reporter for each of those sections.

The General Reporter may, with the approval of the National Society, co-opt one or more assistants.

The papers shall be first submitted to the National Societies. These shall be responsible for selecting them and sending interesting papers only. In case there should be too many papers a quota shall be granted to each country by the Organizing Committee.

The ultimate date up to which these papers are to be sent shall be fixed in the same way. These papers shall be assembled by sections and published in one or more volumes. These volumes shall also include the General Reports; they shall be circularized to the members of the Society at least three months before the opening of the Conference.

Conferences are open to all members of the Society, and to non-members by invitation.

During the Conference the presentation of the General Reports shall be followed by discussion. The Organizing Committee shall fix the ultimate date up to which the text of these discussions are to be sent as well as their size. The discussions shall be published in the final volume of the *Proceedings*.

VI. PAYMENT OF CONTRIBUTIONS

18. Any National Society which has not paid its contribution for more than 12 months shall cease to receive the List of Members. It shall also be deprived of the advantages of any information or service and shall not be permitted to vote.

VII. AMENDMENTS TO THE PRESENT STATUTES

19. The Statutes can be amended by the Executive Committee only.

13° Les candidatures des pays désirant être le siège du Congrès suivant sont à soumettre au Secrétaire avant l'ouverture du Congrès.

L'ordre du jour des travaux du Comité exécutif est établi par le Président et doit être soumis aux Sociétés nationales un mois au moins avant l'ouverture du Congrès.

IV. LISTE DES MEMBRES

14° A la date fixée selon l'article 8, chaque Société nationale envoie au Secrétaire la liste mise à jour de ses membres, de leurs activités et de leurs adresses.

Le Secrétaire publie une liste des membres basée sur ces listes et en fait parvenir des copies aux Sociétés nationales un an, à peu près, avant chaque Congrès international.

V. CONGRÈS INTERNATIONAUX

15° En règle générale les Congrès Internationaux se réuniront à intervalles de 4 à 5 ans; les dates et lieux sont fixés par le Comité exécutif sur la base des candidatures présentées par les Société nationales.

16° La Société nationale du pays dans lequel se réunit le Congrès assume la responsabilité de l'organiser ainsi que prévu à l'article 17. A cet effet la Société nationale désigne un Comité d'organisation dont le Président et le Secrétaire sont membres *ex officio*.

17° Dix-huit mois au moins avant l'ouverture du Congrès, ce Comité d'organisation invite toutes les Sociétés nationales à lui soumettre les communications de ses membres. Celles-ci sont classées dans des sections qui seront définies par le Comité d'organisation en accord avec le Président et le Secrétaire. Ceux-ci désignent également un Rapporteur général pour chacune de ces sections.

Le Rapporteur général peut faire appel à la collaboration d'un ou plusieurs assistants.

Les communications sont soumises aux Sociétés nationales, à qui il incombe de les sélectionner et de ne présenter à la Société Internationale que des travaux dignes d'intérêt. Si le nombre des communications présentées est trop élevé, il sera limité pour chaque pays par le Comité d'organisation d'accord avec le Président et le Secrétaire.

La date limite d'envoi de ces communications sera fixée de la même façon. Ces communications seront réunies par section et publiées en un ou plusieurs volumes. Ces volumes qui comprennent également les Rapports généraux seront distribués aux membres de la Société trois mois au moins avant l'ouverture du Congrès.

Tous les membres de la Société ont le droit de prendre part aux Congrès. Toutefois les personnes qui ne sont pas membres peuvent également y participer par invitation.

Pendant celui-ci la présentation des Rapports généraux sera suivie d'une discussion. Le Comité d'organisation fixera la date ultime de remise des textes des contributions aux discussions ainsi que leur étendue. Elles seront publiées dans les *Comptes Rendus*.

VI. VERSEMENT DES COTISATIONS

18° Toute Société Nationale qui n'a pas payé sa cotisation depuis plus de 12 mois n'a plus droit à recevoir la Liste des Membres. Elle perd également le bénéfice de tous renseignements et services et ne peut participer à aucun vote.

VII. MODIFICATIONS AUX PRÉSENTS STATUTS

19° Les statuts ne peuvent être modifiés que par le Comité exécutif.

# Appendix II Report of the Subcommittee on Problems and Practices of Soil Sampling

# Appendice II Compte rendu du Sous-comité d'étude des Difficultés et des Techniques de prélèvement d'échantillons de sol

### OBJECT

To promote and improve the science and techniques of soil sampling.

### FIRST AIM

To collect the available information on good samplers.

### METHOD OF WORKING

The subcommittee has had the following members: T. Kallstenius, Sweden (convener), G. D. Aitchison, Australia, M. Fukuoka, Japan, J. O. Osterberg, U.S.A., and M. J. Hvorslev, U.S.A. (special adviser). This subcommittee has further been supported by an International Group on Soil Sampling—I.G.O.S.S.—to which members from all National Societies were invited. The I.G.O.S.S. group has consisted of 26 members. National committees on soil sampling have also been formed in many countries. The group members have undertaken to inform each other of any new findings at the earliest opportunity.

### REPORTS ON THE CURRENT STATUS OF UNDISTURBED SAMPLING

The subcommittee has received reports from fifteen countries concerning the present status of sampling in soils. The reports are briefly summarized below.

In *Australia* hand sampling is done most commonly by hand augering, using a 1.5-in. inside diameter, thin-walled sampler (18 per cent area ratio and no inside clearance) which is driven by hammering. A thick-walled, 4-in., open-drive sampler (31 per cent area ratio and 2 per cent inside clearance) is common with percussion type boring rigs. Diamond drills are common. Shrinking and swelling clays cause problems with lightly loaded foundations and they also cause sampling problems.

In *Brazil* disturbed samples are generally taken in connection with penetration resistance tests. Outside diameters are 50, 46, and 41 mm. The wall thickness is considerable and the samplers are of the split-barrel type. Semi-undisturbed samples are taken with 38- and 50-mm inner diameter, thin-walled open samplers (outer diameter, 42 and 52 mm). For consolidation tests thin-walled or composite samplers, 108–125 mm in inside diameter, are used.

In *Canada* 54-mm, thin-walled piston samplers of the

### BUT

Son but est de favoriser la connaissance de la géotechnique et le perfectionnement des techniques d'échantillonnage du sol.

### OBJECTIF PREMIER

Son premier objectif est de recueillir tous les renseignements disponibles au sujet des bons outils de prélèvement.

### MÉTHODES DE TRAVAIL

Les membres suivants faisaient partie du sous-comité: MM. T. Kallstenius, Suède (convocateur); G. D. Aitchison, Australie; M. Fukuoka, Japon; J. O. Osterberg, Etats-Unis; et M. J. Hvorslev, Etats-Unis (conseiller spécial). Ce sous-comité était en outre secondé par un Groupe international d'étude de l'échantillonnage du sol—I.G.O.S.S.—auquel étaient invités à se joindre les membres de toutes les Sociétés nationales. Le groupe I.G.O.S.S. était constitué de 26 membres. Des comités nationaux d'étude de l'échantillonnage du sol ont également été constitués dans de nombreux pays. Les membres du groupe se sont engagés à se communiquer mutuellement leurs découvertes dès que possible.

### COMPTES RENDUS CONCERNANT L'ÉTAT ACTUEL DES TECHNIQUES DE PRÉLÈVEMENT D'ÉCHANTILLONS DE SOLS NON PERTURBÉS

Le sous-comité a reçu de quinze pays des exposés concernant l'état actuel des techniques de prélèvement d'échantillons de sols. Voici un bref résumé de ces comptes rendus.

En *Australie*, on procède habituellement aux carottages pédologiques manuels au moyen d'un carottier à paroi mince dont le diamètre intérieur est de 1,5 po (rapport des surfaces de 18 pour cent; pas de conicité interne) et que l'on enfonce au moyen d'un mouton. Avec les installations de forage par percussion, on emploie habituellement une tête de sonde tubulaire de 4 po, à paroi épaisse (rapport des surfaces de 31 pour cent et conicité interne atteignant 2 pour cent). Des perforatrices à diamants sont communément employées. Les argiles qui se contractent ou se gonflent posent des problèmes lorsqu'il s'agit d'y construire des ouvrages légers ou lorsqu'il faut y prélever des échantillons.

Au *Brésil*, les échantillons de sols perturbés sont généralement prélevés en même temps que l'on effectue les essais de résistance à la pénétration. On utilise des carottiers à coquilles séparables et épaisses, et dont le diamètre externe est de 50, 46 ou 41 mm. Les échantillons de sols semi-perturbés sont prélevés au moyen de têtes de sondes tubu-

Norwegian type are used for soft clays. The Swedish foil sampler as well as thin-walled tube samplers similar to the U.S.-A.S.T.M. standard are also used. In overconsolidated clays difficulties have been encountered in obtaining undisturbed samples.

In *France* diameters for undisturbed samples lie generally between 50 mm and 100 mm. Fifty mm is considered a minimum and diameters greater than 70 mm are preferred. Thin walls and clearances of 0.5 to 1.5 per cent are considered necessary requirements for good sampling. For sand a sampler by Parez uses a nylon fabric to overcome inside friction.

In *Germany* an open sampler of 114-mm inside diameter, 3-mm wall thickness, and 250-mm length is commonly used with well boring equipment (DIN 4021). It is used by a great majority of sampling organizations and is in most cases hammered down. Its length can be extended. Soil stratification is obtained by means of improved boring pile sampling after Burkhart. Diameters rise here to 150–180 mm. Some demand exists for smaller diameter equipment for samling down to depths of 15 m.

In *India* thin-walled, open-drive samplers are used for soft soils.

In *Italy* thin-walled open-drive and piston samplers are used on the soft clays and silts of the Po River Valley. Difficulties arise in sampling highly preconsolidated clays or clays in facies of flysch for which the best results are obtained with double-tube core barrels.

In *Japan* undisturbed samples of soft clay are mostly taken by means of thin-walled piston samplers with an inner diameter of 73–75 mm, a wall thickness of 1–1.5 mm, and a sample length of about 1000 mm. Sample tubes are frequently of brass. Problems have arisen with the buckling of tubes. Sampling is normally performed in open holes but samplers of the Swedish type (foil samplers and composite piston samplers) are used without pre-boring.

In *Norway* piston samplers are used in clay. The Norwegian Geotechnical Institute's piston sampler has a 54.5-mm inside diameter, and a wall thickness of 1.25 mm. Inside clearance is approximately 1 per cent and the sample length is 800 mm for clays and shorter for some other soils. A 54-mm sea bottom sampler with a length of 1.68 m has proven capable of taking good samples. Comparisons between 40–54-mm samplers and 104-mm samplers show that strength values were not appreciably higher for the larger size. In moraine and glacial tills a double-tube core barrel of Swedish make is used.

In the *Netherlands* borehole casing is normally 122 to 107 mm in diameter. Bailers are normally used for cleaning. Undisturbed samples of soil are usually taken by hand with a 65-mm open sampler with length of 440 mm. The sample tubes are tinned iron or steel. A free piston sampler is used together with the deep-sounding apparatus. Samples are 25 mm or 33 mm in diameter and 200 mm in length. In deep boreholes an open tube sampler of composite type with a 62-mm diameter and a 300-mm tube length is used. In sand an open sampler of composite type with plastic liners is vibrated down. Water in the samples is pressed away by means of compressed air. Very long samples in sand can be taken by means of a special sampler.

In *Portugal* 8-in. thick-walled piston samplers of MIT type and 4-in. Osterberg piston samplers are used. For hard clay a 4-in. double-tube core barrel of Denison type and for fine sand a Bishop sampler have been tried.

In *Sweden* it was found that different samplers influenced the results of different laboratory tests differently, and it was

laires d'un diamètre interne de 38 et de 50 mm et à paroi mince (diamètre externe de 42 et de 52 mm). Pour les essais de consolidation du sol, on se sert de sondes composées ou de carottiers à paroi mince, dont le diamètre interne va de 108 à 125 mm.

Au *Canada*, on utilise dans les sols d'argile tendre des carottiers de 54 mm à piston stationnaire et à paroi mince, du type norvégien. On se sert également de sondes suédoises laminaires ("foil samplers") de même que de tubes carottiers à paroi mince, semblables à ceux décrits par les normes U.S.-A.S.T.M. On s'est heurté à certaines difficultés pour le prélèvement d'échantillons non perturbés dans des argiles surconsolidées.

En *France*, le diamètre des échantillons non perturbés se situe généralement entre 50 mm et 100 mm. On considère que 50 mm constitue un diamètre minimal et on préfère des diamètres dépassant 70 mm. On estime qu'il faut utiliser des sondes à paroi mince et à conicité variant entre 0,5 et 1,5 pour cent pour effectuer un carottage efficace. Pour le prélèvement d'échantillons dans les terrains sableux, on emploie un carottier Parez qui a recours au nylon pour vaincre le frottement interne.

En *Allemagne*, on utilise couramment avec l'appareillage de fonçage de puits DIN 4021 une tête de sonde tubulaire à paroi de 3 mm d'épaisseur, dont le diamètre interne est de 14 mm et la longueur de 250 mm. La majeure partie des organisations s'occupant d'échantillonnage du sol l'utilisent et dans la plupart des cas cette sonde est enfoncée au moyen d'un mouton. La tête de cette sonde peut être prolongée. On peut connaître la stratification du sol au moyen d'échantillonnages selon la méthode améliorée de Burkhart "boring pile sampling". Le diamètre de ces outils peut aller de 150 à 180 mm. Il serait toutefois utile de disposer d'outils d'un diamètre plus faible en vue de permettre le prélèvement d'échantillons jusqu'à une profondeur de 15 m.

En *Inde*, on utilise dans les sols mous des carottiers tubulaires à paroi mince forcés dans le sol.

En *Italie*, on pousse dans le sol des carottiers tubulaires à paroi mince et des carottiers à piston stationnaire pour prélever des échantillons d'argiles tendres et de limons de la vallée du Pô. On éprouve certaines difficultés pour l'échantillonnage d'argiles fortement préconsolidées ou d'argiles qui se présentent sous forme de flysch; dans ces cas, les meilleurs résultats sont obtenus grâce à des cylindres carottiers à tubes emboîtés.

Au *Japon*, on prélève la plupart du temps les échantillons d'argile tendre non perturbée au moyen de carottiers à piston stationnaire, à paroi mince et ayant un diamètre interne variant entre 73 et 75 mm; l'épaisseur de la paroi se situe entre 1 et 1, 5 mm, et les échantillons ont une longueur d'environ 1 000 mm. Les tubes carottiers sont fréquemment constitués de laiton et le flambage de ces tubes a occasionné des difficultés. Le carottage est habituellement effectué dans des trous préparés, mais on utilise des sondes de type suédois (sondes laminaires, "foil samplers" et sondes composées à piston stationnaire) sans forage préalable.

En *Norvège*, on utilise les carottiers à piston stationnaire pour le prélèvement d'échantillons dans l'argile. Le carottier à piston stationnaire employé par l'Institut géotechnique de Norvège a un diamètre interne de 54,5 mm et une paroi de 1,25 mm d'épaisseur. Sa conicité interne est d'environ 1 pour cent et la longueur des échantillons est de 800 mm pour les argiles et moindre pour certains autres sols. Une sonde pédologique d'un diamètre de 54 mm, et d'une longueur de 1,68 m s'est révélée efficace pour recueillir des échantillons au fond de la mer. Les comparaisons établies entre les carottiers considered necessary to standardize for routine purposes. The standard piston sampler of the Swedish Geotechnical Society has rapidly been accepted. It has a 50-mm inside diameter and a 700-mm sample length. The sample is contained in three plastic liner tubes. The inside clearance is 0.4 per cent and the edge taper angle is 5°. The foil sampler with diameters of 38 mm or 68 mm is used for taking very long samples. It can be used even in hard soils together with a special rotary boring rig. The "Jalusi" sampler takes series of disturbed samples in one operation and is especially valuable in gravels. Heavy-walled split-spoon samplers or open tube samplers are used with all types of penetration test devices. Heavy-walled casing tubes are often provided with bottom plugs or openings for taking in disturbed samples from the side. Sampling is also done with special double-tube core barrels.

In *Switzerland* thin-walled piston samplers of Norwegian type are used, but with 66-mm diameter tubes 800 mm long. The wall thickness is 2 mm. A small clearance is used.

In the *United Kingdom* the normal borehole sampling procedure is generally in close accordance with the British Standard Code of Practice, CP 2001. In clay, augers are generally used for making boreholes, but boring in clay is often augmented by percussion clay cutters to 2 ft above the sampling level. For sandy strata shells are used. Borehole sizes are 5 in. for post-hole augering and 6 to 8 in. for other borings. In clay soils open tubes provided with blunt shoes are generally used for sampling. The length of the tube is normally 18 in. but it may be extended. The average internal diameter is 4.16 in. and the average inside clearance 1.6 per cent. Tubes, 1.5 in. in diameter, mostly with a length of 8 in. are also used. For sands split-spoon samplers are in common use (internal diameters are 1.375 in. or 2 in.). A special compressed-air sampler with an internal diameter of about 2.5 in. and length of 16.5 in. was developed by Bishop. Block samples are taken from test pits.

In the *United States* the dominant methods for advancing boreholes seem to be wash boring, rotary drilling (using bits with deflected jets), and auger boring. These methods are often combined. Boreholes are stabilized, when needed, with casing or combinations of casing and drilling fluid. The cleaning of boreholes is mostly done by means of washing. The common borehole diameters are 2½, 3, 4, and 8 in. the smaller diameters being the most frequent. Sampling is predominantly done with thick-walled solid or split-barrel samplers. For soft or medium-hard cohesive soils thin-walled samplers are used in about 25 per cent of the cases. The most frequent sample diameter for undisturbed soil sampling is 3 in. and the most frequent sample lengths are 24 and 30 in. There are no significant differences for cohesive soils and cohesionless soils. For thin-walled samplers, diameters of 2 and 3 in. are the most commonly used. The 1/16-in. wall thickness dominates. The inside clearance is usually zero. Driving by hammer or continuous jacking seem to be equally used.

dont le diamètre varie entre 40 et 54 mm et ceux d'un diamètre de 104 mm ont montré que les plus gros n'avaient pas une supériorité appréciable en ce qui concerne les valeurs de résistance. Dans les moraines et dans les argiles glaciaires à blocaux, on se sert d'un cylindre carottier à tubes emboîtés, de fabrication suédoise.

Aux *Pays-Bas*, le tubage du trou de forage a habituellement un diamètre de 122 à 107 mm. On se sert normalement de curettes pour le nettoyage. On prélève habituellement à la main les échantillons de sol non perturbé, au moyen d'un carottier tubulaire de 65 mm de diamètre et d'une longueur de 440 mm. Les tubes carottiers sont constitués de fer ou d'acier étamés. On utilise une tête de sonde à piston libre conjointement à l'appareillage de sondage à grande profondeur. Les échantillons ont de 25 à 33 mm de diamètre et 200 mm de longueur. Dans les trous de sondage profonds, on se sert d'une tête de sonde tubulaire de type composé, ayant un diamètre de 66 mm et une longueur de 300 mm. Dans le sable, on enfonce par vibration un carottier tubulaire de type composé à manchon intérieur de plastique. On chasse l'eau qui se trouve dans les échantillons au moyen d'air comprimé. On peut grâce à un carottier spécial prélever dans le sable des échantillons de grande longueur.

Au *Portugal*, on utilise des carottiers de 8 po à piston stationnaire et à paroi épaisse, de type MIT, et des carottiers de 4 po à piston stationnaire, de type Osterberg. On a expérimenté pour l'argile dure un cylindre carottier de 4 po à tubes emboîtés, de type Denison, et un carottier Bishop pour l'échantillonnage du sable fin.

En *Suède*, on a constaté que les essais en laboratoire donnaient des résultats qui différaient selon le type de carottier employé, et en vue de rendre les essais routiniers, on a estimé qu'il serait nécessaire d'uniformiser les méthodes. On a rapidement adopté comme étalon le carottier à piston stationnaire qu'utilise l'Institut géotechnique de Suède. Le carottier a un diamètre interne de 50 mm et peut recueillir des échantillons de 700 mm de longueur. L'échantillon est contenu dans trois tubes chemisés intérieurement de plastique. La conicité interne atteint 0,4 pour cent et l'angle de dépouille est de 5°. Pour le prélèvement d'échantillons très longs, on utilise le carottier laminaire suédois ("foil sampler") dont le diamètre est de 38 ou 68 mm. On peut même s'en servir dans des sols compacts en l'adaptant à l'extrémité d'une sonde spéciale à forage rotatif. Le carottier "Jalusi" prélève des séries d'échantillons de sols perturbés en une seule opération et il est particulièrement utile dans les graviers. Les carottiers à coquilles épaisses séparables ou les carottiers tubulaires sont employés avec tous les types de dispositifs pour les essais de pénétration dans le sol. Les tubages à paroi épaisse sont souvent munis d'un obturateur au fond ou d'ouvertures permettant de recueillir par le côté des échantillons de sols perturbés. L'échantillonnage peut également se faire au moyen de cylindres carottiers spéciaux à tubes emboîtés.

En *Suisse*, on utilise des carottiers de type norvégien à piston stationnaire et à paroi mince, mais les tubes ont un diamètre de 66 mm et une longueur de 800 mm. L'épaisseur de la paroi est de 2 mm et la conicité est faible.

Au *Royaume-Uni*, la méthode normale d'échantillonnage par forage est généralement conforme de très près au British Standard Code of Practice (CP 2001). On perce généralement les trous de sondage dans l'argile au moyen de tarières, mais le forage est souvent prolongé à l'aide de couteaux à argile fonctionnant par percussion jusqu'à une distance de 2 pi au-dessus du niveau où l'on prélève les échantillons. Dans les couches sableuses, on utilise des tarières à cuillère. Le

QUESTIONNAIRE SENT OUT IN 1962

A questionnaire was sent out to the I.G.O.S.S. group and subcommittee members in order to ascertain their opinions on certain recommendations on sampler dimensions. The majority was in favour of such recommendations.

To satisfy everyone one would need to recommend both thin-walled and composite types of samplers. Further, one would have to give a selection of diameters rather than one single diameter. Possible recommendations were discussed between members by letter and at meetings on several occasions during the Sixth International Conference in Montreal. The result is presented below.

CONSIDERATIONS ON "UNDISTURBED SAMPLING OF SOILS FOR CIVIL ENGINEERING PURPOSES"

Reports from various countries on the present status of soil sampling show that sampling practice is frequently not in line with the care taken in laboratory investigations and mathematical treatment. Practice is also not in line with recommendations by experts on sampling. On the other hand one should consider sampling cost and the necessity of obtaining a statistically sufficient number of samples.

In a number of countries classification of sampling according to the intended use of samples has received increased attention.

Experts agree that different soils require different samplers and sampling specifications. For practical use, however, a routine sampler must be able to sample many different soil types. Therefore recommendations on standard sampler data are helpful for work in practice.

In soil sampling we must consider many variables and our present knowledge can safely be related only to certain soil conditions. It is with some hesitation that the suggestions as to suitable sampler dimensions are given below but it can be maintained that they are in agreement with a reasonably wide range of present sampling experience. No equipment can ensure good samples under all possible conditions, however. Evaluations of the soil properties made on the basis of laboratory tests should always consider the possible disturbances in sampling.

Considered here are those soils which lend themselves to relatively undisturbed sampling by punching of a thin-walled tube into the soil. Undisturbed sampling cannot be achieved without adequate specifications for the equipment, technique, and procedure, prepared in advance by competent soils engineers. Adequate preparation and inspection before sampling and supervision by competent personnel are necessary.

diamètre des trous de forage est de 5 po pour le forage des trous de faible profondeur et de 6 à 8 po pour les autres forages. Dans les sols argileux, on prélève généralement les échantillons au moyen de carottiers tubulaires munis de sabots mousses. La longueur du tube est habituellement de 18 po mais il peut être prolongé. Le diamètre interne moyen est de 4,16 po et la conicité interne moyenne est de 1,6 pour cent. On emploie également des tubes de 1,5 po de diamètre qui dans la plupart des cas ont 8 po de longueur. Pour les terrains sableux, on utilise couramment des carottiers à coquilles séparables (dont le diamètre interne est de 1,375 po ou de 2 po). Bishop a mis au point un carottier spécial à air comprimé dont le diamètre interne est d'environ 2,5 po et la longueur de 16,5 po. Les échantillons massifs sont prélevés dans les fosses d'exploration.

Aux *Etats-Unis*, les méthodes les plus employées pour creuser les trous de sondage semblent être le forage à jet d'eau sous pression, le forage par rodage (utilisant des trépans à jets déviés) et le forage au moyen de tarières. Ces méthodes sont souvent combinées. Les trous de sondage sont stabilisés lorsque le besoin s'en fait sentir, soit à l'aide de tubage ou d'une combinaison de tubage et de fluide de forage. Le nettoyage des trous de sondage se fait principalement par circulation d'eau. Le diamètre normal des trous de sondage est de 2½, 3, 4, et 8 po, les petits diamètres étant les plus fréquents. On procède au prélèvement des échantillons principalement au moyen de carottiers tubulaires à paroi mince ou de carottiers à coquilles séparables. Pour les sols à forte cohésion et mous ou de dureté moyenne, on se sert dans environ 25 pour cent des cas de carottiers à paroi mince. Les échantillons de sols non perturbés ont le plus souvent un diamètre de 3 po et une longueur de 24 ou de 30 po. Il n'y a pas de différence importante entre les sols à forte cohésion et les sols sans cohésion. Pour les carottiers à paroi mince, on emploie le plus fréquemment des diamètres de 2 et de 3 po, et une paroi d'une épaisseur de 1/16 de po. La conicité interne est habituellement nulle. On enfonce les carottiers dans le sol soit au moyen d'un mouton ou d'un vérin.

QUESTIONNAIRE ENVOYÉ EN 1962

Un questionnaire a été envoyé au groupe I.G.O.S.S. et aux membres du sous-comité en vue de se rendre compte de leur opinion au sujet de certaines recommandations relatives aux dimensions des carottiers. La majorité d'entre eux appuyaient ces recommandations.

Pour arriver à satisfaire tout le monde, il faudrait recommander l'usage de carottiers à paroi mince et de carottiers de type composé. Il faudrait en outre offrir un choix de diamètres plutôt que d'en spécifier un seul. Les membres ont discuté entre eux par correspondance, et en plusieurs occasions lors des réunions qui ont eu lieu pendant le Sixième Congrès International à Montréal, des recommandations qu'il serait possible de formuler. Voici les résultats de ces discussions.

CONSIDÉRATIONS RELATIVES AU "PRÉLÈVEMENT D'ÉCHANTILLONS DE SOLS NON PERTURBÉS POUR DES TRAVAUX DE GÉNIE CIVIL"

Des comptes rendus provenant de divers pays sur l'état d'avancement des techniques d'échantillonnage du sol, montrent que souvent les méthodes de prélèvement d'échantillons ne sont pas à la hauteur des soins que l'on apporte aux études en laboratoire et aux études mathématiques. De même, la

*Preparation for Sampling*

To obtain the best possible undisturbed samples, proper preparation of the drill hole is necessary before inserting and punching the sample. The hole must be drilled in such a way that the soil below the depth drilled is not disturbed. For cased holes, driving of the casing long distances without cleaning can cause excessive pressure at the bottom and disturbance of the soil to be sampled. In cased holes the water level must be maintained at or above the water table. For uncased holes in soft soils without adequate stabilization by drilling mud, the soil can heave and expand below the bottom. The bottom of the hole should be cleaned of sediment and disturbed soils by a clean-out auger or other appropriate equipment before sampling.

Where piston samplers are used, thorough cleaning is not necessary since the closed sampler can be pushed through the soft disturbed material. However, due allowance must be given to the increased end disturbance.

*Smoothness and Cleanness*

Friction between a soil and a sampler has great influence on sample disturbance. It is necessary to use clean and smooth sampler surfaces, preferably of non-corroding materials and with a low coefficient of friction between soil and sampler.

*Inside Clearance*

Inside frictional forces can in many cases be reduced by inside clearance ratios, i.e. the lower end of a sampler should have slightly smaller inside diameter than the upper end. The proper inside clearance ratio, (greater diameter — smaller diameter) / greater diameter, differs for different soils and different samplers. If the surfaces of the tube are clean and smooth and the coefficient of friction is low, an inside clearance ratio of 0.5–1.0 per cent is suggested for sampling to depths of 20 m in non-swelling soils.

Under no circumstances should the inside diameter of a sampler for undisturbed sampling have a smaller value anywhere than at the cutting edge. Large clearances (>1–3 per cent) cause deformations of samples, opening of fissures, and swelling of soils containing gases; they are generally not desirable. A need for excessive inside clearances may indicate bad sampler design or sampling technique.

technique employée n'est pas conforme aux recommandations des experts relativement à l'échantillonnage. D'autre part, il faut considérer que le prélèvement d'échantillons coûte cher et qu'il faut recueillir un nombre suffisant d'échantillons pour que les études soient valables au point de vue statistique.

Dans un certain nombre de pays, on s'est préoccupé d'une manière accrue de la classification des échantillons en fonction de l'usage que l'on se propose d'en faire. Les experts conviennent que des sols différents requièrent des sondes pédologiques et des normes d'échantillonnage différentes. Dans la pratique, cependant, une sonde pédologique classique doit pouvoir servir au prélèvement d'échantillons dans de nombreux types différents de sols. Les recommandations visant à la normalisation des sondes pédologiques constituent donc un effort utile en ce sens.

Nous devons considérer que l'échantillonnage du sol est une technique qui est soumise à plusieurs facteurs variables et nos connaissances actuelles ne peuvent s'appliquer qu'à certaines conditions géotechniques. Les propositions qui suivent au sujet des dimensions souhaitables des sondes pédologiques sont avancées avec quelque circonspection, mais on peut toutefois affirmer qu'elles s'appuient sur une expérience suffisamment étendue des travaux d'échantillonnage actuels.

Aucun appareillage ne peut toutefois permettre de prélever d'une manière parfaitement satisfaisante des échantillons dans toutes les conditions que l'on est susceptible de rencontrer. L'interprétation des résultats d'essais en laboratoire pour l'évaluation des propriétés des sols doit toujours tenir compte des perturbations possibles au cours de l'échantillonnage.

Nous nous occupons ici des sols où l'on peut prélever des échantillons sans perturbation notable en enfonçant un tube à paroi mince dans le sol. Pour procéder au prélèvement d'échantillons non perturbés, il est nécessaire d'utiliser un appareillage répondant à des normes adéquates, et d'employer des techniques et des méthodes mises au point par des géotechniciens compétents. On doit également procéder à une préparation et à une inspection adéquates avant le prélèvement des échantillons et les travaux doivent être effectués sous la direction d'un personnel qualifié.

*Préparatifs nécessaires avant l'échantillonnage*

Pour obtenir des échantillons aussi peu perturbés que possible, il est nécessaire de préparer correctement le trou de forage avant d'y introduire le carottier et de l'enforcer dans le sol pour en retirer l'échantillon. Le trou doit être foré de façon que le sol situé au-dessous du forage ne soit pas perturbé. Dans les cas où le trou doit être muni d'un tubage, il ne faut pas enfoncer le tube de revêtement à une grande profondeur sans nettoyer le trou car il pourrait se produire au fond de celui-ci une pression excessive qui perturberait le sol où l'échantillon sera prélevé. Dans les trous munis d'un tubage, le niveau de l'eau doit être maintenu à la hauteur de la nappe phréatique ou au-dessus de celle-ci. Dans les trous non tubés foncés dans des sols mous sans stabilisation adéquate au moyen de la boue de forage, le sol peut se déplacer latéralement et faire défaut au-dessous du fond du trou. Avant de procéder à l'échantillonnage, il faut débarrasser le fond du trou des sédiments et des sols perturbés à l'aide d'une tarière de nettoyage ou d'autres outils appropriés. Lorsqu'on utilise des carottiers à piston stationnaire, il n'est pas nécessaire de nettoyer parfaitement le trou car le carottier fermé à la base peut être passé au travers du sol mou perturbé. Il faut toutefois tenir compte d'une manière suffisante de l'augmentation de la perturbation au fond.

*Wall Thickness and Edge Taper Angle*

Deformation of a soil causes disturbances in it. Deformation by displacement is small if the wall thickness of the sampler is small. This consideration has led to thin-walled samplers.

On the other hand, a greater wall thickness may be accepted if it is situated at a sufficient distance from the edge where the sample enters the sampler, and it may result in more robust samplers. Small disturbances may be ensured by using sufficiently sharp edges. The volume displacement during sampling has been represented by the "area ratio" i.e. $(De^2 - Di^2)/Di^2$ where $De$ is the external diameter of sampler, and $Di$ is the internal diameter.

The following combinations of area ratio and edge taper angle may, at the present state of knowledge, be suggested as suitable for undisturbed sampling. They cover the range between extremely thin-walled samplers and good composite samplers, and they should suit samplers of about 3 in. in diameter.

| Area ratio in per cent | Edge taper angle in degrees |
|---|---|
| 5 | 15 |
| 10 | 12 |
| 20 | 9 |
| 40 | 5 |
| 80 | 4 |

The lower end of the cutting edge may be given a greater edge taper angle than the one stated above. It may be 60° until a wall thickness of about 0.3 mm has been reached or, for coarser soils than clay, until the size of the 10 per cent grain fraction has been reached.

*Sample Length*

For tests requiring undisturbed samples of clay one should generally not use the lowest and highest parts of the sample, i.e. within a distance of two diameters from the sample ends. In soft soils where the hole is not pre-bored and the sampler is pushed in continuous sampling, the soil extending at least three diameters from the ends should not be used.

The optimum length of sample should be determined by considering the type of soil and the sample diameter. The following optimum lengths are suggested:

| Type of soil | Greatest length to diameter ratio |
|---|---|
| Clay ($S_t > 30$) | 20 |
| Clay ($S_t$ 5–30) | 12 |
| Clay ($S_t < 5$) | 10 |
| Loose frictional soil | 12 |
| Medium loose frictional soil | 6 |

*La Paroi du carottier doit être lisse et propre*

Le frottement entre le sol et le carottier influe considérablement sur la perturbation affectant l'échantillon. On doit utiliser des carottiers dont la paroi est lisse et propre, de préférence en métal résistant à la corrosion, et ayant un faible coefficient de frottement avec le sol.

*Conicité interne*

Dans de nombreux cas, les forces de frottement interne sont diminuées si le diamètre interne de l'extrémité inférieure du carottier est légèrement plus petit que celui de la partie supérieure. Le rapport approprié de conicité intérieure, (grand diamètre — petit diamètre)/grand diamètre, n'est pas le même pour différents sols et pour différents carottiers. Si la surface du tube est propre et lisse, et que le coefficient de frottement est faible, un rapport de conicité interne de 0,5 à 1 pour cent est à conseiller pour le prélèvement d'échantillons de sols non gonflants jusqu'à une profondeur de 20 m.

Le diamètre interne d'un carottier destiné à prélever des échantillons de sol non perturbé ne doit en aucun cas et en aucun endroit être plus petit qu'à son tranchant. En général une conicité interne considérable (> à une valeur de 1 à 3 pour cent) n'est pas à conseiller car elle peut entraîner la déformation des échantillons, la formation de fissures et le gonflement des sols contenant des gaz. S'il est nécessaire de recourir à une forte conicité interne, ceci peut signifier que le carottier est de conception fautive ou que la technique d'échantillonnage est inadéquate.

*Épaisseur de la paroi et angle de dépouille du tranchant*

La déformation d'un sol y provoque des perturbations mais la déformation par déplacement est faible si l'épaisseur de la paroi du carottier est peu considérable; de là l'emploi de carottiers à paroi mince.

D'autre part, on peut utiliser des carottiers à paroi plus épaisse si cette partie plus épaisse de la paroi est située à une distance suffisante du tranchant qui pénètre dans le sol lors du prélèvement de l'échantillon; de tels carottiers peuvent être plus solides. On peut s'assurer que le sol ne sera pas beaucoup perturbé en voyant à ce que le tranchant soit bien affilé. Le volume déplacé pendant l'échantillonnage a été représenté par le "rapport de surface", c'est-à-dire $(De^2 - Di^2)/Di^2$ où $De$ est le diamètre externe du carottier et $Di$ est le diamètre interne. Selon les connaissances actuelles en matière d'échantillonnage, on peut proposer les combinaisons ci-dessous du rapport de surface et de l'angle de dépouille que l'on croit adéquates pour le prélèvement d'échantillons non perturbés. Elles concernent toute la gamme de carottiers, allant des carottiers à paroi extrêmement mince aux carottiers composés, et elles devraient convenir aux sondes pédologiques d'environ 3 po de diamètre.

| Rapport de surface en pourcentage | Angle de dépouille en degrés |
|---|---|
| 5 | 15 |
| 10 | 12 |
| 20 | 9 |
| 40 | 5 |
| 80 | 4 |

La partie inférieure du tranchant peut avoir un angle de dépouille supérieur à celui susmentionné. Cet angle peut atteindre 60° jusqu'à une épaisseur de paroi de 0,3 mm ou, pour les sols plus grossiers que l'argile, jusqu'à ce que leur fraction granulométrique atteigne 10 pour cent.

Under favourable circumstances much longer samples than those suggested above may be taken, but such samples may be damaged during extrusion if it is not performed immediately after sampling.

*Sample Diameter*

The following sample diameters are suggested as preferable because they are frequently used: 38 mm, 50 mm, 75 mm, 100 mm, and 125 mm. The diameter of samples required should be determined by the grain size of the soil and the quality of sampling. For samples obtained by punching, a diameter of 75 mm or more is required by many experts. Diameters smaller than 50 mm cannot be suggested for undisturbed sampling.

*Escape of Air, Water, etc.*

If air, water, or soil which is contained in the sampler before sampling cannot escape upwards or sideways, the sample cannot enter the sampler properly and it may be damaged. Samplers must therefore be provided with pistons or ample openings for the above purpose. Punching speed must be so slow that such escape is possible without great increase in pressure. A uniform velocity of about 2 m/min is regarded by the subcommittee to be optimum.

*Operations after Sampling*

Procedures with the samples after sampling must be designed so that a minimum of disturbance will result before the soil is tested in the laboratory. Proper sealing, packing, and care in shipment are required. Ejection of some soils from the entire tube length may result in disturbance when the friction between the soil and tube increases with time of storage. For these cases and where the soil is not too soft, it may be advisable for long tube samples to eject the soil in the field after sampling, cutting the samples into manageable lengths and sealing them for shipment and storage. For soft soils which cannot be ejected in the field and where too much disturbance will be caused by ejection of the full length in

*Longueur des échantillons*

Quand les essais doivent être effectués sur des échantillons de sol non perturbés, on ne devrait pas en général utiliser les parties supérieures et inférieures des échantillons, soit les parties situées dans l'espace compris entre les extrémités du carrottier et un point situé à une distance équivalente à deux fois le diamètre de celui-ci. Dans les sols mous où le trou n'est pas foré d'avance et où le carottier est enfoncé en vue d'obtenir des échantillons continus, on ne devrait pas utiliser le sol situé dans l'espace compris entre les extrémités du carottier et un point situé à une distance équivalente à trois fois le diamètre de celui-ci.

La longueur optimale des échantillons devrait être déterminée en fonction du type de sol et du diamètre des échantillons. On propose les longueurs optimales suivantes:

| Type de sol | Rapport le plus grand entre la longueur et le diamètre |
|---|---|
| Argile ($S_t > 30$) | 20 |
| Argile ($S_t\ 5 < S_t > 30$) | 12 |
| Argile ($S_t < 5$) | 10 |
| Sol meuble d'attrition | 12 |
| Sol semi-meuble d'attrition | 6 |

Dans des conditions favorables, on peut prélever des échantillons beaucoup plus longs que ceux proposés ci-dessus, mais ces échantillons peuvent être endommagés lors du dégagement de la sonde si cette opération n'est pas effectuée aussitôt après l'échantillonnage.

*Diamètre des échantillons*

On conseille de prélever de préférence des échantillons des diamètres suivants, car ils sont fréquemment utilisés: 38 mm, 50 mm, 75 mm, 100 mm et 125 mm. Le diamètre requis des échantillons devrait être déterminé selon la granulométrie du sol et la qualité désirée de l'échantillonnage. Pour les échantillons prélevés au moyen d'un carottier enfoncé dans le sol, beaucoup d'experts exigent un diamètre de 75 mm ou plus. Pour le prélèvement d'échantillons de sol non perturbé, on ne peut conseiller des diamètres inférieurs à 50 mm.

*Échappement de l'air, de l'eau, etc.*

Si l'air, l'eau ou le sol qui sont contenus dans le carottier avant l'échantillonnage ne peuvent s'échapper par le haut ou par les côtés, l'échantillon ne pourra y pénétrer correctement et il peut être détérioré. Les carottiers doivent donc être munis d'un piston ou de grands orifices de dégagement. La vitesse d'enfoncement doit être assez lente pour permettre l'échappement de l'air, de l'eau, etc., sans forte augmentation de la pression. Le sous-comité sonsidère qu'une vitesse uniforme d'environ 2 m/min est optimale.

*Opérations à effectuer après le prélèvement des échantillons*

Après le prélèvement des échantillons, ceux-ci doivent être manipulés de façon à ce qu'ils soient aussi peu perturbés que possible avant les essais en laboratoire. Il est nécessaire d'apporter beaucoup de soin à la préparation, à l'empaquetage et à l'expédition des échantillons. Le dégagement d'échantillons de certains sols sur toute la longueur du tube peut entraîner un remaniement si le frottement entre la carotte et le tube augmente avec le temps passé par l'échantillon dans le tube de prélèvement. Dans ce cas et si le sol n'est pas trop mou, il peut être bon de dégager sur les lieux et immédiatement après l'échantillonnage, les échantillons recueillis dans de longs tubes, de les couper en longueurs the laboratory, it may be necessary to cut the tube into shorter lengths and eject each length separately. Ejection in any case must be done with a close-fitting flat disc pressed perpendicularly to the axis of the tube.

maniables et de les empaqueter hermétiquement en vue de l'expédition et de l'emmagasinage. Dans le cas des carottes de sols mous que l'on ne peut expulser du carottier sur les lieux du prélèvement, et qui seraient trop perturbées si l'on les dégageait sur toute la longueur du tube en laboratoire, il peut être nécessaire de couper le tube en tronçons moins longs et de dégager chaque tronçon de la carotte séparément. Le dégagement des échantillons doit toujours être réalisé au moyen d'un disque plat à ajustement serré, que l'on pousse perpendiculairement à l'axe du tube.

# Opening Session in Honour of Karl Terzaghi
# Séance inaugurale à la mémoire de Karl Terzaghi

LA GRANDE SALLE, PLACE DES ARTS, 8 SEPTEMBER/SEPTEMBRE 1965

## Participants

DR. R. F. LEGGET, Chairman, Organizing Committee, Sixth International Conference

THE HONOURABLE PAUL COMTOIS, Lieutenant-Governor, Province of Quebec

ALDERMAN J. LYNCH-STAUNTON, Pro-Mayor, City of Montreal

DR. B. G. BALLARD, President, National Research Council of Canada

DR. A. CASAGRANDE, President, International Society of Soil Mechanics and Foundation Engineering

DR. R. B. PECK, Professor of Foundation Engineering, University of Illinois

DR. L. BJERRUM, Director, Norwegian Geotechnical Institute

MR. H. TAYLOR, British Columbia Hydro and Power Authority

DR. RUTH D. TERZAGHI, Winchester, Massachusetts

DR. A. W. SKEMPTON, Past President, International Society of Soil Mechanics and Foundation Engineering

THE BAND OF THE ROYAL 22ND REGIMENT
(By kind permission of the Officer Commanding, Quebec Command)

DR. R. F. LEGGET

Excellence, Invités Distingués, Mesdames et Messieurs, Ladies and Gentlemen, Distinguished Guests, Your Excellency, would you do us the honour of declaring this great conference opened.

L'HONORABLE PAUL COMTOIS

Monsieur le Président, Mesdames et Messieurs,

Il m'est très agréable de constater que les dirigeants de la Société Internationale de Mécanique des Sols et des Travaux de Fondations ont choisi la métropole du Canada comme siège de leur sixième congrès. Après les Etats-Unis, la Hollande, la Suisse, l'Angleterre et la France, c'est le Canada, et en particulier la province de Québec, qui a le plaisir de recevoir les représentants de cette très importante Société.

Messieurs, c'est un honneur que celui de vous avoir parmi nous. Vous trouverez ici j'en suis sûr, non seulement une ambiance propice aux délibérations fécondes d'un congrès tel que le vôtre, mais également une atmosphère de saine détente dont vous pourrez jouir pendant les quelques loisirs que vous saurez vous accorder, durant votre séjour chez nous. A titre de Lieutenant-Gouverneur il m'est particulièrement agréable de souhaiter une chaude bienvenue dans la belle province à chacun des distingués représentants des quelques cinquante pays membres de l'association. J'estime qu'en formulant cette invitation, par l'entremise du Conseil National de Recherches, le Gouvernement du Canada avait pressenti l'effort gigantesque que prendra le Québec dans les domaines industriels et scientifiques, et je considère comme une reconnaissance des réalisations déjà obtenues dans ces sphères, autant qu'un aveu de confiance dans un avenir chargé de grandes promesses, l'acceptation gracieuse de votre Société à tenir ses délibérations de 1965 dans la plus grande ville du Québec et du Canada. Mesdames, Messieurs je vous souhaite un séjour des plus féconds et des plus agréables à Montréal, puissiez-vous le bien goûter afin de nous revenir dans deux ans, individuellement ou en groupe, pour assister à l'exposition universelle de 1967.

Il me fait maintenant grandement plaisir de déclarer dûment ouvert ce Sixième Congrès International de Mécanique des Sols et des Travaux de Fondations.

Ladies and Gentlemen, as I have been informed that everyone attending this Conference is bilingual or can be bilingual with the acoustical aids you have, it would be superfluous to repeat in English what I have just said in French. However, may I express the hope that the organizers have left you ample time to benefit from your short stay in this metropolis and that you will be allowed sufficient hours of leisure to appreciate the hospitality which is extended to you.

I now take pleasure in declaring open this Sixth Conference of the International Society of Soil Mechanics and Foundation Engineering.

DR. LEGGET

Excellence, je vous remercie beaucoup pour vos paroles si aimables.

Ladies and Gentlemen it is my pleasure to invite Mr. Alderman J. Lynch-Staunton, the Pro-Mayor of Montreal, to bring to us the greetings of the great city in which we are meeting.

ALDERMAN J. LYNCH-STAUNTON

Excellence, Monsieur le Président, Invités distingués chers membres et amis de ce Congrès,

Je voudrais, tout d'abord, excuser l'absence du Maire de Montréal qui devrait être devant vous ce matin mais malheureusement un certain nombre de devoirs municipaux le retiennent ailleurs, et il m'a chargé en son nom et au nom

OPENING SESSION CEREMONIES IN THE GRANDE SALLE

de tous nos concitoyens, de vous souhaiter la plus cordiale bienvenue dans la ville de Montréal. Nous sommes toujours flattés en notre ville de recevoir des congrès de grande importance. Nous sommes surtout flattés de recevoir le vôtre, connaissant si bien son importance, et surtout parce que c'est la première fois que vous vous réunissez au Canada et seulement la deuxième fois que vous tenez votre Congrès en Amérique du Nord.

A recent visitor to Montreal asked: "What are you doing to your city? Are you tearing it down or are you building it up?" Anyone who has had a chance to spend a few hours in certain areas of the city will realize the validity of the question. Perhaps it is only coincidental that you are holding your reunion in Montreal but it is certainly appropriate that you should come and see what is being done here at this particular time. The two major projects in our city at the moment are the preparations for the Exposition of 1967 —already an island has been literally created in the middle of the river—and the seventeen-mile subway which if all goes well—and it has so far—should be in operation within a year or so. These two multi-million dollar projects have in turn stimulated a great deal of development by the private sector. The unique feature of this city, unique at least in North America, is that the private and public sectors are engaged simultaneously in major developments. In five or ten years, when these developments are completed, you will find our city quite different, a city of the 1960's where government and industry have together created what will be a greater and better Montreal.

As professionals, you, I hope, will look at these projects in their initial stages with a very critical eye, and I do not doubt that the local members of your organization and all others interested in these projects will be glad of any contributions which you can make from your experience.

I hope that your stay in Montreal will be not only a working one but also a very pleasant social one. We think we have a lot to offer you; those who have been here before are, I hope, happy to be back and those who are here for the first time will, I hope, leave with pleasant memories. Tonight the city looks forward to seeing many of you at the Chalet where we can repeat our welcome, perhaps in a less formal way. Meanwhile, I hope that the few days you have here will be pleasant ones, that you will come back very soon. I can assure you that whether you come back as a group or as individuals your welcome in Montreal will be no less warm or sincere than the one I bring you this morning.

Dr. Legget

Thank you very much Mr. Lynch-Staunton. Would you be good enough to convey to His Worship the Mayor our greetings and our thanks for all his appreciation and his interest in the Conference. Finally, Ladies and Gentlemen, it is my privilege to call upon the President of the National Research Council of Canada, Dr. Guy Ballard, to bring you greetings from the Research Council and from Ottawa —Dr. Ballard.

Dr. B. G. Ballard

Excellence, Votre Honneur, Mesdames et Messieurs,

Your Excellency, Your Honour, Ladies and Gentlemen,

I should first like to express our gratitude to the Lieutenant-Governor for coming from Quebec City to open this Conference and to the Pro-Mayor for his gracious welcome. It is a very special privilege for the National Research Council to be your host and on its behalf I welcome you most warmly to these meetings. There are representatives here from nearly fifty countries and the Conference promises to be a most successful one.

It has been my privilege to know Dr. Legget, the Chairman of the Organizing Committee, very well and he is a very subtle man. When I discussed this meeting with him, he said that I would only need to speak for a short time. I believe that that is a subtle way of telling me not to talk for too long. However, I do want to tell you something of the National Research Council. To my knowledge, no other country has an organization quite like it.

Canada is a large country geographically and has a number of unique problems. Our population is small, however, and to deal with these problems effectively we have consolidated much of our work. As a result the National Research Council has a wide variety of responsibilities. Generally, our function is to promote science in Canada.

We do this by supporting research in universities, and by offering scholarships. We have a laboratory system with about nine divisions in separate disciplines including one which deals with Building Research, and it is the Division which is generally responsible for all of our work in soil mechanics and foundation engineering. These laboratories spread over about 550 acres and employ about 2700 people. We also have an extensive system of committees, including associate committees, to explore a whole range of scientific problems. We act to some extent as an academy in promoting exchanges of scientific knowledge and personnel and arranging international meetings.

It is from the National Research Council that the Canadian National Committee for Soil Mechanics originates. An associate committee of the National Research Council, it was formed over twenty years ago by Dr. C. J. MacKenzie the then President of the National Research Council. Thus this Conference marks over twenty years of corporate activity in the field of soil mechanics in Canada.

On behalf of the National Research Council and its Associate Committee on Soil and Snow Mechanics, I now have the pleasure of handing over the Conference to your President, Dr. Casagrande of Harvard University.

Dr. A. Casagrande

Your Excellency, Your Honour, Mr. President, Fellow Members of our Society, Ladies, and Gentlemen,

Four years ago, at the Paris Conference, our Past President, Professor Skempton, was privileged to open the conference by reading a message from Karl Terzaghi. In this message Terzaghi briefly traced the progress of soil mechanics since our First Conference in 1936, and he concluded by expressing the hope that the Paris Conference would be as constructive as its predecessors.

KARL TERZAGHI

It is for me a matter of deep sadness that I must open this Conference without a message and good wishes from Karl Terzaghi. Instead, I ask you to stand for one minute in silent thought of the man to whom we all owe so much.

I should like to use this opportunity to tell you that, upon my return from the Paris Conference, Professor Terzaghi listened with the greatest interest to everything I was able to tell him about that meeting, and about his many friends whom he would have liked to see again. He was delighted to learn that the Sixth Conference would be held in Canada, and he repeated this to Robert Legget and Carl Crawford when some months later they visited him at his home for the purpose of obtaining his views concerning the organization of the present Conference.

Although Terzaghi was truly a citizen of the world, and no country could claim him as their own, I am happy to say that Canada played a prominent role in his activities. During the last fifteen years of his life, he designed several dams in British Columbia, and he served also as a member of the board of consultants on the South Saskatchewan River dam. Only six months before his death we had a meeting of the board at his home; it was his last contribution to this difficult project. The design and construction of this dam owes much to his judgment. However, it was another very difficult dam project, the Mission Dam in British Columbia, to which he devoted more time than any other single consulting project in his career. This dam was the subject of the publication on which he was still at work when I visited him a few days before his death. It is the dam which to-day will be named in his honour.

Many warm professional friendships bound Terzaghi to Canadian engineers; and, in turn, the soil mechanics fraternity of Canada has honoured Terzaghi on a number of occasions in various thoughtful ways which he always greatly enjoyed and appreciated. We will witness this morning one more expression of the deep gratitude of our Canadian colleagues.

Our first speaker at this Memorial Meeting will be Professor Ralph Peck who has collaborated closely with Professor Terzaghi over almost a quarter of a century in the application of soil mechanics to many projects, starting with the Chicago subway in 1939. They also collaborated in the writing of *Soil Mechanics in Engineering Practice.*

I do not need to describe Professor Peck's professional achievements, but I would like to mention that among his many honours is the Norman Medal, the American Society of Civil Engineer's highest award, and that in 1963 he delivered the First Terzaghi Lecture before the annual A.S.C.E. meeting in San Francisco.

Dr. R. B. Peck

In preparation for these remarks I took the occasion to review the file of personal letters between Dr. Terzaghi and myself over a period covering the last twenty years of his life. As you may imagine, it was a stimulating experience. Some of the thoughts that came into my mind during this experience I should like to share with you. They may serve as sidelights to the biography prepared by Professor Casagrande with such sensitivity for the Anniversary Volume.

I was struck first with the sheer volume of the correspondence, and secondly by its detail. No point was too small to attract Karl Terzaghi's attention and comment, or to serve as a basis for even more detailed questions. But most of all, I was struck by the realization that I was only one of a large group of people to whom he wrote frequently. The questions he raised with me, the ideas he set forth for further consideration, and the outright assignments of work he thought I should undertake could well have occupied all my time. Yet, I know that he devoted similar attention and thought to the work of a number of other people including, certainly, many of you who are in this audience. By his letters, often in his own handwriting, he gathered the threads of a field of knowledge fully into his own hands and at the same time he exerted a remarkable influence on the advancement of his field.

Much of our correspondence and most of our conversations dealt with the applications of soil mechanics to practical problems. If I could select one theme that runs through his letters from the earliest days of the Chicago Subway project, it would be that, in spite of the uncertainties of subsurface conditions, the engineer should never be caught by surprise. During his periodic visits to the University of Illinois he unfailingly inquired what work I had undertaken. He would listen to my descriptions of each of the projects, asking questions until he was fully familiar with them. Time and again during those years, it would become apparent that my conclusions or my course of action were based on a hope or on wishful thinking concerning the outcome. I can vividly recall his incisive questions about the basis for my conclusions, about the alternatives, and about the consequences of making the wrong inferences concerning the subsurface conditions. Then would finally come the wordless but kindly smile and the long penetrating gaze until I, too, was forced to smile and to admit that I had overlooked some detail that might go wrong without providing a suitable alternative.

The conviction that one should never be caught by surprise, which Karl Terzaghi invariably demonstrated in his own practice, does not, of course, mean that he was reactionary or overly conservative. On the contrary, he was a most resourceful and imaginative man. He tried many new ideas and was himself often not sure of their outcome, but in a remarkably dispassionate and unbiased manner he always evaluated not only the probabilities but the possibilities that his conclusions might not agree with reality. He made specific plans for dealing with each eventuality if it should arise and then he set up the means for making the crucial observations that would disclose to him what the real conditions were. The planning and execution of these observations were for him among the most absorbing efforts of his professional career. I well remember the anticipation with which he awaited the first results of some of these observations, results that would tell him whether his best judgment up to that time had been accurate or whether Nature had yet another surprise for her distinguished adversary.

That Mission Dam in British Columbia should come to bear Dr. Terzaghi's name seems to me to be especially appropriate because this project, possibly more than any other, epitomizes the approach of which I have been speaking. It is not a large dam but its design and construction were fraught with many complexities. It was a project in which he was in complete and absolute control of all the critical phases, a project requiring and receiving the devotion of all his artistry. Artistry, I believe, is the right word because I am convinced that he took far more pleasure in the act of creating than in the creation itself.

Moreover, on every project the act of creation for Karl Terzaghi did not end with the job. Although he looked forward to and was stimulated by the day-to-day decisions required as the various aspects of a job developed, he also looked forward to the end of the job when he could withdraw from the immediate pressures, digest the data, and evaluate what he had learned. The final report on each project was written at least as much for himself as for his client. I know of many jobs on which he spent days and weeks in preparation of the final report, far beyond the limits of any time imagined by or known to his client. He never allowed himself to become so busy that he cut short these periods of intense review and concentration. These, indeed, were the periods of greatest advancement of the art of applied soil mechanics and engineering geology.

Almost always these final reports became incorporated in technical papers or served as the basis for the manuscript of one of the papers that now form such an outstanding series in the annals of the practice of civil engineering. The paper on Mission Dam was the last of this series. Although the finishing touches on the manuscript were made by others, Karl Terzaghi maintained the determination and strength required for the period of analysis and concentration on this, one of the last of his projects and one that he considered the most complex of his career. He once expressed the thought that he could not possibly leave this work undigested and unfinished, and I would not be surprised if the compelling urge to learn the extent to which the performance of Mission Dam fulfilled his expectations sustained him in the last months of his life.

Karl Terzaghi was engaged in many projects larger than Mission Dam. Many of his professional contributions may turn out to have more lasting significance or more impact on posterity than this one. Yet, none was closer to his heart or was a greater challenge to him than this relatively small structure in a wild and beautiful part of one of his favourite corners of the world. And, although his projects stand in all the continents, it is altogether fitting that this dam in the western part of the country acting as our host for this Conference should bear his name.

Dr. Casagrande

Our next speaker will be Dr. Laurits Bjerrum, Director of the Norwegian Geotechnical Institute. Professor Terzaghi had followed with sincere interest Dr. Bjerrum's remarkable career and the equally remarkable growth of the Norwegian Geotechnical Institute which, under Bjerrum's leadership, has grown rapidly to its present eminent position. On several occasions, when Dr. Bjerrum visited the United States, he was privileged to stay as a house guest at the home of the Terzaghis. This gave him a rare opportunity to become well acquainted with Professor and Mrs. Terzaghi.

Dr. L. Bjerrum

Mr. President, Mr. Chairman, Ladies, and Gentlemen,

Those who have had the good fortune to know Karl Terzaghi during the development of soil mechanics in the past few decades have been privileged to witness the writing of a chapter in the history of civil engineering. Such a privilege also involves the responsibility to take care of the information and material required for future generations to understand the development of our science and its originator. This is exactly the purpose of The Terzaghi Library which has now been established in Norway and which I am going to tell you about.

The story of how the idea of a Terzaghi Library was born starts as early as the fall of 1957. I was on my way to

Yugoslavia when I stopped for a couple of days in Vienna to see Terzaghi's old laboratory and visit his successor at the Technische Hochschule, the late Professor O. K. Frölich. Frölich was just retiring at the time of my visit and he was busy removing all his papers in order to make his office ready for his successor. During our tour through the University we stopped in Terzaghi's old office, and here Frölich took me into a small filing room and showed me a large pile of dusty papers on the floor in one of the corners. He explained to me that this material was left by Terzaghi when he left Vienna hurriedly, shortly after the Anschluss in 1938. The material had remained in the filing room for these many years and Frölich now asked me to advise him on what to do with it, as he hesitated to throw it away.

A quick look at the papers showed that they contained manuscripts, reports, and correspondence dating back as far as 1910, and that they included, for instance, material from Terzaghi's early work in Istanbul. I asked Frölich to keep the material until I had been in contact with Terzaghi and had received his personal instructions. In a letter to Terzaghi I pointed out that this material could prove invaluable for future generations. I offered to try to arrange to have the most valuable part sorted out and sent to him in the United States. As a result of our correspondence the material was sent to Oslo, where we performed the screening process and prepared a list of contents so that Terzaghi himself could decide which papers he was interested in having sent to the United States.

Out of this accidental occurrence grew the idea of a Terzaghi Library. Terzaghi appreciated that his papers and reports were of a general interest. He asked us to keep the Vienna material and, in full agreement with his wife, Ruth Terzaghi, he decided in 1958 that the material collected in the United States should after his death also be included in a Terzaghi Library, and that this library should be established in Oslo.

After his death Mrs. Terzaghi spent several months sorting through the enormous amount of material collected in Terzaghi's office and in their home in Winchester. In June of last year it was shipped to Oslo, where a librarian is now working on the registration, arranging, binding, and cataloguing of the material. To give you an idea of the type of material included in the Terzaghi Library, I have selected some examples referring to various periods of Dr. Terzaghi's life.

From Dr. Casagrande's biography of Terzaghi, published in the Terzaghi Volume, you will have learned that Terzaghi's first attempt to reach a rational approach to earthwork and foundation engineering was based on the idea that it might be possible to correlate construction experience with the geology of the soil and rock involved. He hoped to be able to do this on the basis of experience accumulated in the United States, and he spent the years 1912 and 1913 travelling to dam sites and foundation jobs all over the United States. All his notes, hand-drawn sketches, and reports, arranged and interpreted according to the type of problem, were among the material found in Vienna.

As you know, this attempt was a discouraging failure and Terzaghi had to give up this line of attack on the problem. The following years, which coincide with the First World War, represent a restless and unsettled period in Terzaghi's life. We can follow this in some of the most fascinating documents in the Library, a collection of 28 letters that he wrote to Professor Wittenbauer. Wittenbauer was a well-known professor at the Technische Hochschule in Graz where Terzaghi was a student and it was Wittenbauer who saved him from being expelled from the University. The letters to Wittenbauer, which cover the period from 1909 to 1920, permit a deep insight into those soul-searching years of Terzaghi's life and his undecided personality.

This period ended abruptly on a day in March, 1919. As Terzaghi has told the story to me, he was sitting in a mood of depression on a piece of rock outside Robert College in Istanbul. The First World War was over and, like all citizens of the defeated nations, he had been dismissed from his position at the Imperial School of Engineers. In order to survive, he had been obliged to accept a poorly paid teaching job at Robert College. When sitting outside the College looking out over the Golden Horn, he suddenly visualized what was needed to obtain a rational approach to the problems involved in earthwork and foundation engineering. He realized that progress depended entirely on the development of testing equipment and methods which could give a quantitative measure of the mechanical properties of the soils involved. On two sheets of paper he listed a number of possibie ways of testing soils, made the sketches of the equipment needed, and suggested how the results could be interpreted. These sheets of paper represent the birth of soil mechanics; Terzaghi emphasized several times their importance for the Terzaghi Library. However, he never showed them to me, and even Mrs. Terzaghi had never seen them until we found them after his death.

From that day Terzaghi's life changed completely. His restlessness and indetermination were as if blown away. He had now found the subject into which he could throw all his ingenuity and imagination. The progress of his work was unbelievable. It is our good fortune that we can follow it from day to day. At the beginning of April, 1919, Terzaghi started a diary in which every day he entered what he had accomplished, the main results of his testing and ideas, and suggestions that he considered important to remember. From this diary we know, for instance, that the first consolidation test on a clay had already been carried out in May, 1919, and that it was on October 30, 1923, that Terzaghi solved the mathematical problems involved in the theory of consolidation by discovering the analogy with the thermodynamic processes.

This diary was—with minor interruptions—kept until his death. At the end of each year, he wrote a short summary of what the year had meant to him. In addition he kept a second set of records. This was not a systematic diary, but an occasional record of his thoughts on life. These notes are, I would say, almost of literary value, giving a picture of Terzaghi himself and the world surrounding him. Terzaghi also wrote an autobiography, covering his life from his childhood to 1939.

It is of special interest to follow the development of the new science of soil mechanics from Terzaghi's first primitive experiments in 1919 to its successful application to practical problems. In the handwritten manuscript of his lectures in the United States and in Vienna, in the notes for the papers he gave to engineering societies, in the manuscript of two unpublished books which he worked on in the mid-'thirties, we can read the story of how the original ideas were formulated into consistent concepts and how these again were applied to engineering problems. The extensive correspondence with leading engineers all over the world illustrates the impact of Terzaghi's work on the profession. Of interest to our Society is the comprehensive ccrrespondence which preceded its formation in 1936 in connection with the First International Conference at Harvard University.

Above all, the most valuable part of the Library is an almost complete collection of material on Terzaghi's consulting jobs. This includes his reports, notes, correspondence, memos, and instructions for the important and difficult construction work with which he was connected. It starts in the early 'twenties in Istanbul, includes his first assignments in the United States in the late 'twenties, and the period of extensive consulting work during the years in Vienna with dams in the U.S.S.R and in North Africa. Most complete are the files from the work of the last three decades in the United States, starting with the Chicago Subway and terminating with the Mission Dam—now to be renamed the Terzaghi Dam. We are at present putting this material in order, and during this work it happens that almost every time I get one of the reports in my hand, I forget time and place and become completely absorbed in it. These files represent an invaluable source for a study of the application of soil mechanics and engineering geology to practical problems and, in contrast to Terzaghi's own publications about the jobs, they give the full story of how the problems were attacked.

I hope this brief description has shown that the Terzaghi Library is a unique treasure, telling the complete story of the birth and growth of a science and of its ingenious father.

I do not need to tell you that our small country is proud of the assignment to take care of this material, and we shall do our utmost to preserve it and give it the setting it deserves. We appreciate fully that our country is only the host country and that the Terzaghi Library is the true property of our profession and our Society. The Terzaghi Library will therefore be established as an independent institution and its statutes will be formulated such that its integrity is preserved for the future.

The Terzaghi Library should be more than a museum for the originator of soil mechanics. We hope it will develop into an active centre for the history of our science, open for study to all who are interested, and communicating the results in a series of special publications. It is our hope that we will be supported in this work by interested members of our Society, for instance by donations of relevant material.

As this is the first time the establishment of the Terzaghi Library has been made known, I would like to end this talk by expressing warm thanks to Mrs. Terzaghi, who so wholeheartedly agreed to the idea. I am sure that I speak in the name of our Society and in the name of this and future generations of our profession when I express our sincere gratitude to Ruth Terzaghi for her generous support of the Terzaghi Library.

DR. CASAGRANDE

Our next speaker will be Mr. Harold Taylor, engineer with the British Columbia Hydro and Power Authority. Mr. Taylor was the owner's representative during the construction of Mission Dam, and in this capacity he was usually in attendance during Terzaghi's many visits to Vancouver and to the project. Upon completion of Mission Dam, Mr. Taylor was put in charge of the extensive programme of observations of piezometers, settlements, and seepage.

Because of Mr. Taylor's personal contacts with Professor Terzaghi on this project, Dr. Shrum, Co-Chairman of the British Columbia Hydro and Power Authority, has delegated Mr. Taylor to convey to us the plaque which is to be erected on the dam, and to tell us something about other work which Professor Terzaghi has carried out in British Columbia and what that part of Canada meant to Professor Terzaghi.

MR. H. TAYLOR

It is an honour and a pleasure for me to take part in this ceremony as the representative of the British Columbia Hydro and Power Authority.

Our association with Dr. Terzaghi started in 1950, when a powerhouse developed a foundation condition that required expert advice. Our consulting geologist, Dr. Victor Dolmage who knew Dr. Terzaghi, said to us "Why don't you get Terzaghi? He is a fine man to know and to work with, very easy and approachable. I think he will come." So we wrote to him and he accepted the assignment. His help and reassurance on that occasion so charmed our management, and our British Columbia scenery so charmed Dr. Terzaghi, that it was the most natural thing that he should stay associated with us on other projects. He loved to travel in our mountainous country and every spare moment he had he was out looking at something new in our rugged province.

He was asked to provide a consulting service for our Cheakamus Dam. Some of you will have read his paper, "Storage Dam Founded on Landslide Debris," in which he describes the design and construction of this dam. An article on this dam is also included in the Terzaghi Anniversary Volume, *From Theory to Practice in Soil Mechanics*.

In 1955, when it was decided to construct a storage dam across the Bridge River, Dr. Terzaghi accepted our invitation to serve as consultant on this project, even though he was 72 years of age. Right from the start he stated that the proposed dam site had one of the worst dam foundations he had ever encountered. Probably this was his main reason for taking on this difficult and important assignment. After extensive investigations he assured the owners that a safe structure could be constructed at this site.

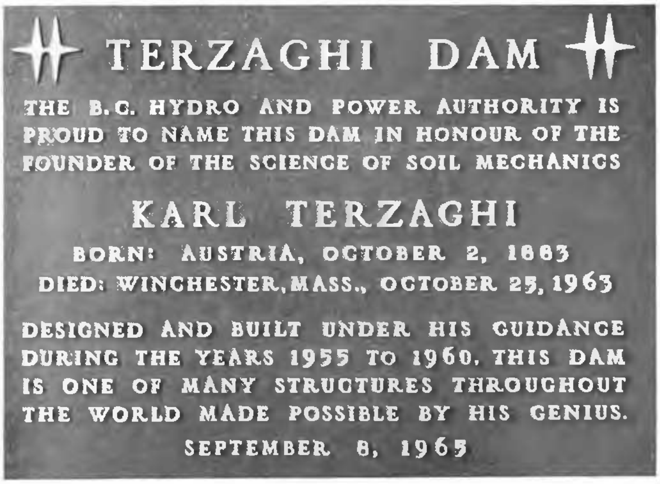
Mission Dam forms a storage reservoir which is 1200 feet higher than nearby Seton Lake. From the reservoir water is diverted through tunnels and penstocks down to two powerhouses on Seton Lake.

One may say that, unknown to himself, Dr. Terzaghi's connection with this dam started in 1925 when he published a series of articles on the Principles of Soil Mechanics in the *Engineering News-Record*. About the same time engineers started to look at the Bridge River area for power development. A dam site that seemed obvious was in a gorge about 800 feet wide at river level between two solid granite spurs. The V-shaped gorge is 500 feet deep and is filled with alluvial deposits, in part pervious sand, gravel, and slide rock, and in part a very soft blue clay layer 60 to 80 feet thick. In those days the engineers were not at all sure of the soft blue clay as a foundation material below an earth-rock dam. They had read the Terzaghi articles and they were thinking hard. But for various reasons the construction of the dam was deferred, which may have been just as well. It was not until 1948 that a low diversion dam was constructed at this site which later became the upstream toe of the larger dam.

In providing consulting advice on this new and larger dam, Dr. Terzaghi had to reach important decisions on many problems. Some of these were: (1) how to grout effectively a deep gorge filled with sand, gravel, and slide material; (2) how to instal a row of sheet piles between two rows of existing sheet piles with interconnecting cross-walls and with the top of this structure buried 50 feet below the working area; and (3) how to provide for a permanent water barrier on the upstream face of an embankment that might settle unevenly up to 20 feet. All of this work was successfully completed five years ago and the dam has performed satisfactorily.

Those of us who attended Dr. Terzaghi's frequent visits to the dam and were present at discussions and read his many memoranda realize that this project was a "labour of love" with him. Dr. Terzaghi was the senior author of an article on Mission Dam which was published in the March, 1964, issue of *Géotechnique*. He was working up to his last day on this article.

We are very pleased that his name is coming back to us to stay by the renaming of this dam, which meant so much to him, in his honour. This plaque which will be erected on a monument on the dam bears the following inscription:




UNVEILING OF THE TERZAGHI DAM PLAQUE. MRS. TERZAGHI AND MR. H. TAYLOR

Dr. Casagrande

The Organizing Committee has invited the wife of Karl Terzaghi, Dr. Ruth Terzaghi, to participate in the ceremony of renaming Mission Dam. Not many readers of Terzaghi's publications know of Mrs. Terzaghi's important role in the writing of his papers. Since their marriage in 1930, Mrs. Terzaghi edited practically every word her husband wrote; and if anything was not clear to her, he would rewrite it until she was satisfied.

While Mrs. Terzaghi was working on her doctoral research in Harvard's Department of Geology she became interested in the compressibility of sedimentary lime deposits. This led her, one day in 1929, to call on Professor Terzaghi at M.I.T. to discuss her views with him and to have some consolidation tests made in the M.I.T. laboratory. That started their long and very successful joint venture.

Since their marriage, Mrs. Terzaghi has carried out several significant research projects which were usually initiated by questions that she would ask her husband and which generally started with the words: "Why don't they. . . ." Such questions sometimes boomeranged, and then she had a research job on her hands. One such question led to her study of the deterioration of concrete exposed to sea water. For one of the papers resulting from this work, she was awarded the Clemens Herschel Prize by the Boston Society of Civil Engineers. More recently her work turned to a study of the jointing of rocks, and a paper on this subject will appear in this month's issue of *Géotechnique*.

I should also mention that in her husband's course in Engineering Geology at Harvard she presented regularly a number of lectures on the more purely geologic topics.

Dr. Ruth D. Terzaghi

The design and construction of the dam which has been renamed today challenged Karl's professional skills and his human qualities as no other construction project had ever challenged them. He therefore felt a more intense personal attachment to this dam than to any of the other projects with which he had been associated. Hence I feel sure that no tribute could have given him greater satisfaction than that which the British Columbia Hydro and Power Authority has paid him today in giving his name to this particular dam.

This is a happy occasion and it seems an appropriate one to speak of Karl's own feelings about his accomplishments. His attitude was perhaps most clearly expressed in a talk he gave to students in Istanbul in 1923. In that talk he said, "To develop a thought into a finished visible entity is as stupendous a marvel as the transformation of a seed into a tree." Note how he put it: it is not the tree, not the dam, that is the marvel, but the transformation, the development, that produced each. A strikingly similar view of life was expressed a century ago by the Russian novelist Dostoievski. Because his words so accurately represent Karl's own thoughts, I shall quote them too. Dostoievski said, "Perhaps the only goal on earth toward which mankind is striving lies in the process of attaining, in other words in life itself, and not in the thing to be attained."

I should like to think that we are honouring today not only Karl's attainments, perhaps not even primarily his attainments, but his view of life which lay behind them.

Everyone who had personal contacts with Karl must have realized that his scientific and engineering competence represented only a part of his versatile nature; Professor Casagrande has kindly suggested that I might share with you my own close-up of other aspects of his character.

Some of you are perhaps aware that early plans for Karl's Anniversary Volume provided for a chapter giving a wife's eye view of the journey from theory to practice in soil mechanics. Karl, always good at suggesting titles, had one for this chapter too. It was to be called "Life with Father

TERZAGHI DAM DURING CONSTRUCTION

TERZAGHI DAM—CONSTRUCTION COMPLETED AND RESERVOIR FILLING

of Soil Mechanics". However, it soon became apparent that the chapter would tend to include such episodes as my discovery of Karl standing on a subway platform wrapped in thought and in a dense cloud of smoke which was billowing from his overcoat pocket, and the subsequent discovery of a large lighted cigar in the pocket. Plans for the chapter on "Life with Father" were dropped.

Nevertheless, it was clear that no one was more amused by such incidents than Karl. This was probably because he realized more clearly than anyone else that these lapses provided the necessary comic relief in his periods of intense mental effort.

His strenuous intellectual activity was always followed—or even interrupted—by wonderful interludes of relaxation. He once explained these alternations by comparing the periods of creativity to a "struggle with nature to rescue a treasure which is surrounded by a belt of impenetrable jungle. After the feat is accomplished," he continued, "the toiler may relax for a while and joyfully contemplate the achievements of others." The achievements of others which so enriched his own life represented a broad spectrum of the arts. They included such diverse creations as a perfectly prepared Scottish salmon, already immortalized in the pages of *Géotechnique*, and specimens of primitive art which he happily retrieved on distant travels as well as the most sophisticated triumphs of advanced cultures.

Beyond this inner world of his own struggles and his own joys, Karl had throughout his mature years a profound concern for the fate of man. At the celebration of his eightieth birthday he spoke to a small group of friends about this concern. "I realized very early," he said, "that the historic events which govern our destinies grow out of the lust for power of a small minority, concealing their true motives behind a screen of hypocrisy. Hence at the age of thirty," he continued, "when I witnessed at close range the holocaust of the First World War, I took it for granted that the suffering people would never again submit to the cruel dictates of their suppressors and that a radical re-organization would ensue which would prevent a recurrence of the abuse of the power of a few. Co-operation on this re-organization appeared to me more important than all the other tasks I could think of at the time."

"Yet at the end of the war," he went on, "when I experienced in Istanbul, also at close range, the after-effects of the war on the mentality and actions of the ruled, I realized that my expectations were utterly unjustified. . . . Hence at that stage, . . . approaching the age of forty, I decided to forget my wish-dreams and to concentrate my efforts on cultivating a small field all my own. This decision I never regretted." Then he spoke of the greatly increased gravity of the threat of war in the nuclear age, and of the brainwashing and deception practiced by the ruling minorities, including those in our own country, to secure the co-operation of their citizens.

"Fortunately," he concluded, "in our country and in England the number of influential men at work to counteract the suicidal tendencies of their governments has increased amazingly since the Second World War, and for the first time in history there is a slight prospect that a major catastrophe can be prevented by the wish and will of its potential victims. Hence joining this movement becomes the duty of all those who are unbiased enough to realize the danger and have any prospect to be heard. This group includes all the thinking and articulate members of the younger generation."

Dr. Casagrande

I now call on our Past President, Professor Skempton, to express thanks to Mrs. Terzaghi.

Dr. A. W. Skempton

Karl Terzaghi was a genius, and like every man of genius he would have carried out the work he had to do whatever the environment in which he found himself. If, however, such a man is fortunate enough to find the perfect environment his life is made incomparably happier and the world is the richer, for his contributions then pour out in abundance and he is able to inspire his contemporaries by a sort of inner radiance which, once encountered, can never be forgotten. Ruth Terzaghi created the perfect intellectual and personal environment for her husband, and we are all indebted to her for doing so.

We are glad that she is with us on this occasion, when we pay honour to the memory of a great man. Let us show our appreciation of a remarkable and charming lady who has graced our Society by her presence here today.

Dr. Casagrande

In closing this session in memory of Karl Terzaghi, I should like to add my personal and heartfelt thanks to my Canadian colleagues for this wonderful and appropriate expression of their high esteem and gratitude. Had he lived, I know that he would have been very happy about this great honour which Canadian engineers have bestowed upon him.

We will now adjourn until two o'clock this afternoon.

# Literature Information Service—A Search for New Ways

## Service d'information des publications—recherche de nouvelles techniques

PRESIDENTIAL ADDRESS DELIVERED 8 SEPTEMBER 1965
ALLOCUTION DU PRÉSIDENT LE 8 SEPTEMBRE 1965

A. CASAGRANDE, *Gordon McKay Professor of Soil Mechanics and Foundation Engineering, Harvard University, Cambridge, Massachusetts, U.S.A.*

SUMMARY

Few problems facing our engineers and scientists are as important and demanding of solution as the need to devise means of coping effectively with the mass of technical literature being published today. There are two equally important but quite different aspects to this problem: (1) information retrieval for intensive literature search, that is how to find everything pertinent to a specific topic; and (2) how to keep up efficiently with one's professional literature, that is how to assist the individual member of a profession in selecting for reading all items that are important to his particular interests without wasting a prohibitive amount of his time perusing a large number of other items that are of little or no value to him. This address deals with the second aspect of the problem, with particular attention to the needs in the field of soil mechanics.

After reviewing literature information services available in other disciplines, it is concluded that an abstract journal would be an essential element in any comprehensive effort. However, in their present forms the abstract journals are deficient because (1) their contents are not classified in sufficient detail, and (2) they contain no ratings of usefulness to assist the reader in finding efficiently all items that are of principal concern to him. To overcome the first deficiency it is proposed that the International Geotechnical Literature Classification, developed by a subcommittee of this Society, be adopted. Concerning the second deficiency it is proposed that all entries be rated according to one of four categories of usefulness, and in addition classified according to their primary concern with engineering practice or with research. Such a rating system could be co-ordinated with the reviews that normally precede acceptance for technical publication. In time the abstract journal should be supplemented by a digest journal that would contain digests of the more important papers rated in the former. The digests would include all essential factual data, including figures, and the text would be written in a new "digest style" designed for both brevity and clarity.

Effective planning and publication of the proposed journals would require international co-operation which could best be realized under the sponsorship of our Society.

SOMMAIRE

Nos ingénieurs et nos scientifiques ont à résoudre peu de problèmes qui soient plus importants que celui de la nécessité de trouver des moyens de faire face à l'amoncellement d'ouvrages techniques publiés actuellement. Ce problème présente deux aspects également importants quoique bien différents: (1) comment trouver l'information en vue de recherches bibliographiques intensives, à savoir, comment trouver tout ce qui a trait à un sujet particulier; et (2) comment se tenir au courant des œuvres techniques de tel ou tel auteur, c'est-à-dire, comment aider un membre quelconque d'une profession dans le choix des communications importantes sans qu'il ait, pour cela, à lire un nombre incalculable d'articles qui n'ont pour lui qu'une valeur relative. Le présent exposé traite du second aspect du problème, tout particulièrement des besoins dans le domaine de la mécanique des sols.

Il nous faut reconnaître, après avoir examiné les services de renseignements bibliographiques disponibles, qu'une revue analytique s'avérerait un outil essentiel et des plus précieux. Toutefois, sous leur forme actuelle, ces revues analytiques sont incomplètes du fait que (1) leur contenu n'est pas indexé suffisamment en détail, et (2) qu'elles n'offrent pas un classement par ordre d'utilité permettant au lecteur de mettre la main sur des textes qui sont pour lui du plus grand intérêt. Pour surmonter cette première difficulté, on propose l'adoption du système international de classification de la bibliographie géotechnique mis au point par un sous-comité de la Société. En ce qui concerne la seconde difficulté, on propose que chaque article reçoive un indice correspondant à une des quatre classes d'utilité, compte tenu également de leur objectif principal, soit l'application technique ou la recherche. Un tel système de classification pourrait être coordonné avec les études qui précèdent habituellement l'agrément de publication. Ultérieurement, la revue analytique serait complétée par une revue d'abrégés qui ne contiendrait que les abrégés des articles les plus importants traités dans la revue analytique. Les abrégés contiendraient des données authentiques, accompagnées d'illustrations, et le texte aurait un style condensé, clair et concis.

Une collaboration internationale serait indispensable à l'efficacité de la préparation et de la publication des revues projetées. Cette collaboration serait réalisée au mieux sous les auspices de notre Association.

> The problem of our time is the control of quantity —of births, energy, knowledge. We cannot assimilate, much less organize it in some meaningful pattern.
> LEWIS MUMFORD

### ON THE AIMS OF OUR SOCIETY IN A RAPIDLY CHANGING WORLD

ANY ORGANIZATION TRYING TO STAY AT THE FOREFRONT of developments, be it an industry, a university, or a professional society like ours, must review periodically and carefully its aims and the means to achieve them. For this purpose, the Secretary of our Society mailed to all National Committees a circular letter in which I discussed some of the problems that should be reviewed by our Executive Committee during its meetings here in Montreal. I requested that a consensus of the membership of each country be sought on each problem and sent to the Secretary in London, who would then make a summary of the replies available to all National Committees prior to this Conference. I am very pleased to report that about 80 per cent of all member countries responded to this request. Our Executive Committee meetings yesterday and this morning proved that such a prior review of the more important questions is of great value. Most delegates were familiar not only with the majority views of the members in their own country, but also with the prevailing views of the members of many other countries.

The most important item which we reviewed was the question of increasing the scope of the activities of our Society. The Executive Committee voted yesterday that the paragraph on the aims of our Society be changed to include the civil engineering applications of geology and of rock, snow, and ice mechanics.

Until now the most important activities of our Society have been the international and regional conferences and the publication of the proceedings of those meetings. Our committee work has been of much less importance. Several National Societies suggested additional tasks that could be performed by committees of our Society. It is, of course, not difficult to propose many tasks that need attention; the difficulty is to find a group of qualified men who are willing to devote the necessary time to a given task. Also, many of the important tasks that are in need of special attention would require substantial financial support which, generally, can be obtained only from governments. Our International Society is not necessarily the proper organization for the solution of most of the problems that we would like to see solved, and a realistic attitude in this respect would in the long run be our best guide.

As you may conclude from these remarks, I am not convinced that our Society should sponsor many subcommittees. However, after long and careful study I have come to the conclusion that there is one vital service which could be made truly effective only by an international effort and which our Society should sponsor for the benefit of its entire membership. I shall call this task Literature Information Service. The purpose of this service would be to assist the members of our profession in keeping up effectively with the literature. I need hardly emphasize that since the last war this problem has grown enormously in magnitude and difficulty in almost all branches of science and technology.

An example will illustrate how inefficient our present methods of publication are in disseminating important information. Not until 1962, when reading a paper by Hantush in the *Geophysical Journal*, did I become aware that the 100-year-old Dupuit formulas, which have always been considered approximate formulas, are actually rigorous solutions. Later I discovered that this had already been proven in 1951 in a Russian paper; that it was proven again by a very elegant approach in a French paper published in 1956 in the *Proceedings* of the French Academy of Sciences; and that a reference to the French paper was contained in a letter to the editor of *Géotechnique*, published in the September, 1957, issue. Normally I do not read letters to editors, but this is one letter I should have read. It was no comfort to me that I had to depend on the 1962 paper by Hantush, who himself had not been aware of these earlier publications; and it was no comfort to me to discover that colleagues who also specialized in groundwater movement were equally ignorant of these publications and equally astonished when I called them to their attention. I would not mind if I could keep myself informed of all really important developments in my areas of specialization with a time lag of not more than two or three years, but a time lag of more than ten years is far too long.

Thus, the purpose of this paper is to examine new ways for increasing many times—if possible by one order of magnitude—the reader's efficiency in keeping up with his professional literature. (Methods for increasing the efficiency of literature retrieval are not within the scope of this paper.)

### REVIEW OF EXISTING LITERATURE INFORMATION SERVICES

Most present efforts to facilitate use of literature are concentrated on *information retrieval*, which is merely one aspect of the many-sided problem of Literature Information Service. There is no doubt that a computer-based retrieval system, using keywords, can quickly furnish hundreds of references for each combination of keywords. The great majority of these references are of no interest, and the task of digging out the few pertinent ones becomes the major problem. When we complain about this task, the librarians reply that the selection of the items that are of particular interest to the individual is not their task; that it is the task of knowledgeable and experienced men in each discipline to grade the professional literature in a meaningful manner. This is precisely the advice we must follow if we want to succeed in our desire to keep up with our literature with much greater efficiency, without wasting as much time as we do now in scanning and reading so many papers that are of little or no value to the particular interests of the individual reader.

From my efforts to learn what is being done about this problem in other professions, I conclude:

1. All face the same problem, but it is already worse in many other disciplines than in soil mechanics.
2. In the judgment of leading men in several disciplines only about 20 per cent of all papers, on average, contain material of real value.
3. In the United States (and probably in other countries) the pressure to "publish or perish," which hangs like a dark cloud over the members of the academic world, is a principal reason for the publication of the large percentage of unim-


NUCLEAR
SCIENCE
ABSTRACTS

Volume 19 Number 13

Abstracts 24226–25819

July 15, 1965

UNITED STATES ATOMIC ENERGY COMMISSION
Division of Technical Information

FIG. 1. Title page, *Nuclear Science Abstracts*, July 15, 1965.

## TABLE OF CONTENTS

**Volume 19, Number 13, July 15, 1965**



FIG. 2. Contents page, *Nuclear Science Abstracts*, July 15, 1965.

portant papers which a busy member of the profession could well afford to omit from his reading list, but which cause him to waste much of his time in searching for items that are of significance.

4. Very good and comprehensive abstract journals are published in all those sciences that are important to defence and space research and development. These are indispensable for information retrieval, and yet they fall far short of what we need to keep up effectively with the large mass of literature.

In an effort to clarify in my own mind the kind of abstract service that would be most helpful for our purposes, I have

**24736** MEASUREMENT OF SAND-DRIFT ON THE SEA-BED BY A WATER-TIGHT G-M DETECTOR. Kentaro Minami (Japan Atomic Energy Research Inst., Tokyo). Radioisotopes (Tokyo), 14: 83-8(Mar. 1965). (In Japanese)
An investigation of sand movement in the sea, using radioactive tracers, has been carried out widely in several parts of the Japanese coast since 1954. A G-M detector or scintillation detector, which is water-tight and sensitive to γ rays, was used in order to trace the radioactive glass-sands deposited at the definite point on the sea bed. By knowing the detection level, it was possible to estimate not only the necessary amount of the radioactive glass-sands to be deposited, but also the detectable limit on the area covered by the dispersing glass-sands on the sea-bed. A bundle of three G-M tubes was used in a normal run to trace the $^{60}$Co labeled glass-sands in investigations at Niigata and Nakaminato harbors. In these measurements, when the background was 85 cpm for 10 minutes counting time, the net count, which was distinguished from the background with 95.4% reliability, was 22 counts for 1 minute. In this case, the minimum detectable amount determined experimentally was $2.5 \times 10^{-4}$ $\mu$C/cm$^2$. (auth)

**24737** EFFECT OF THE PRODUCT OF LOGGING SPEED AND THE TIME CONSTANT OF THE INTEGRATING CIRCUIT ($v \times \tau$) ON RADIOACTIVE WELL-LOGGING CURVES. Shih-ho Yung, Chi-ping Han, and Shao-chi Chu (Inst. of Petroleum, Peking). Ti Ch'iu Wu Li Hsueh Pao, 13: 305-23(Dec. 1964). (In Chinese)
In determining the thickness, depth of a rock layer, and also the true amplitude values of a radioactive logging curve directly from the measured curve, it is always necessary ... trations were low. Data from samples of fossil oolite and coral from the Florida Keys and the Bahamas are summarized. One sample of coral from the basement rock from the Berry Islands, Bahamas gave an age of 200,000 years. Another sample, from one of the terraces, gave an age of 80,000 years. Other dates obtained from the data are given. (M.C.G.)

**24740** RADIOLOGICAL WELL LOGGING USING NEUTRON COLLIMATOR TO REDUCE THE EFFECT OF WELL FLUID ON THE LOG. Allen D. Garrison and Elmer Eisner (to Texaco Inc.). U. S. Patent 3,163,761. Dec. 29, 1964. Filed June 28, 1956.
A well logging device consists of an elongated instrument housing adapted to be raised and lowered through a well bore and including a radiation detector and a source of neutrons. The housing is generally enclosed by a neutron shield having a collimating aperture facing one side. Resilient means are provided for continuously urging the source toward the side of the well bore toward which the neutrons are directed; thus the neutrons directed into the formations traverse a minimum amount of well fluid. The neutron shield is arranged to thermalize fast neutrons from the source and to capture the thermalized neutrons to prevent their emission into the well fluid. (A.C.W.)

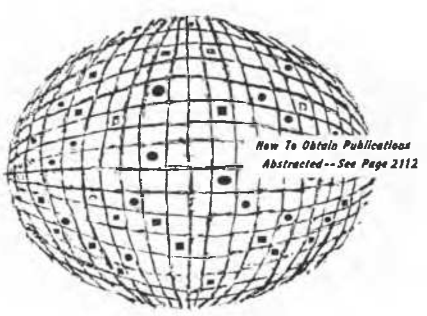
**24741** RADIOACTIVITY BORE HOLE FLUID LOGGING. Fontaine C. Armistead (to Texaco Development Corp.). U. S. Patent 3,164,720. Jan. 5, 1965. Filed Apr. 2, 1962.
A method for measuring the size of a bore hole through an earth formation by radioactivity analysis is patented. Essentially, an apparatus for measuring either the neu-

FIG. 3. Typical item, *Nuclear Science Abstracts*, July, 15, 1965.

ACCESSION NOS. A65-25239 to A65-28460

INTERNATIONAL AEROSPACE ABSTRACTS

AUGUST 1, 1965 VOLUME 5 NUMBER 15

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Scientific and Technical Aerospace Reports

A SEMIMONTHLY ABSTRACT JOURNAL WITH INDEXES

JULY 23, 1965
VOLUME 3 • NUMBER 14
N65-24390—N65-25549

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FIG. 4. Title pages of *International Aerospace Abstracts*, Aug. 1, 1965 (left) and *Scientific and Technical Aerospace Reports*, July 23, 1965 (right).

reviewed a number of abstract journals in various disciplines. The following outstanding examples have many common characteristics. (I will not attempt to describe, or even list, all the abstract services that are of interest to members of our Society, and in particular, I will not include those published in other languages.)

*Nuclear Science Abstracts* is published twice each month by the United States Atomic Energy Commission. As can be seen from the title page (Fig. 1), about 25,000 abstracts of publications, reports, and books had accumulated during the first six months of 1965, or a total of about 50,000 each year. (Accession numbers start with "1" at the beginning of each year.) Publication of this journal requires a full-time staff of 34 professional editors, abstractors, and specialists. In Fig. 2, the Table of Contents shows the division into 12 major subject categories most of which are further subdivided: e.g., physics has 16 subdivisions; geology and mineralogy 4. In Fig. 3 a part of one page is reproduced from this journal. For each abstract item, the title in capital letters is followed by the author's name (with his affiliation in parentheses), where and when the article was published, and finally the abstract which is either the author's, or has been prepared by an abstractor whose initials appear at the end.

Each volume includes author and subject indices. In addition, every third month a thick volume is published which contains comprehensive author and subject indices for the preceding six volumes of the journal. Such a subject index looks like a thesaurus of keywords. Although no keywords are included with the abstracts, preparation of a comprehensive subject index requires a working list of representative keywords for each item.

*International Aerospace Abstracts*, published by the American Institute of Aeronautics and Astronautics, and *Scientific and Technical Aerospace Reports*, published by the National Aeronautics and Space Administration (NASA), form companion volumes; the former contains abstracts of publications and the latter abstracts of reports. Both are published twice a month. As seen from the accession numbers on the title pages in Fig. 4, about 25,000 items are abstracted in each journal in six months, for a combined total of about 100,000 abstracts per year. Both journals use the same 34 subject categories.

A sample item from *Aerospace Abstracts* is reproduced in Fig. 5 (accession Number 25350 on the *Mechanics of Incremental Deformations* by M. A. Biot). After title, author, publisher, year, number of pages, and price, there follows a reference to the sponsor of this work. The informative abstract was prepared by the abstractor, identified by his initials. No keywords are listed. Each abstract volume has author and subject indices (Figs. 6 and 7). Every three months a comprehensive quarterly index is published for each of these journals.

The *Technical Abstract Bulletin* shown in Fig. 8 is published twice each month by the Defense Documentation Center. The contents are arranged in 38 major divisions and include reports on government-sponsored research only. Fig. 9 shows that each abstract is preceded by a list of "Descriptors" (keywords). This example, the author's own abstract of a report entitled *Influence Diagrams for Stresses and Displacements in a Two-Layer Pavement System for Airfields*, lists 16 keywords of which "Landing Fields" and

**SUBJECT INDEX**

and axial compression A65-25979 15-32
**ELASTIC SYSTEM**
Book on oscillations of elastic systems in aircraft structures and methods of calculating natural frequencies as well as damping them A65-26330 15-32
**ELASTIC WAVE**
Elastic vibration equation for rod in moving coordinate system A65-25597 15-32
Propagation of waves generated by axisymmetric pressure applied at circular hole in anisotropic plate A65-25598 15-32
Energy transport mechanism by magnetic and magnetoelastic wave propagation A65-25687 15-26
Growth of plane discontinuities propagating into homogeneously deformed elastic material with corrections and additional results A65-25899 15-32
Numerical solution of partial differential equation by method of characteristics for transient vibrational response of semiinfinite circular rod A65-26119 15-32
**ELASTICITY**
Doubly-periodic plane problem in elasticity for grid formed by boundaries of identical circular holes A65-26079 15-32
Book on deformation and motion of elastic and plastic solids including variational calculus and tensor analysis A65-26357 15-32
Elasticity theory with mixed boundary conditions for elastic layer and semispace discussed, using dual integral equations solution A65-26363 15-32
**ELASTOHYDRODYNAMICS**
Elastohydrodynamic analog to study upstream inclined waves in two-dimensional MGD flow for aligned magnetic and velocity fields and perfectly compressible fluid A65-25311 15-28
**ELASTOPLASTICITY**
Similarity criteria for elastoplastic body under dynamic loading from equilibrium equation in elasticity theory A65-26240 15-32
Strain theory solution of quasi-static thermoplasticity problem for elastoplastic body with prescribed temperature at spherical cavity surface A65-26365 15-32

FIG. 6. Sample from Subject Index, *International Aerospace Abstracts*, Aug. 1, 1965.

**A65-25350**
MECHANICS OF INCREMENTAL DEFORMATIONS.
M. A. Biot.
New York, John Wiley and Sons, Inc., 1965. 504 p.
$17.50.
Research sponsored by the Shell Development Co.; Contracts No. AF 49(638)-266; No. AF 49(638)-837; No. AF 49(638)-1329.

This book presents the theory of elasticity and viscoelasticity of initially stressed solids and fluids, including thermodynamic foundations and applications to finite strain. The work is characterized by the use of Cartesian concepts and of elementary mathematical methods that do not require a knowledge of the tensor calculus or other more specialized techniques. The explicit introduction of a local rotation field in the three-dimensional equations leads to a theory which separates the physics from the geometry and is equally valid for elastic and nonelastic materials, using either rectangular or curvilinear coordinates. The methods have permitted new insights and a unified outlook in such diversified areas as rubber elasticity, internal gravity waves in a fluid, and tectonic folding in geodynamics. The theory provides rigorous and completely general equations governing the dynamics and stability of solids and fluids under initial stress in the context of small perturbations. Nonlinear theories of deformation and applications to problems of finite strain are obtained by the extension of the concept of incremental deformation in a medium under initial stress. Advantages of the simplified approach over the conventional use of tensor analysis are discussed for problems of plates and rods, isotropic media, and rubber elasticity. The general analysis of stability in the presence of hydrostatic stress clarifies some fundamental paradoxes. Other topics discussed include: elastic stability of anisotropic incompressible media; dynamics of continuous elastic media under initial stress (including a study of vibrations and gravitational-, acoustic-, and Rayleigh-wave propagation in such media); and mechanics and thermodynamics of viscoelasticity with initial stress. Nonlinear theories and finite strain are discussed in detail in an appendix, and author and subject indices are presented. D.H.

FIG. 5. Typical item, *International Aerospace Abstracts*, Aug. 1, 1965, pp. 15–32.

**PERSONAL AUTHOR INDEX**

**BEZIRGANIAN, P. A.**
Reflected X-ray integral intensity dependence on duration of coherent emission and width of diffraction peak A65-25655 15-16
**BEZRUKIKH, V. V.**
Electron and proton fluxes at geocentric distance of 7 Earth-radii measured by charged particle traps on interplanetary station Zond-2 A65-25405 15-29
Elektron II satellite charged particle flux measurements at distances up to 11.6 Earth-radii, using three-electrode charged particle trap A65-25409 15-29
**BHATTACHARJI, S.**
Scaled suspensions forced through pipes by fluid pistons for investigation of non-Newtonian behavior of geological processes A65-25669 15-12
**BIBRING, H.**
Microfractographic study of bcc niobium embrittlement under high temperature dynamic vacuum conditions due to residual interstitial oxygen and nitrogen A65-26335 15-17
**BIDENKO, N. A.**
Observed differential shifts of solar Fraunhofer lines without consideration of line broadening and Stark effect A65-25692 15-30
**BIJLAARD, P. P.**
Critical buckling stress determination for sandwich panels subjected to nonuniformly distributed longitudinal loads at ends A65-26017 15-32
**BIOT, M. A.**
Elasticity and viscoelasticity incremental deformation mechanics of initially stressed solids and fluids, including thermodynamic applications to finite strain A65-25350 15-32

FIG. 7. Sample from Personal Author Index, *International Aerospace Abstracts*, Aug. 1, 1965.

"Stresses in Pavements" are starred to indicate the principal topics.

*Bibliography on Snow, Ice and Permafrost* is an abstract journal which has been published at irregular intervals since 1951 by the United States Cold Regions Research & Engineering Laboratory (CRREL) in Hanover, New Hampshire. In Fig. 10 a typical item is reproduced from the June, 1965, issue containing 1,000 abstracts (Nos. SIP 22001 to SIP 23000). The details of presentation are similar to those in the abstract journals discussed above, except that the Universal Decimal Classification number for each item is also given. No division of the contents into major categories is used; on the other hand, this journal also contains, in addition to an author index and a comprehensive subject index, a very useful geographic index of which a page is reproduced in Fig. 11.

All the abstract journals described above have in common direct reproduction from typewritten sheets by some photo-offset process, ensuring a combination of maximum speed and minimum cost of publication. Almost all use consecutive accession numbers that start at the beginning of each year. The title, in capital letters, is followed by the author's name and other pertinent information. The abstract is written either by an abstractor, or by the author, or "author's modified". Only one of these journals includes a list of keywords with each item. All journals contain author and subject indices, and one has a geographic index as well. Separate, comprehensive index volumes are published periodically for most of these journals.

When talking to engineers and scientists who use these abstract journals, I heard the frequent complaint that the subject matter is not broken down into a sufficient number of divisions; that they have to waste too much time finding those items that are important to their particular specialty. However, they all agreed that these abstract journals are an indispensable aid in keeping up with their professional literature.

After the verbal presentation of this paper, my attention was called to a new effort by the *Engineering Index* to provide broader, deeper, and faster abstracting and indexing services in all the engineering disciplines. At present only a pilot study has been initiated in the plastics field, and the first monthly abstract bulletin appeared in September, 1965. These abstracts are organized in 23 categories, that is, a much more detailed breakdown than that used in the other abstract journals described. The explanatory comments state

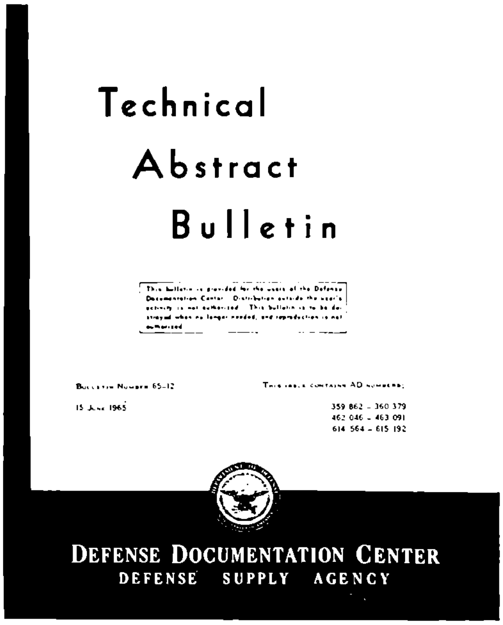


FIG. 8. Title page, *Technical Abstract Bulletin*, June 15, 1965.

AD-614 693 Div. 13, 33
CFSTI Prices: HC$3.00 MF$0.75

Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
INFLUENCE DIAGRAMS FOR STRESSES AND DISPLACEMENTS IN A TWO-LAYER PAVEMENT SYSTEM FOR AIRFIELDS. PART I.
Technical rept. no. 1, 15 Apr 57-33 Sep 59, by Donald M. Burmister. Jan 65, 72p
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Unclassified report

Descriptors: (*Landing fields, Pavements), (*Pavements, Stresses), Shear stresses, Deflections, Loading (Mechanics), Reinforcing materials, Reinforced concrete, Asphalt, Laminates, Construction, Design, Deformation, Elasticity, Partial differential equations, Composite materials, Graphics.

Part I presents Influence Diagrams for Stresses and Deflections in Two-Layer Pavement Systems for Airfields, which are intended to provide the essential background and bases for understanding the character and effectiveness of layered system reinforcing action. Influence diagrams of vertical stresses and shear stresses at intervals of depth in layered systems and deflections at the surface are presented covering suitable ranges of the basic two-layer system parameters. The significance of these influence diagrams are discussed with regard to the character and effectiveness of two layer system reinforcing and to their interacting influences on pavement system performances under wheel loads. The major objectives are to develop a 'feeling', intuition, and judgment regarding the nature of vertical stress, shear stress, deflection, and shear deformation phenomena and performances, as essential bases for developing relationships and criteria for design of multilayer pavement systems. (Author)

FIG. 9. Typical item, *Technical Abstract Bulletin*, June, 15, 1965, p. 53.

SIP 22921 624.131:551.345

Broms, Bengt B. and Leslie Y. C. Yao
SHEAR STRENGTH OF A SOIL AFTER FREEZING AND THAWING. Proc. Amer. Soc. Civil Engrs. J. Soil Mechanics and Foundations Div. 90(SM4):1-25 incl. tables, graphs, diagr., appendix, July 1964, Pt. 1. 16 refs.
DLC, TA710.A495

The shearing strength and deformation characteristics of a silty clay that has been subjected to freezing and thawing has been investigated. The soil was compacted in a rigid steel cylinder at the optimum moisture content to its standard Proctor maximum dry density. The soil was frozen under open or closed drainage conditions at freezing rates of 3.0 or 0.5 in/day and at a surcharge load corresponding to 6.0 or 24.0 in. of soil. After coring, the frozen soil was allowed to thaw in a triaxial cell under drained or undrained conditions at a confining pressure of 21, 33, 7.11, or 1.78 psi. Then the thawed soil specimens were tested to failure under undrained conditions. (Author's abstract)

FIG. 10. Typical abstract, *Snow, Ice and Permafrost*, June, 1965.

| | | | |
|---|---|---|---|
| Sweden (Continued) | | | |
| Lake ice | | | 22917 |
| Limnology | | | 22917 |
| Polygons | 22329 | 22858 | 22913 |
| Snow erosion | | | 22858 |
| Soils--Frost action effects | 22857 | 22858 | 22913 |
| Solifluction | | 22857 | 22858 |
| Switzerland | | | |
| Excavation techniques | | | 22073 |
| Glaciers | 22713 | 22966 | 22967 |
| | | | 22968 |
| Glaciers--Ablation | | | 22971 |
| Glaciers--Mass balance | 22966 | 22967 | 22969 |
| Glaciers--Velocity | 22046 | 22073 | 22966 |
| | | 22969 | 22970 |
| Meteorology | | | 22713 |
| Tibet | | | |
| Glaciers | | | 22770 |
| Glaciers--Formation | | | 22611 |
| Snow cover--Thermal properties | | | 22611 |
| Tien Shan | | | |
| Avalanches | | | 22844 |
| Glaciers--Melting | | | 22447 |
| Snow melt and run-off | | | 22447 |
| Union of Soviet Socialist Republics | | | |
| Air temperature | | | 22430 |
| Antarctic regions--Exploration | | | 22652 |
| Avalanches | | | 23000 |
| Climatology | | | 22433 |
| Construction | 22754 | 22782 | 22837 |
| Construction--Permafrost regions | 22438 | 22660 | 22665 |
| | | 22834 | 22862 |
| Dams--Freezing | | | 22446 |
| Excavating machinery | | 22748 | 22862 |
| Frost action | 22089 | 22846 | 22848 |
| Foundation construction | | | 22089 |
| Foundation construction--Permafrost regions | | 22438 | 22990 |
| Frozen ground | | | 22867 |
| Geography | | | 22435 |
| Geophysical exploration | | | 22252 |
| Glacial geology | 22836 | 22999 | 23000 |
| Glaciation | 22900 | 22901 | 22999 |
| Glaciers | | 22202 | 22667 |
| Glaciology | | 22284 | 22659 |
| Ground ice | | | 22383 |
| Hail--Destructive effects | | | 22432 |
| Hail--Distribution | | | 22432 |
| Hail--Estimating methods | | | 22432 |
| Hailstorms | | | 22432 |
| Ice | | | 22906 |
| Ice breaking | 22311 | 22317 | 22361 |
| | | 22748 | 22782 |
| Ice formation | | | 22435 |
| Lake Ice | | | 22446 |
| Lake ice--Estimating methods | | | 22446 |
| Lake ice--Formation | | 22319 | 22778 |
| Lake ice--Melting | | | 22319 |
| Mining--Permafrost regions | | | 22784 |
| Permafrost | 22010 | 22252 | 22328 |
| | | 22664 | 22846 |
| Permafrost--Distribution | 22433 | 22848 | 22907 |
| Permafrost research | | | 22660 |
| Permafrost—Thawing | | | 22433 |
| Power lines--Meteorological effects | | | 22435 |

| | | | |
|---|---|---|---|
| USSR (Continued) | | | |
| Power plants | | | 22655 |
| River ice--Formation | 22316 | 22319 | 22655 |
| | | | 22782 |
| River ice--Melting | | 22319 | 22655 |
| Sleds | | | 22574 |
| Snow cover | 22202 | 22249 | 22445 |
| Snow cover--Distribution | | 22444 | 22445 |
| Snow loads | | | 22781 |
| Snow melt and run-off | | | 22647 |
| Snow precipitation | | | 22246 |
| Snow removal--Railways | | | 22961 |
| Snow removal--Roads | | | 22661 |
| Snow removal equipment | | | 22661 |
| Snow surveys | | | 22292 |
| Snow vehicles | | 22574 | 22748 |
| Snowdrifts | | | 22961 |
| Soil temperatures | | | 22664 |
| Soils | | | 22328 |
| Soils--Frost action effects | | 22846 | 22848 |
| Surveying methods | 22201 | 22292 | 22394 |
| | 22444 | 22445 | 22654 |
| Transportation equipment | | 22748 | 22821 |
| Utilities--Permafrost regions | | | 22438 |
| United States | | | |
| Air temperature | 22332 | 22698 | 22702 |
| | | | 22717 |
| Climatology | 22697 | 22698 | 22699 |
| | 22700 | 22701 | 22702 |
| | | | 22818 |
| Ecology | | | 22942 |
| Flora--Frost action effects | | | 22309 |
| Frost action | | 22859 | 22874 |
| Glacial geology | 22264 | 22642 | 22827 |
| Glacial lakes | | | 22642 |
| Glaciation | | | 22827 |
| Hail--Distribution | 22261 | 22820 | 22925 |
| Ice wedges | | | 22859 |
| Oceanography--Antarctic regions | | | 22739 |
| Paleoclimatology | | | 22874 |
| Permafrost | | | 22859 |
| Polygons | 22309 | 22859 | 22874 |
| Snow cover | | 22309 | 22466 |
| Snow precipitation | 22697 | 22699 | 22700 |
| | 22701 | 22702 | 22717 |
| Soils--Frost action effects | 22309 | 22859 | 22874 |
| Solifluction | | | 22309 |
| Temperature | | | 22384 |
| Ural Mountains | | | |
| Glaciers | | | 22201 |
| Victoria Land | | | |
| Glacial geology | 22349 | 22398 | 22421 |
| | | | 22629 |
| Glaciation | | 22421 | 22629 |
| Glaciers | | | 22421 |
| Glaciology | 22527 | 22534 | 22536 |
| Lakes | 22352 | 22355 | 22425 |
| Polygons | | | 22349 |
| Snow--Pit studies | | 22527 | 22534 |
| Washington | | | |
| Glaciers--Mass balance | | | 22414 |
| Glaciers--Thickness | | | 22414 |
| Weddell Sea | | | |
| Oceanography | | 22723 | 22724 |
| Sea ice | | 22724 | 22795 |
| Sea water--Temperature | | | 22723 |

FIG. 11. Example from Geographic Index, *Snow, Ice and Permafrost*, June, 1965, p. 261.

that ". . . since it is impractical to list abstracts more than once in a given bulletin, the abstracts under any given category may not include all the abstracts dealing with that subject." In Fig. 12 a typical abstract from this first bulletin is reproduced, for which the document number contains the following information:

| | |
|---|---|
| Year | 1965 |
| Issue | 9 = September |
| Section | B = code for the discipline "Plastics" |
| Category | 22 = General Product Design and Applications |
| Accession number | = 75297 |

An excerpt from the subject index, with headings in alphabetical order, is reproduced in Fig. 13. The "notation of content" may be the original title or a version more indicative of the contents of the article. This plastics abstract journal is believed to be the first computer-processed index which makes full use of the *Thesaurus of Engineering Terms*, published by E.J.C. However, the keywords used are not included with the abstract.

NEW WAYS TO IMPROVE LITERATURE INFORMATION SERVICES

In a nutshell, we would all like to minimize the time that we now waste on scanning and reading papers which offer little or nothing of value; and in addition we would like to ensure that we will not overlook any new information that would be of particular value to us, no matter where and in what language it is published.

An international journal for soil mechanics abstracts or, on a broader scale, for geotechnical abstracts, similar to the abstract journals which I have described, would certainly form the necessary backbone for a comprehensive solution. However, in my judgment such journals are lacking in two important respects: (1) the literature is not classified in sufficient detail to enable the reader to concentrate on those abstracts that are of principal interest to him, or is not classified at all; and (2) there is a conspicuous absence of any rating of the usefulness of each item. In fact, most abstracts are no more than a detailed table of contents presented in sentence form.

B22-75297
Bodenverbesserung mit Kunstharzschaumstoffen. H.BAUMANN. Kunststoffe v 55 n 5 May 1965 p 389-90. Soil improvements with plastic foams; description of experience gained in rendering arid soils usable by plastic foams; Styromull polystyrene foam is suitable for breaking up, aerating and draining heavy soils without itself absorbing $H_2O$; Plastsoil urea-formaldehyde foam stores water until needed by plants, and can replace ordinary soil for growth of plants by plastophonics process. Summary of paper before 11th German Plastics Conference, Luebeck-Travemuende, May 4-6 1965.

FIG. 12. Typical item from Plastics section, *Engineering Index*, September, 1965.

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SOIL/MATERIAL
   SOIL IMPROVEMENT WITH PLASTIC FOAMS
                                        65-09  B22-75297
SPACECRAFT
   TESTING EQUIPMENT FOR MEASURING MECHANICAL
     PROPERTIES OF GLASS-REINFORCED EPOXY AT LOW
     TEMPERATURES                       65-09  B02-55273
   PROPERTIES TESTING OF REINFORCED PLASTIC LAMINATES
     THROUGH 20 K RANGE                 65-09  B17-70471
   CONSUMER AND INDUSTRIAL APPLICATIONS OF NYLON FILMS
                                        65-09  B18-55266
SPACECRAFT, MATERIALS
   NEW AROMATIC-HETEROCYCLIC POLYMERS FOR AEROSPACE
     INDUSTRY                           65-C9  B02-55241
SPECIFIC HEAT
   SPECIFIC HEAT OF SYNTHETIC HIGH POLYMERS--12.
     ATACTIC AND ISOTACTIC POLYSTYRENE
                                        65-09  B02-50536
SPECTROSCOPY
   SEE  INFRARED SPECTROSCOPY
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FIG. 13. Sample from Subject Index of Plastics section, *Engineering Index*, September, 1965.

At the moment every reader has to judge from the contents of the abstract whether a particular item is worth detailed study. But not until he has read the entire paper carefully will he have formed a definite opinion concerning its usefulness. Thus he will have rated the paper. This effort of rating is repeated by every reader; yet the compound judgment of many knowledgeable readers is lost. Furthermore, if a reader has little time for literature study, or if he is not a specialist on a certain topic, he may easily overlook important information, or in scanning misjudge a paper's usefulness. Why not collect the ratings of several readers who are particularly experienced in the subject of a paper and include this information with the abstract, using a simple rating system? If ratings by a number of reviewers were included with each abstract, the reader would be substantially protected against a single biased judgment.

I foresee that even the great increase in the efficiency with which we would be able to keep up with our literature if we had an abstract journal available that included ratings and was based on an appropriate literature classification would fall far short of what we will need in the not too distant future to cope with the flood of papers and reports. Eventually we will have to devise additional means to greatly increase the speed with which we can absorb new information. I believe that this could be accomplished by informative digests written in a kind of telegram style—a new style developed to achieve maximum brevity and clarity. I envision that such digests would be prepared for the more important items of literature only, and that they would be published in a separate journal. The combination of (1) an abstract journal utilizing an appropriate literature classification and a rating of papers, and (2) a digest journal, could in my estimation increase about tenfold the reader's capacity for finding and absorbing all the useful information in his professional literature. Let me now examine step-by-step to what extent such an ideal solution could be carried out.

*Use of Geotechnical Literature Classification*

I propose that the subject categories in a geotechnical abstract journal be based on the Geotechnical Literature Classification which our subcommittee has been developing for many years and which is now undergoing a final review. With modifications that were tentatively adopted during the Montreal Conference, this classification consists of the following twelve Principal Groups.

*A General*—includes textbooks, handbooks, periodicals, nomenclature, professional institutes and firms, professional societies and meetings, etc.

*B Geology*—as related to soil and rock mechanics, groundwater, permafrost, etc.

*C Site Investigations*—includes equipment and techniques of exploration, sampling, field testing (except tests for engineering properties), and field observations.

*D Soil Properties and Testing*—includes identification and classification, engineering properties, all laboratory testing (including apparatus and techniques), and those field tests which measure engineering properties.

*E Theoretical Soil Mechanics*—includes settlement analysis, bearing capacity, earth pressure, stability, seepage and groundwater movement, dynamic problems, frost action, etc.

*G Rock Properties and Testing*

*H Theoretical Rock Mechanics*

*K Design*—includes foundations, retaining walls, sheeting and bracing, cuts, cofferdams, embankments and dams, waterfront structures, railways, roads, airfields, and underground structures.

*L Construction*—includes construction materials, methods, and equipment used in foundation and earthwork engineering.

*P Projects*—includes detailed information on specific projects; complete synthesis of investigations, design, and construction; data on performance; etc. Divided according to principal types of structures such as buildings, earth- and rockfill dams, etc.

*Q Related Disciplines*—includes literature from related disciplines (highway engineering, sanitary engineering, etc.). A practitioner would include here those fields that have a special bearing on his own activity.

*S Snow and Ice Mechanics*

In addition to these Principal Groups, the tentative Geotechnical Literature Classification contains three Identification Groups: Soil types, Rock types, Regions and countries. In an abstract journal these groups might serve for index purposes.

Each of the Principal Groups is broken down into main divisions as for example:

*E Theoretical Soil Mechanics*

EA General
EB Stresses in ground caused by gravity and applied loads
EC Deformation and settlement
ED Bearing capacity of soils
EE Bearing capacity of piles
EF Earth pressure
EG Stability of slopes
EH Seepage, hydraulic problems, and erosion
EI Soil dynamics
EK Frost action and heat transfer
EL Trafficability

There is further breakdown into subdivisions:

*EF Earth Pressure*

EF1 Basic principles and theories
EF2 Retaining walls
EF3 Temporary supports
EF4 Free and anchored sheet-pile walls
EF5 Double wall and cellular cofferdams
EF6 Tunnels and shafts
EF7 Conduits
EF8 Silos

Inherently the proposed classification is very flexible. The great majority of individuals and small organizations would find it entirely sufficient to use only the principal groups and the main divisions for their libraries and card indices. For intense specialization in a given area the corresponding subdivisions would be used. At the other extreme, for a comprehensive literature retrieval service one would make full use of the keywords (descriptors). Our subcommittee has already prepared a list of about 1300 keywords. Eventually an alphabetical listing in the form of a thesaurus will be prepared. Thus, this entire classification system would consist of first-, second-, and third-order divisions and a thesaurus of keywords.

When using this literature classification system for subject categories in an abstract journal, the question of whether to use only the 12 Principal Groups, or the Main Divisions of each group as well, will have to be studied further. Certainly, one would not go so far as to use the subdivisions. The question of whether numbers or letters would be more practicable for identifying the Principal Groups and Main Divisions should also be studied. I have consulted both experts in the computer field and librarians and they all assure me that either numbers or letters can be used with equal ease. Professor Oettinger, Director of the Harvard Computation Laboratory, in answer to my question, wrote as follows: "There is no reason whatever why numbers should be preferred to letters for machine processing purposes since keypunching and sorting, etc., are just as easy in either case. I quite agree with you that the double letter scheme is to be preferred since it is more economical certainly and, as you point out, possibly more mnemonic than the four-digit combination." Should we decide to use only the Principal Groups and Main Divisions in the abstract journal, we would need either four-digit numbers or two letters as used in the preceding presentation of the main divisions for Group E. The letter combinations would be remembered much more easily.

*Use of Keywords in a Soil Mechanics Abstract Journal*

Although their principal use is for library retrieval, I envision the following procedure for using keywords to decide on the subject category in which a given item should be listed: the author or the abstractor would select one, or two, but *normally not more than three principal keywords*, and list them in order of importance. They would be printed at the head of the list of keywords and identified more prominently than the other keywords (e.g. by caps, underscoring, or italics). The first of these principal keywords would determine the subject category in which the abstract would appear, and in addition would control the identifying number. The title, author, and identifying number, but not the abstract, would also be included under the subject categories corresponding to the other principal keywords. Thus most items would be listed in more than one subject category, so that the reader would usually be alerted to all abstracts that might be of interest to him, even if they were included in a category which he normally would not peruse. To ensure that the reader would immediately recognize such a cross-reference, the identifying number would not appear in its normal place, but in parentheses after the title.

The identifying number of each abstract could be made up so as to (1) indicate the issue of the abstract journal, e.g. 653 for issue No. 3 in 1965, (2) identify the subject category, e.g. EE for "Bearing Capacity of Piles", and, if more than one item of literature is to be listed in that category, (3) add a consecutive item number, e.g. 5. The complete identifying number thus would be 653-EE5. Such a number would have the advantage of informing the reader where the abstract is to be found and its general topic. In contrast to the usual consecutive accession numbers, this proposed designation would convey to the reader all essential information and thereby also make the use of an author index more efficient.

*Rating of Usefulness of Papers*

To facilitate rating of items with respect to their usefulness to the reader, I would divide all papers into two groups:

papers concerned primarily with *engineering practice* would be identified with the letter E; and those concerned primarily with *research* with the letter R. I would propose four ratings:

*Rating A*—judged to be *immediately useful to a large number of readers.*

*Rating B*—judged to be *immediately useful to a relatively small number of readers*, e.g., highly specialized topics; regional soil studies; case histories; or papers containing important observational data.

*Rating C*—judged to contain *little or no immediately useful material, but of potential future value.* Useful results may accrue from further investigations, e.g. a paper containing an early development stage for a new theory, or a progress report on a construction or research project.

*Rating D*—judged to be of *no value to the great majority of readers.* This would include papers on subjects that have been covered equally well or better in earlier publications, or containing highly speculative or doubtful material.

To guard against errors in judgment, independent ratings from at least two, and preferably three or more reviewers should be obtained before the ratings are published. The following examples will illustrate such ratings.

Example 1: E-AAB; R-BC. For engineering practice, two reviewers rated this item as "A", and one as "B", that is, this item is rated highly. For research it is given a lower rating by two reviewers, whereas the third did not rate it.

Example 2: R-CCD. This item is rated only with respect to research. The research worker would realize from the ratings that two colleagues judged it to contain material which might become useful when more work had been accomplished, while the third reviewer did not recommend it for detailed study.

Inclusion of such ratings in the abstract journal would fulfil the following needs:

1. They would convey to the reader at a glance valuable information which would guide him effectively in the selection of items for study.

2. By also including the ratings in the subject index, literature search would be made more effective.

Once the use of such ratings becomes well established, I envision that they would become a powerful motivating force for controlling the large number of unnecessary publications, and the unnecessary length of worthwhile publications. The ratings would also assist university administrators in correcting their over-emphasis on quantity of publications when comparing the qualifications of professional men. The threat of "publish or perish," under which the younger faculty members now labour, would thus be substantially modified, and excellence rather than quantity of publications would be emphasized. In the long run such indirect benefits may become as great as the direct benefit which the user of an abstract journal would derive from the ratings.

The proposed rating system would work only if we were able to find enough competent reviewers who would be willing to accept the assignment of rating papers. One source of raters would be the reviewers who had judged a paper before it was accepted for publication. Surely by the time such a reviewer has completed a careful reading of the paper and has written his comments to the editor, he would be able to decide quickly on an appropriate rating in the proposed system. However, it would be desirable that no more than two of these reviewers be asked to contribute a rating, and that additional ratings be obtained from specialists who had not reviewed the paper prior to publication. I believe that it should not be difficult to convince many specialists who normally do not accept review assignments to contribute ratings of papers in their own specialty. They would realize that the small effort expended in reporting their ratings would constitute a valuable service to their profession, and that in exchange they would benefit from the cumulative knowledge of many other specialists. There is an enormous difference between the time required to write a meaningful review of a paper, and that required merely to express one's opinion in the form of a simple rating.

In case the editor should have difficulty in obtaining a sufficient number of ratings from specialists, he could also include ratings from generally knowledgeable and experienced members of the profession. I anticipate that such a man might hesitate to contribute a rating even though he had carefully studied the item and formed an opinion. By permitting him to use small letters for his rating (e.g. E-a; R-b), he could be persuaded to contribute his rating.

I am convinced that a well-established abstract journal would encounter no difficulties in obtaining a sufficient number of ratings, at least for all worthwhile items of literature.

### COMMENTS ON USE OF ABSTRACT JOURNAL

The procedure for using the abstract journal would depend on the principal interests of the individual user. For example, he may elect to read all abstracts in certain divisions, and only the well-rated abstracts in the other divisions. Using symbols of his own choosing (different colours for different users of the same copy of the journal), he would mark some items "must read", others "scan", and still others "future reference". These symbols, together with any marginal notes he may add after he has reviewed an article and identification for locating the article in his personal library, would serve well for future reference. If he has sufficient secretarial help, the marked items, marginal notes, the abstract journal's accession number, and the identifying number to personal library would be transferred to index cards and filed in accordance with any subdivisions or main divisions of the Geotechnical Literature Classification that the user elects for his purposes. The accession number on an index card would enable him to locate quickly the abstract in the abstract journal. He may also find it desirable to prepare a card index by authors.

By virtue of the breakdown of the material in accordance with the Geotechnical Classification, and of the ratings, the abstract journal could easily be used also for literature search on a specific topic. The personal symbols and marginal notes might prove useful as supplementary aids to the searcher. For all these reasons, and also to permit others to use the journal (or to inherit it), I consider it very important that the abstract journals be kept together for permanent reference, and be treated like valuable books.

### PROPOSAL FOR A DIGEST JOURNAL

Properly classified and rated abstracts would greatly increase our ability to select all pertinent items for reading. But I foresee that within a few years even such an abstract journal would no longer be sufficient for a busy man to cope effectively with the literature explosion. Unless we experiment with radically new time-saving devices which will increase the rate at which we can absorb new information, our fate will be to drown intellectually in the literary effluent of our affluent society!

It is generally recognized that the text of most papers could be presented with greater clarity in much less space. However, such concise writing requires much more effort than most writers are willing to expend, and usually much more skill than most writers possess. Thus, we cannot hope to achieve brevity of presentation by persuading the authors to adopt a new style of writing. However, I consider it feasible to prepare digests of papers in an abbreviated writing style.

In a primitive form abbreviated styles of writing are, of course, extensively used: the student who takes notes during lectures; inter-office memos; telegrams; diaries; the modern "newsletter" for which I believe the prototype is the *Kiplinger Letter* (a weekly Washington newsletter written particularly for industrial and business leaders).

I propose in all seriousness that we start experimenting with a new "digest" style of writing in which all unnecessary words are omitted, a style which combines the utmost brevity with clarity, such as that in a carefully worded telegram. Principles of writing in digest style would have to be developed by trial and systematic study. The sentence structure would have to be simple and short. Each paragraph might start with a few underscored "paragraph keywords" followed immediately by a brief statement of the essential information. To the maximum extent possible words would be replaced by appropriate abbreviations, figures, and other graphical presentations.

The advice of experts in machine translation should be sought for developing this digest style. Such co-operation might lead to a style that would make machine translation practicable, and which in turn could lead the way to effective bridging of the language barrier, and to publication of a digest journal in several languages.

In addition to skilful use of the digest style, the digest writer would require competent guidance to ensure that he will extract all significant information from the original. The reviewers who furnish the ratings for the abstract journal would be the best qualified to furnish the editor of the digest journal with a marked-up copy of the original, in which they have designated the significant parts that should be digested and the figures that should be included. The reviewers, while thus guiding the digest writers, must keep in mind that such digests are primarily intended to conserve the time of the busy and knowledgeable members of their profession who are trying to keep up with important contributions in the minimum of time. Therefore, all parts of a paper that are primarily intended for educating the non-specialized or less experienced readers, should be omitted from the digest, and only what is really new and significant should be summarized. The ratings of the papers in the abstract journal would furnish guidance for the selection of items that are worth the effort of condensation into a digest. I estimate that the number of words needed in a meaningful digest would be on average only about 20 per cent of the original paper. Other advantages that would accrue from such brevity and simplicity of style are: (1) easier recall of pertinent information; (2) facilitation of translation.

I believe that we should not make a special effort to produce and publish a digest too soon after publication of a paper. A time lag of one year, and up to two years, would not be excessive. It often takes that much time to develop an objective judgment of a new idea. The digest journal should cover not only current literature but also the most important literature that was published long before the start of the journal. For selection of older and well-known publications that deserve to be included in the digest journal, guidance would hardly be needed. I envision that, with increasing coverage of all important literature, the digest journal would also serve as excellent text material for graduate students.

How should we go about developing this new digest style, and training men in the art of writing such digests? In my teaching experience I have observed that foreign students with limited knowledge of English will often use their meagre vocabulary in examinations to write telegram-style answers which are short and clear (even if the answer is wrong). On the other hand, the student who writes in his native English may waste his time with lengthy sentences which lack clarity. Once I asked a doctoral candidate, who had difficulty in expressing his thoughts clearly while writing his thesis, to prepare for me telegram-style abstracts of several papers. I was pleasantly surprised when I read these abstracts. They were highly condensed and perfectly clear. As a result of such experiences I concluded that the deliberate use of a simplified style of writing actually improves clarity of expression for most writers because it frees them from inhibitions about their writing skill, which are reflected in involved sentences and a generally lengthy and unclear style.

As an experiment I propose that professors of soil mechanics encourage among their graduate students a competition in the writing of a digest of an important paper, not necessarily a recent one. The professor would divide the students into groups of three or more, and let each group prepare a digest of the same paper. Then he would discuss the pros and cons of various forms of abbreviated writing that the students had tried. All participants in this effort would gradually develop a feeling, perhaps even a set of tentative guiding rules, for the writing of such digests. Eventually, the professor would amalgamate the best of these efforts and submit the digest to the editor of the digest journal. If every advanced degree candidate in soil mechanics were required to co-author at least one "digest" suitable for publication, we would soon develop sufficient qualified manpower for the support of a digest journal.

Occasionally a paper on the art of writing such digests should be included in the digest journal. Then, after years of such efforts, certain basic principles would crystallize which would greatly facilitate teaching the art of writing digests.

An incidental but important result of such efforts would be that the students would learn to examine critically the writing of others. They would learn to recognize styles of writing that are unclear and verbose; and they would learn to avoid such faults in their own writing. The reduction in the length of all papers which a new generation of writers would produce could be substantial.

I would also hope that an experienced member of our profession would occasionally write a digest of a paper in which he was particularly interested. As an encouragement, such men should be permitted to write an original supplement which would contain a discussion or a comparison with other available information on the subject—all, of course, written in digest style. Thus the reader would gain the advantage of a competent digest and valuable supplementary information. Once the digest style becomes well developed and its skilful application widely practised, it is likely that many authors would voluntarily undertake to prepare digests of their own papers.

### ORGANIZING AND FINANCING LITERATURE INFORMATION SERVICES

I need not explain that the resources of our Society are entirely insufficient to support financially such ventures as I have outlined. However, I am confident that within a period of two years after an abstract journal in English is started, a sufficient number of subscriptions will have accumulated to make such a service self-supporting.

The organization and publication of the proposed abstract journal with ratings would require the co-operation of organizations in several countries. The Swedish Geotechnical Institute (to whom we are already indebted for a major effort in connection with the development of the Geotechnical Literature Classification) has indicated its willingness to organize such a co-operative effort.

Publication of a digest journal would be a much more difficult undertaking, requiring many years of preparatory work. I hope that my paper will lead at least to an examination of the merits of such a proposal, and to some experimentation which, in turn, would demonstrate how one should proceed further.

Thank you for listening so patiently to this very dry but, for us, all important and urgent subject.

(NOTE: Subsequent to the presentation of this paper, (1) the Executive Committee voted to appoint a sub-committee on Geotechnical Literature Abstracts, composed of five members, one representative from each of Sweden, Great Britain, France, Germany and the United States; and (2) my attention was called to the following very important publication which deserves careful reading by anyone seriously interested in this general subject: *Science and Government*—A Report of the President's Science Advisory Committee, January 10, 1963 (available from the Superintendent of Documents, Washington, D.C., for 25 cents).

# Banquet

GRAND BALLROOM, QUEEN ELIZABETH HOTEL, 14 SEPTEMBER/SEPTEMBRE 1965

The "Loyal Toast" was proposed by Dr. R. F. Legget, Chairman of the Canadian Organizing Committee for the Conference.

Dr. Legget then introduced the Vice-Presidents of the International Society and the National Delegates.

Brigadier J. P. Carrière, Chairman of the Local Arrangements Committee, thanked all volunteer workers for their co-operation and invited the Chairmen of the Subcommittees to stand and be recognized. The names of these gentlemen appear on page 7 of this volume.

PRESIDENT CASAGRANDE

Mr. Minister, Ladies, and Gentlemen. Since this is such a happy social occasion, graced by the presence of so many lovely ladies, it is just the opportunity for me to express on behalf of the entire Conference our sincere thanks to those ladies, whom Brigadier Carrière introduced to us, who have worked so hard and so well in taking care of *our* ladies. To think of wives of "Soil Mechanics" on duty even early Sunday morning fills me with amazement. Indeed, we are most grateful to you Mrs. Kraus, and to every member of your committee, for your splendid work.

Since I am on this very interesting, very exciting, and sometimes controversial subject—I am not referring to the shear strength of highly sensitive clays but to our ladies—let me tell you what happened to me on the good ship S.S. *Tadoussac* during our wonderful weekend cruise on the St. Lawrence and Saguenay rivers under a lovely full moon. But let me quickly assure you that I am not going to reveal any secrets.

During that delightful cruise—and I wish that all of you could have participated—I had the pleasure of talking to many old friends and of meeting many members of our Society I had not met before, and their wives. It seems that almost everyone asked me: "Where will the next Conference be held?" All I could tell them were the names of the four countries that had extended invitations, namely Australia, Germany, India, and Mexico. To my surprise almost all ladies exclaimed: "Oh, let us have it in Mexico!" I did not pay much attention to these reactions because on the basis of our discussions in the Executive Committee meetings last week it appeared to me fairly certain that a majority would vote either for Australia or for Germany: for Australia, because of the strong moral commitment which was passed on to us from the Paris Conference; for Germany, in order to enable a maximum number of our members to attend the next conference. After those discussions the decision was made to postpone the final vote until this week, to allow the members of our Executive Committee to think about it. Now my question is: "How exactly did my good fellow

VIEW OF THE BANQUET HEAD TABLE, GRAND BALLROOM, QUEEN ELIZABETH HOTEL, TUESDAY, SEPTEMBER 14.

members carry out their thinking over the weekend?" All I know is that when we counted the votes last night, a strong majority had voted for Mexico. This change of mind is particularly astonishing to me because only a small percentage of the delegates are accompanied by their wives.

Perhaps there is a moral in this story which my good friend Laurits Bjerrum should heed because he was elected last night as President of our Society for the next four years. I am also very happy to announce to you our new Vice-Presidents: for Africa, Mr. Kantey from the Republic of South Africa; for Asia, Prof. Zeitlen from Israel; for Australasia, Prof. Trollope from Australia; for Europe, Prof. Brinch Hansen from Denmark; for North America, Dr. Turnbull from the U.S.A.; for South America, Prof. Moretto from Argentina.

May I now call on you, Mr. Minister, to be so kind as to address our Conference.

THE HONOURABLE C. M. DRURY, MINISTER OF INDUSTRY, GOVERNMENT OF CANADA

Mr. Chairman, distinguished delegates to the Sixth International Conference on Soil Mechanics and Foundation Engineering, Ladies, and Gentlemen. I understand that there are some 47 countries represented here and my first words to you are those of welcome on behalf of the Government of Canada. As a Montrealer, I wish to congratulate you upon your excellent choice of this city as a meeting place. As one of the truly great cosmopolitan cities in North America, Montreal is uniquely equipped to ensure that your deliberations are carried on in a centre that is as noted for its Gallic charm and hospitality as it is for its modern facilities.

It is indeed fitting that this conference honours the memory of Dr. Karl Terzaghi who dedicated his life to the science of soil mechanics and who served as your first President, later becoming your Honorary President. It is certainly gratifying that Mrs. Terzaghi could be with us tonight. Mrs. Terzaghi, I scarcely need to tell you of the extremely high regard in which your husband's memory is held throughout the world of foundation engineering. Soil engineering, I am told, has been studied for many decades but it was not until 1936 that it became formally recognized as an accredited branch of civil engineering. Indeed, it has now progressed to the point where it is making an impressive contribution to the betterment of mankind throughout the world.

Many of you attending this conference have crossed Canada on your way to Montreal and have had the opportunity of seeing some of our major engineering works. Three projects come to mind, the first is the St. Lawrence Seaway now fully completed, the second is the South Saskatchewan Dam Project already well advanced, and the third is the Columbia River development now in its initial phase. In all of these soil mechanics has and is contributing much. It is interesting to note that two out of the three projects, the first and the last, are international in scope inasmuch as they have involved the participation of both Canada and the United States. As the principal occupants of the North American continent, I should like to point out that for our two countries these activities exemplify the close co-operation

VIEW FROM THE BANQUET HEAD TABLE, GRAND BALLROOM, QUEEN ELIZABETH HOTEL, TUESDAY, SEPTEMBER 14.

which has marked our relations for more than a century. Some of the delegates to this conference may already have seen the size of this country as it extends from east to west, but even few Canadians realize that it is almost as long from south to north. Future generations may well record co-operation in no less dramatic undertakings with our neighbour to the north.

More than one-half of the area of Canada rests upon permafrost. It was therefore appropriate that one of the lectures at this conference was on the subject of permafrost in the Soviet Union. This was given by Professor Tsytovich and it is indeed gratifying to note the close and cordial relations which have developed in this field of endeavour between our two countries. Exchanges of information are most useful and I believe that important benefits will result from the interchange of experts within our respective regions. You may have heard that in an allied field in building research a joint Soviet Union-Canadian technical paper on snow has recently been produced. It is my hope that this is but the first of many such mutually beneficial joint ventures.

Most of the construction in our northern regions is carried out by the Government of Canada. In addition, the government through its Departments of Public Works, Transport, and National Defence undertakes many construction projects across the length and breadth of the country. All these agencies regularly use soil mechanics fully in their work and have well-equipped laboratories for this purpose. So also do provincial agencies and especially provincial highway departments.

As you know, our construction engineers are faced with many problems associated with climatic extremes. Employment of the techniques of soil mechanics has made possible vast construction projects which would formerly have been considered impossible. The Grand Rapids Generating Station of Manitoba Hydro is an excellent example of the benefits of modern soil studies. This project necessitated the building of sixteen miles of earth dykes rising to a maximum height of one hundred feet in order to harness the fall of the great Saskatchewan River into Lake Winnipeg. Soil studies proved that such earth structures could be safely utilized and it was only when this knowledge was available that such a project could be initiated. It is now in operation and appropriately enough its site is on one of the historic grand portages on the canoe route to western Canada.

When a branch of engineering science makes possible what was previously impossible then the debt of the public to the pioneers is a very real one and should be recognized. It is indeed fitting that this conference, in association with the British Columbia Hydro and Power Authority, has decided to honour the memory of your first President, by the renaming of the Terzaghi Dam amid the mountains of British Columbia. So often the men who devote their lives to the advancement of science are soon forgotten by the public they serve. That cairn in our western mountains, the plaque for which Mrs. Terzaghi unveiled last Wednesday, is a most fitting memorial to a great man.

As an outsider, perhaps I may be permitted to reflect that the science of soil mechanics has a certain excitement and drama about it. In every country represented here at the conference there must have been pioneer investigators working on their own, making their own special contributions and yet who, through the chance of circumstance, became diverted into other channels. Canada is no exception. Speaking as a graduate of McGill University, let me mention but one local example. It was in 1885 that a young man named Samuel Fortier set out from the University and, like a fair number of Canadians since that time, was attracted southwards to the United States. He went to the western States and became very well known in agricultural engineering circles, concluding his career as Associate Chief of the Division of Agricultural Engineering of the United States Department of Agriculture. In the course of an outstanding career he became interested in the use of soil in engineering work, especially for the building of dams. I am told that his writings show a keen awareness and grasp of many of the principles of modern soil mechanics, but chance intervened and his greatest fame lies in the annals of agricultural engineering rather than in soil mechanics.

The emergence of soil mechanics and foundation engineering as an established discipline marks the opening of yet another in man's struggles with nature. Perhaps, we would do well to recall the words of the Roman naturalist, Pliny, the Elder:

> The waters deluge man with rain, oppress him with hail, and drown him with inundations; the air rushes in storms, prepares the tempest, or lights up the volcano; but the earth, gentle and indulgent, ever subservient to the wants of man, spreads his walks with flowers, and his table with plenty; returns, with interest, every good committed to her care; and though she produces the poison, she still supplies the antidote; though constantly teased more to furnish the luxuries of man than his necessities, yet even to the last she continues her kind indulgence, and, when life is over, she piously covers his remains in her bosom.

However, rather than conclude my remarks on what some might consider to be a note of despair, perhaps the words of this English poetess of the last century, Joanna Baillie, best describe the challenge which you face: "I believe the earth on which we stand is but the vestibule to glorious mansions, to which a moving crowd is forever pressing."

PRESIDENT CASAGRANDE

Mr. Minister, it was very gracious of you to come to us from Ottawa and to honour our Conference by addressing us. I am sure that I am speaking for all my fellow members when I express to you our very best thanks for your inspiring and stimulating words.

# Closing Session Séance de Clôture

## LA GRANDE SALLE, PLACE DES ARTS, 15 SEPTEMBER/SEPTEMBRE 1965

PRESIDENT A. CASAGRANDE

The President introduced the General Reporters who in turn presented their Closing Remarks. (*These appear separately on pages 591–6.*)

The President thanked the General Reporters for their valuable contributions, and then summarized the work of the Executive Committee. (*The Minutes of the Meetings of the Executive Committee appear separately on pages 55–71.*) The President then continued.

It was a great pleasure for me to work with the very able representatives of our membership countries who form our Executive Committee. They are all dedicated to the cause of our Society and earnestly seek solutions to the problems that are in the best interest of our profession. Much of the credit for the progress achieved in the Executive Committee meetings we owe to the thorough preparatory work which the National Societies carried out prior to our Conference, in an effort to obtain a consensus of their members concerning the many questions and proposals which had been presented to them in numerous communications. The Executive Committee meetings last week and this week demonstrated clearly that such preparatory work is essential for reaching well-considered decisions. However, a number of proposals for the creation of new subcommittees arrived too late for such a thorough preliminary study by the National Societies. The Executive Committee hesitated to appoint new subcommittees merely on the basis of a brief discussion during its meetings. Perhaps the best way to deal with each such proposal would be for our new Advisory Committee to appoint an *ad hoc* committee consisting of three or more members who are particularly well qualified to judge the merit of the proposal.

The membership of our Society increased by about 3000 since the Paris Conference and stands now at about 7700 members. Fortunately, attendance at our international conference has increased only linearly with time since the first one in 1936. From this practically straight-line relationship I anticipated an attendance of about 1200 at our present Conference. The latest registration figures are 1233 delegates and 279 family members. On this basis we should expect about 1500 delegates in four years in Mexico City, and a total registration approaching 2000.

Since our Paris Conference, six or seven regional conferences and many national conferences were held. In addition, the National Societies of several countries hold yearly soil mechanics conferences. The total effort that goes into all these meetings, and the proceedings of these conferences, is indeed impressive. Some friction developed when the organizers of a regional conference solicited contributions of papers and attendance from countries outside that region, while at the same time another regional conference was being organized with similar scope. It will be one of the tasks of our new Advisory Committee to try to minimize such conflicts.

The principal purpose of the Advisory Committee will be to collect all experience data and suggestions concerning organization of our international conferences, to analyse these data, and to make the conclusions available to future organizing committees. It is not the intent to dictate to an organizing committee the rules that they must follow. I believe that the organizers of future conferences should make decisions in accordance with their best judgment. But at least they will have at their disposal an analysis of past experience and the judgment of senior members who have attended most of our international conferences.

During the last few days many of my colleagues have made suggestions as to how such conferences could more effectively serve practising engineers. They all expressed their regret that the sessions contained only a little information of direct interest to practitioners. I should like to encourage all fellow members who have specific comments or recommendations concerning future conferences to send them to the members of the Advisory Committee.

To summarize my own impressions as well as comments I have heard, not only during the present but also during past conferences, I could say that the great majority of the delegates are practising engineers who attend all sessions diligently in the hope of obtaining reliable information on the state of the art in all branches of applied soil mechanics. On the other hand, the minority of research specialists are not happy because they are not given sufficient opportunity for group meetings with colleagues having similar interests. To satisfy such divergent demands will tax the imagination of our Mexican friends.

I now come to the pleasant duty of expressing our great indebtedness and thanks to all who have made it possible for our Society to meet here in this beautiful Canadian city. I would therefore move

> That this Sixth International Conference on Soil Mechanics and Foundation Engineering, in its final meeting assembled, hereby records its appreciation for the assistance of those many Canadian agencies, public and private, that have contributed to the success of its proceedings; and the Conference requests the Organizing Committee to transmit the thanks of the Conference in appropriate manner to all who so assisted; and in particular, the

Conference requests that its special thanks be transmitted to

His Honour the Lieutenant-Governor of Quebec,
The Premier of the Province of Quebec and his Minister of Public Works,
The Mayor of the City of Montreal and his Deputy, and to
The President of the National Research Council of Canada

for their special and personal contributions, and for the hospitality so graciously extended to the Conference by the Provincial Government of Quebec and by the City of Montreal. The Conference also records its appreciation, and requests that it be also transmitted appropriately by the Organizing Committee, to the Management of the Place des Arts for the excellent meeting arrangements, and to the unseen operators of interpretation and projection services for their competent assistance.

Just before the start of this closing session, I was handed a note from a member of the Organizing Committee, requesting me to make my mention of the work of that Committee very brief. Reluctantly I will abide. I am sure that I am speaking for all delegates to this Conference when I express deep gratitude to our former Vice-President for North America, Dr. Robert Legget, the Chairman of the Canadian Organizing Committee, and to every member of the Organizing Committee, for the untold hours of strenuous efforts which they devoted to the organization of the Sixth Conference and all its associated activities. As *ex-officio* member of that Committee I was able to observe what a formidable task it is to organize a conference of this magnitude. I would like to ask Dr. Legget to convey also to the staff of the Division of Building Research of the National Research Council of Canada our thanks for the long hours they have contributed in connection with our Conference, and particularly to Mr. M. K. Ward, the Secretary of the Organizing Committee, who carried the heavy responsibility for co-ordinating all activities and communications.

In the preparatory work for the Conference one of the major tasks has been the publication of the technical literature upon which our sessions have been based. Responsibility for this was delegated by the Organizing Committee to a Papers Subcommittee under the very able chairmanship of Dr. D. H. MacDonald. The printing of the *Proceedings* and other technical material was assigned to and excellently produced by the University of Toronto Press. Planning by the Papers Subcommittee commenced early in 1964, and the work began in earnest with the receipt of the first papers in June of that year. Between July 1, 1964, and August 31, 1965, this Subcommittee and the University of Toronto Press, with the aid of a small paid staff and a large volunteer staff, carried out the work of reviewing, assessing, editing, checking, and translating all papers and general reports through their various stages of publication. Some idea of the magnitude of this task is conveyed by the fact that it required more than 6000 man-hours on the part of the Subcommittee and its staff alone. By virtue of this effort Volumes I and II were completed in time for their mailing to conference registrants to begin according to schedule on July 1 of this year.

The Organizing Committee allocated 241 papers amongst 43 countries and published 218 papers from 40 countries. The papers allocated but not published, less than 10 per cent of the total, include those that were never submitted, one that was not shortened and re-submitted as requested, and those that were officially withdrawn. Overlength papers proved to be the most difficult and time-consuming problem. The Organizing Committee undertook to implement the instructions regarding the length of papers that were issued by the Executive Committee after the Paris Conference. Despite the requirements stated in the Conference bulletins, one-third of all papers initially exceeded the length limit of 5 pages. Papers as long as 12 pages were received.

But the work of the Papers Subcommittee is not yet complete. Immediately following this Conference work will begin on Volume III of the *Proceedings* which will include the record of our meetings, the special lectures, the General Reports, the oral and written discussions, and the report of the Organizing Committee. May I urge all those who have material to contribute to Volume III to send it as quickly as possible to the Conference Secretary in Ottawa. Written technical discussions will be accepted and should be submitted on the specially prepared forms provided here, but the Organizing Committee wishes me to advise you that October 15 is the final date for receipt of technical material for Volume III, and that publication of material received after that date cannot be guaranteed. If everyone co-operates we can look forward to receipt of Volume III in 1966, published to the same high standards as Volumes I and II.

For completion of this enormous task in such a fine manner I know you will want me to extend on your behalf the thanks of all of us to the Papers Subcommittee, the University of Toronto Press, and to all others who have aided and participated in its work.

The next-to-last item on my agenda for this closing session is to repeat the announcement which I made during yesterday's banquet, that the Executive Committee voted, during its meeting the day before yesterday, to accept the invitation from the Mexican National Society to hold our next International Conference in Mexico City. I should also mention that this invitation was strongly supported by telegrams from the President and other high officials of the Mexican Government.

I would now like to introduce to you my successor. According to the statutes of our Society, the president and past-president nominate the next president. Some months ago Professor Skempton suggested to me that it would not be desirable to have two presidents in succession from the same country. After this decision, we quickly agreed to nominate Laurits Bjerrum. It is really not necessary for me to enumerate in detail Dr. Bjerrum's eminent professional record and his qualifications for the presidency. He has to his credit remarkable achievements as organizer and leader of team efforts in soil mechanics research as well as in applied soil mechanics. It is largely due to his leadership that the Norwegian Geotechnical Institute has attained its present pre-eminent position. His services to our Society as Vice-President for Europe are well known to you. His fluency in several languages and his personal knowledge of many countries are also very important assets for the duties of our president. I am most happy that I can pass the affairs of our Society into such competent hands. May I now ask you, Laurits, to address the Conference, as you take over the duties of the President for the next four years.

Dr. L. Bjerrum

First of all I would like to say that it is an extremely great honour for me to be elected the next President of our

International Society. I thank the Executive Committee for their confidence, and Dr. Casagrande for the very kind remarks he has just made about me.

I would like to take this opportunity to express, on behalf of all members of our Society, our deep gratitude to Dr. Casagrande for the skill with which he has conducted the office of the presidency of the Society during the past four years. During Dr. Casagrande's period as President a number of important problems required detailed consideration, and the agenda of the Executive Committee has never been so crowded as at this meeting. Only those who have had the opportunity to follow his work closely can imagine how much time and work Dr. Casagrande has put into these items. I think we all owe Dr. Casagrande a warm vote of thanks for his four years as our President.

We have just learned that the next International Conference will be held in Mexico City in 1969. I think it is appropriate to mention that Mexico City is, without any doubt, the world's record holder for the most difficult foundation conditions. In addition, Mexico has so much to offer from a tourist point of view. Expressing the hope that all of us—including the ladies—will be able to meet again in four years I would like to end this little talk by saying "Au revoir in Mexico."

PRESIDENT CASAGRANDE

We have now arrived at the conclusion of our Sixth International Conference, which has been another major achievement—one more milestone—in the remarkable growth of our International Society. I declare this Conference adjourned and hope to see you again at our Seventh Conference in Mexico City.

# Statement of Conclusions by the General Reporters

# Exposé des conclusions par les Rapporteurs généraux

PRESENTED AT THE CLOSING SESSION, 15 SEPTEMBER 1965

PRÉSENTÉ Á LA SÉANCE DE CLÔTURE, 15 SEPTEMBRE 1965

## DIVISION 1: J. E. JENNINGS (SOUTH AFRICA)

I will start my final report by giving again the definition of the work which Division 1 (Soil Properties—General) is supposed to cover: soils, their occurrence, classification, and description; physico-chemical properties; permeability; methods and apparatus for determining these properties; soil sampling. I have already declared that this description is too diverse and that there is need for closer definition, probably with the creation of further divisions.

Before dealing with these further divisions, I propose asking a hard but, I think, a related question which probably also applies personally to everyone in the audience. What do I expect from the International Society and its Conferences? Am I justified in coming 10,000 miles and are the lessons I have learned worth the effort which has to be made. I do not refer to the social sense—this Conference has been fun. I have met with old friends and made new ones, and the private discussions outside the Conference Hall have been as important, if not more important, than the proceedings at the meetings. For these opportunities we have to thank the quiet and efficient planning and operation of the Conference by our Canadian friends.

But let us look at the work of Session 1 and see what we have learned towards the solution of our engineering problems. I think there are some good lessons, and in seeking these I will cover my experiences both inside and outside the Conference Hall.

### ENGINEERING GEOLOGY

We have learned that the Canadians are paying a great deal of attention to their geology and that it plays a leading part in all site investigation. We have been told of six most advanced dams, the success of which will depend largely on the excellence of the site and subsoil exploration. Great attention has been given to fissures and joints both in soils and in rocks. The importance of the proper and systematic recording of the strata in a profile cannot be overestimated.

Further we have seen airphoto interpretation applied to muskeg. This is a powerful tool which has a wide application to a variety of problems in site investigation.

Perhaps these three points—more attention to engineering geology, better profiling, and airphoto interpretation—are thoughts we can put into our mental purse.

### SOIL SAMPLING

We have heard little of this in the Conference Hall, but outside this room I have been told of developments which are interesting and may be of importance in our special problems.

### PHYSICAL CHEMISTRY OF SOILS

I am happy to report that our physical chemists accepted the suggestion that they should meet and decide on their future work in soil mechanics. Under the chairmanship of Professor Rosenqvist, they met and examined their own field fairly critically. They concluded that research on the physico-chemical aspects of soil engineering has been of much value and that further work and co-operation is needed. They also ask that at the next Conference a special seminar or session be devoted to the physical chemistry of soils. This is a good idea and I recommend it to the organizers of the next Conference.

I do not agree with the iconoclasts who are dissatisfied with the progress made by the physical chemists, but at the same time I do not agree with the physical chemists who are trying to solve our problems in a quantitative way. I say this to them: give us a mechanistic understanding of what is happening when phase changes occur in the solids-gas-water system. Do not worry if your work is complicated. If you can show us and convince us that this knowledge will help us understand and solve our practical engineering problems, then we will do the work which is necessary, even if it takes our midnight hours.

### THE MECHANICS OF PARTLY SATURATED SOILS

A great deal of attention has been given to the problems of partly saturated soils throughout all the sessions of the Conference. It is now recognized that the problems of heave and collapse of frame structure occur in a wide variety of engineering problems in almost every type of climatic environment, except perhaps the muskeg.

Again there has been a meeting, under the chairmanship of Mr. Reginolto of Argentina, and a continuing exchange of information has been arranged on the question of additional settlement due to wilting of the subsoil. The problem is too involved to discuss in detail now, but perhaps our mental purse can also accept the idea that problems of heave or collapse are occurring in my country and all that is required is the wisdom to observe them.

I think we can agree that Session 1 of the Conference has provoked ideas and given us important thoughts to take home. I believe it has contributed to the justification I sought for my participation in the Conference, and I hope these reminders will help you feel the same way.

But let me look forward to the next Conference and ask our Mexican friends to think carefully about the organization of its technical content. What we all look for in these Conferences is to be brought up to date quickly and painlessly in the progress which has been made in the intervening four years. I do not look for great and new advances to be disclosed for the first time at the Conference. Of course the Conference must be fun and I will look forward to meeting my friends, but please, can I also take back with me a mental purse full of ideas and thoughts which will sustain me in the next inter-conference period.

## DIVISION 2: O. MORETTO (ARGENTINA)

When trying to summarize in a few words the results achieved during Sessions 2 and 3 held on September 8, in which the shear strength of soils under static loading, soil deformation under static loading, and soil behaviour under dynamic loading were discussed, the following remarks appear necessary to focus their outcome. These remarks are not intended as a summary of the discussions held during the sessions. Those contributions stand by themselves and should be read in full. Instead, I wish to comment on the state of our knowledge and give my opinion on what should be the future trend in practical research.

### SHEAR STRENGTH OF SOILS UNDER STATIC LOADING

1. The study of the behaviour of soils in shear has gone a long way in the development of dependable methods for testing, both in the laboratory and in the field, and devices to perform the tests have grown into very elaborate procedures. In the laboratory, apparatus is available to allow the control of nearly every facet of the phenomena involved during testing up to and past the peak load to any desired deformation. It is highly comforting that many of these testing procedures have gone beyond the limits of research and entered usefully into the everyday life of the practising engineer. This event alone is a real achievement.

2. The improvement of methods of testing will no doubt continue in the future and refinements will decrease the hazard of errors still so frequent in today's procedures. The main effort should, however, be directed toward the thorough study of typical soils and the analysis of soil behaviour in general under the various conditions of stress developing in nature. Although the triaxial test with a cylindrical stress distribution will continue for some time to be the basic stress condition for routine studies, the shear strength of soils under other stress conditions should be fully investigated with much attention devoted to plane strain and to the effect of rotating stresses in soil failure. Although, in the field, only singular points and singular lines are really subjected to a cylindrical state of stress, plane strain, rotation of stresses, and other anisotropic states of stress prevail.

3. Many of the structures built today subject soils to very high stresses. The most simple and evident examples are foundation piles and high dams. In non-cohesive and hard cohesive soils, a state of stress develops near the pile points that can only be approached by studying the shear strength of these soils under high confining pressures. Many of the anomalies encountered in today's studies of the behaviour of piles driven into such soils will possibly disappear the day that the behaviour of these soils under high confining pressures is rightly taken into account. Field tests alone will never solve this or any other soil mechanics problem.

4. Safety reasons make it imperative that the now evident curved nature of the Mohr's envelope, the large deformations necessary to obtain failure, and the real values of pore pressures developed under such pressures be taken into consideration in the design of high dams. The resulting decrease in strength may be significant, and its oversight dangerous.

5. The curved nature of the Mohr envelope and the large deformations necessary to obtain failure are not exclusive to soils. All brittle materials, that is to say all those materials having a tensile strength not higher than their pure shear strength under zero normal pressure, behave in this way. Consequently, analyses of soil behaviour under high confining pressures should include study of similar investigations made on concrete, marble, and other brittle materials by von Mises, Ross, Richart, Brandzaeg, Vanderperre, Brice, and Caquot, and others, because the comparison of behaviours may help us to understand soil behaviour.

6. The study of the behaviour in shear of non-saturated soils needs and will, no doubt, receive the attention of many soil mechanics workers in the near future. It constitutes possibly the weakest point in our present knowledge of the shear strength of soils. The complicated nature of the problems involved, together with the challenge for an understanding at the same level as that now existing for saturated soils, appears to have hidden the way to a solution. Yet a solution is needed, and immediately. Furthermore, engineers working with non-saturated soils are presently using various kinds of solutions. They are all of an approximate nature and many probably far from right. Let these solutions be known, and through discussion we will surely find a way to a better approximation and so progress in this matter.

7. The final purpose of all soil testing is to obtain parameters that will be of use to the engineer and represent soil behaviour in nature. Planned field observation of the shear strength of soils is seldom possible because to obtain it requires producing failure. Therefore, field observations are often limited to the recording of deformations without failure ensuing. One has to rely on accidents, like slides of natural or artificial slopes and occasional failures due to faulty design, to be able to compare laboratory testing with real soil behaviour. For these reasons, studies in which the representativeness of laboratory soil testing in relation to field soil behaviour is analysed are of the utmost importance, and every opportunity to make these studies should be seized. Pile loading tests provide one such possibility and, in my belief, no chance should be lost to carry these tests to soil failure and to publish the results.

### SOIL DEFORMATION UNDER STATIC LOADING

8. While an optimistic view can be taken of the achievement of recent studies on the shear strength of soils, it is difficult to carry these feelings over to studies of soil deformability. These studies appear to have reached a stage at which a complete re-examination of the problem is needed, because neither the laboratory nor the field tests in use are reliable. Novel approaches must be evolved in which new testing methods to measure soil deformability under various stress conditions are developed. To be of any use these studies must be followed by field observations of full-scale structures so as to compare predictions with real behaviour. Only when the complete cycle of laboratory field testing and field measurement is completed will the new methods now being evolved be of real practical use. There appears to be little doubt that this cycle will still require a long period of time.

9. In the meantime the practising engineer will be compelled to continue with the existing tools, testing procedures, and methods of computation. However, having realized fully their limitations, he will utilize the existing tools with great

caution and mature judgment and remain on the alert for the discrepancies that will develop in the field. This in itself will be a major and immediate improvement.

### SOIL BEHAVIOUR UNDER DYNAMIC LOADING

10. Our knowledge of the dynamic properties of soils has been significantly increased by studies made of landslides, subsidence, and lateral displacements resulting from recent earthquakes in Chile, Mexico, Japan, and the United States. Because of the large potential damage which may occur in populated areas during future great earthquakes it is inevitable that there will be continued effort toward further understanding of the problem of soil dynamics.

11. Recent requirements for stable foundations for radar towers, missile tracking stations, and machine foundations have led to increased research on the behaviour of foundations under dynamic loading. Field and laboratory methods have been developed for evaluating a modulus of elasticity for soils in the range of strains anticipated beneath vibrating footings. Correlations exist for this modulus for granular materials as obtained from laboratory devices and from field tests on the basis of the elastic half-space theory. The correlations between different methods of obtaining a modulus for cohesive soils also appear to be reasonably adequate but subject to more possible differences.

12. Highway engineers also have contributed and are contributing to a great extent. Much progress will come from their studies of the behaviour of pavements under repeated loadings.

13. Soil behaviour under dynamic loading appears to require treatment in a separate division or subdivision. Much of the work on soil dynamics has in the past been directed toward mechanical engineering and earthquake engineering meetings. Having been a subject for discussion in our International Conferences for the first time, thought should be given to whether the time has been reached in which it should be permanently introduced as a separate subject at our conferences. Being of direct concern to them, I think our Mexican colleagues may want to have it for the Seventh Conference.

### ACKNOWLEDGMENTS

In closing, I must say a few words of thanks to the two panels that shared my work. They were most co-operative at all times and their discussion was extremely valuable. I feel that no better men could have been selected for that purpose. Special thanks are due to Professor F. E. Richart, Jr., who on short notice substituted for Dr. Barkan from the U.S.S.R. Having written a fine contribution and circulated it among the other panel members, Dr. Barkan unfortunately could not attend this Conference. I have asked the Canadian Organizing Committee to publish his discussion as part of our panel discussion and you will be able to read it in Volume III.

## DIVISION 3: E. E. DE BEER (BELGIQUE)

Les deux séances consacrées à la Division 3 traitant des problèmes des fondations directes et des revêtements ont donné lieu à des interventions intéressantes tant de la part des pannellistes que des autres membres du congrès, quoique que l'on puisse regretter que par un manque de temps une véritable discussion n'ait pu s'établir concernant certains points d'actualité. Toutefois pour les problèmes des revêtements cette lacune a pu être compensée par une réunion séparée des spécialistes en la matière, grâce à une initiative heureuse du professeur Moraldi.

En ce qui concerne les fondations directes, ont été successivement examinés les problèmes de la capacité portante limite, des répartitions des réactions sol-fondation, ainsi que ceux des tassements.

Dans le domaine de la capacité portante limite l'attention est surtout allée vers les sols pulvérulents. Obligation est de constater qu'il n'existe pour le moment pas encore de méthode de calcul permettant d'obtenir une parfaite concordance entre les valeurs calculées et les valeurs obtenues par des essais sur modèles réduits et des essais en vraie grandeur. Pour arriver à une meilleure concordance il est nécessaire de mieux connaître les paramètres caractérisant la résistance au cisaillement des matériaux pulvérulents, et notamment de tenir compte de l'influence de l'état de déformation plane ou triaxiale, et de la contrainte normale moyenne sur cette résistance. En outre la prudence s'impose dans l'extrapolation des résultats d'essais sur petits modèles aux cas des semelles réelles, cela, à cause du phénomène de la progressivité de la rupture, d'ailleurs intimement lié aux phénomènes de dilatance positive et négative, qui ne sont pas nécessairement reproduisibles à l'échelle. Il est par ailleurs évident que les formules basées sur l'hypothèse du refoulement ne peuvent fournir la réponse exacte dans tous les cas où la rupture se fait par enfoncement et non par refoulement.

En attendant des développements ultérieurs il semble bien que la méthode qui permette aux praticiens de trouver pour les sols pulvérulents une valeur par défaut, sans s'écarter trop de la réalité de façon à éviter des solutions anti-économiques consiste dans l'utilisation des formules du professeur B. Hansen. Les valeurs de $N_\gamma$ sont obtenues en majorant de 10 pour-cent l'angle de cisaillement obtenu par des essais triaxiaux normaux, sans approfondir pour autant les raisons de cette majoration, tandis que les valeurs de $N_q$ correspondent aux angles non majorés et que sont maintenus provisoirement les coefficients de forme et de profondeur de cette méthode. Des essais en cours montrent d'ailleurs que dans un avenir rapproché ces coefficients subiront de substantielles modifications.

Dans de nombreux cas, l'on se trouve par ailleurs confronté avec le problème de la détermination de la capacité portante limite au cas d'un sous-sol composé de couches multiples ou à caractère anisotrope. Pour de tels cas des règles générales ne peuvent être avancées, mais le praticien pourra se laisser utilement guider par certaines solutions qui ont été avancées dans ce congrès.

En ce qui concerne les problèmes de la capacité portante limite on est arrivé à un stade ou une progression de nos connaissances ne peut être obtenue que par un programme systématique d'essais en vraie grandeur, conçu de telle façon que l'on puisse sérier les variables. Eu égard aux dépenses afférant à un tel programme, sa réalisation postule une large coopération entre divers organismes.

Les problèmes de la répartition des réactions sol-fondation se traitent de plus en plus en caractérisant le sol par un module de déformation constant. On ne peut toutefois se dissimuler que les propriétés de déformabilité réelles du sol peuvent être beaucoup plus compliquées. Les résultats de calculs mathématiques n'ont qu'un intérêt pratique fort limité, s'il sont basés sur des caractéristiques de déformabilité qui s'écartent par trop des propriétés réelles. Il s'agit donc par une confrontation des résultats des mesures avec les valeurs calculées d'obtenir plus de données à ce sujet. Au cours des débats l'attention a aussi été attirée sur l'influence que peuvent avoir les réactions tangentielles dans le plan de contact sur la répartition des réactions normales. D'autre part il s'agit aussi d'introduire les caractéristiques de déformabilité appropriées des matériaux dont sont constitués le radier et la superstructure. En effet sous des déformations lentes les modules de déformabilité du béton peuvent être beaucoup plus faibles que ceux correspondant aux vitesses de déformation normales d'essais effectués en laboratoire sur éprouvettes de béton.

Finalement une tendance d'avenir en ce domaine pourrait être un calcul en plasticité.

L'étude des tassements constitue très souvent la partie la plus importante du problème de fondation. Il est à nouveau apparu que la question essentielle ne réside pas tant dans le choix d'une méthode de calcul, mais bien dans une meilleure connaissance des paramètres caractérisant la déformabilité. La limitation de la signification des résultats d'essais œdométriques a été clairement indiquée, notamment pour les sols pulvérulents et les argiles surconsolidées. Des suggestions intéressantes ont été formulées pour effectuer les essais en laboratoire de telle façon que l'influence de la contrainte normale moyenne et du déviateur sur les caractéristiques de déformabilité puisse être prise en compte. En attendant des développements ultérieurs il faut bien constater que les méthodes semi-empiriques, restent fort utiles sinon indispensables pour permettre aux praticiens de circonscrire les problèmes de déformation de sols pulvérulents. Il est d'ailleurs évident que l'on ne peut attendre de telles méthodes une grande précision, et qu'il s'agit de les utiliser avec discernement.

Ici aussi l'avancement de nos connaissances postule des observations plus systématiques des tassements de construction réelles, pour lesquelles un examen rationnel du sous-sol aura été préalablement effectué.

En ce qui concerne les revêtements l'attention s'est essentiellement portée sur le dimensionnement des revêtements souples. Ce problème est encore beaucoup plus compliqué que celui des fondations directes. Un traitement rationnel exige de garder une sécurité suffisante par rapport à l'équilibre limite de rupture de toutes les couches intervenant dans le problème, compte tenu du caractère statique et dynamique des charges et des effets de fatigue dûs à la répétition, d'autre part de déterminer les déformations provoquées par ces charges, tenant compte des propriétés élastiques et viscoélastiques de couches intéressées et de l'influence de la température et du degré d'humidité sur ses propriétés, et de fixer une limite de déformation encore admissible pour la roulabilité. Des efforts considérables sont constentis dans certains pays pour aboutir à l'établissement d'une méthode rationnelle qui tienne compte de tous ces facteurs. On peut exprimer le souhait que l'on persévère dans ces efforts pour aboutir dans un avenir rapproché à des résultats concrets.

En attendant de disposer d'une telle méthode, les practiciens doivent continuer à utiliser des méthodes semi-empiriques, dans lesquelles on ne peut tenir qu'indirectement ou imparfaitement compte de plusieurs des facteurs cités, mais dont on ne doit toutefois aussi pas sous estimer la valeur pratique, eu égard à la grande somme d'expérience sur laquelle elles sont basées.

Les méthodes existantes peuvent être améliorées en introduisant, par exemple, des critères séparés pour la stabilité et pour la roulabilité. D'autre part, il faut tâcher de mieux connaître encore les paramètres à introduire dans les formules ce qui peut être obtenu en accumulant la plus grande quantité possible de résultats expérimentaux, en ayant recours tant aux méthodes statiques que dynamiques d'auscultations des chaussées.

Pour limiter les déformations, qui en ce qui concerne la part provenant du sol de fondation sont grandement influencées par la teneur en eau d'équilibre, il s'agira de prêter une plus ample attention à la constitution et à l'entretien des bermes, ainsi qu'aux phénomènes d'attrition.

Finalement au fur et à mesure que se perfectionnent les méthodes de dimensionnement, il s'agira de rationaliser aussi davantage les méthodes d'examen du sous-sol, par un programme approprié de reconnaissances *in situ*, en faisant intervenir certaines notions de statistique, par exemple.

Je voudrais terminer en attirant l'attention sur le fait que notre congrès n'est pas seulement un congrès de mécanique des sols, mais aussi un congrès des travaux de fondations, notion qui est encore plus clairement exprimée par l'appellation anglaise "foundation engineering." Tout en appréciant toute l'importance de la recherche fondamentale en la matière, on peut comprendre l'irritation qu'elle soulève auprès de nombreux praticiens, qui ne peuvent toujours attendre les résultats d'un telle recherche, et qui parviennent même en leur absence de résoudre les problèmes avec lesquels ils sont confrontés. On peut dès lors se poser la question si à l'avenir on ne devait pas réserver dans les congrès une part plus importante aux travaux de fondation proprement dite. Nous rétablirions ainsi un meilleur équilibre entre la théorie et la pratique qui doivent mutuellement pouvoir se fructifier. Cet équilibre est en définitive tout l'art de notre métier, et pour tâcher de le réaliser il n'y a de meilleur guide que l'étude de la façon magistrale avec laquelle Terzaghi a su résoudre les problèmes pratiques avec lesquels il était confronté.

## DIVISION 4: Á. KÉZDI (HUNGARY)

The increasing interest in the problems of pile foundations, as displayed in the statistical table in my General Report, the great construction activity in this field and, in consequence, the theoretical and practical research being done, are certainly responsible for the definite progress in the understanding of pile behaviour that has been made at this Conference. Developments in other branches of soil mechanics—earth pressure, bearing capacity, shearing strength, etc. —also give help in many respects: the mutual influence and information testify that there is no isolated, highly specialized activity in soil mechanics today and that the majority of the profession keeps contact with the construction industry. Like Anteus, we always gain new help, new power in our work whenever we touch the Earth. This Earth, almost literally, means for us construction in the field and the experiences collected in the battle of the civil engineer against earth and water.

The optimism I expressed right now is justified, in the first place, by the papers presented at this Conference. I could propose for particular reference the problems of stresses and deformations in and around piles—which are, in my opinion, the principal problems of pile behaviour—only because research activity in this field is great and successful. These papers furnished a sound background for the ensuing discussions which also definitely added to our knowledge. Perhaps, the increasing knowledge of the state of stress and of the deformations around piles is responsible for the fact that field tests (pile loading tests) can be planned and carried out more intelligently than before and that the evaluation of these tests can be made on a sounder basis.

This was reflected clearly by some of the panel discussions, and also in many talks I had after the sessions with distinguished members of the profession. Unfortunately, many experiences in this field have not been published yet. The better planning and evaluation of the tests also represent a significant development for the future, in the real spirit of scientific and semi-empirical soil mechanics.

The second important fact that can be established from the papers and discussions of this Session is that the superstitions I mentioned in my earlier presentation are slowly disappearing, although we must take care, of course, not to introduce new ones or to give new strength to the old ones. Pile driving formulae and efficiency formulae have not been mentioned in the papers and the discussions which were mainly devoted to intelligent testing and theoretical work. And this is why I think that the Conference made progress in the field of pile foundations.

Third, the correlation of field testing with model tests, which can be carried out at moderate cost in the laboratory, is also a welcome development. Its importance has to be emphasized in future research.

Fourth, the interactions between pile groups and soil have been further classified in this Session. Of course, we need much additional research in this field, but there are some points of crystallization visible and these bits of information will certainly help further research.

There are of course equally important problems that were not or could not be treated in the papers and discussions. There are, for example, the particular problems associated with the bearing capacity of piles with extraordinarily large diameters, the pulling resistance of piles, the variation of the soil constants caused by installing the piles, and also the behaviour of laterally loaded piles where we still have to eliminate some superstitions in this age of reason of soil mechanics. These questions will surely be treated at subsequent conferences. However, if we proceed with the same enthusiasm, and with the same skill and knowledge that was reflected in the majority of the papers and discussions, we shall be able to perform the operations with the ease and skill of the country blacksmith I spoke of in my presentation, and also with the deep knowledge and wide experience of the professors. If we apply more criticism to the research results, we also avoid the dangers inherent in the constant growth of information which Professor Casagrande mentioned in his Presidential Address.

## DIVISION 5: V. MENCL (CZECHOSLOVAKIA)

The three sources of knowledge in civil engineering science, namely, observing existing structures, studying advance models, and statistical analysis (connected with investigation of properties of structural materials), appear fully in the activities covered by Division 5. Such a general introduction could be given at any of the previous conferences but let us observe how the methods of investigation have changed in the last few years.

As an example of the first item, observations of erected structures, the measurements in tunnel and mining excavations may be cited. Whilst only pressures of rock or soil masses against the lining and the deformations of the linings were measured in the past, modern underground construction methods have encouraged the exact investigation of the deformations of the mass in the broad zone of the environment of the underground excavation. The measurements of fields of stress, both in natural conditions and in the course of excavation, have progressed. It may be said that such measurements *in situ* have presented a basis for the introduction both of modern tunnelling methods, resulting in considerable economy in manpower as well as in final cost, and of modern mining techniques. It is in this that the trends of modern development and the increase in the bond between civil and mining engineering are to be seen.

This tendency appears in the field of earth pressure but to a less pronounced manner, probably because setting the measuring points within the soil mass is more difficult. Nevertheless, it is to be hoped that the ability to invent ingenious techniques of measurement, as appear for instance in the activity of both the Canadian and British Building Research Stations, will succeed in this field as well. On the other hand excellent examples of the measurements of flexible sheet pile walls can be cited. They appear in the contributions to the Fifteenth Canadian Soil Mechanics Conference as well as in the activities of the German Arbeitsausschuss für Ufereinfassungen. Probably the activity of other institutions, namely of those in Belgium and in the U.S.A., should not be omitted, but to his sorrow the General Reporter cannot be omniscient.

To illustrate the second item, the use of models, many contributions might be quoted. The activity of Belgian, British, French, and Italian investigators appeared in the contributions to this Conference, deserving close attention not only for the results themselves but also for the refined measuring techniques. The review of the work of the mining laboratory in Essen under Professor Jacobi's and Dr. Everling's guidance, of that in Leipzig under Dr. Höfer, of the models invented by Professor Kuznecow in the U.S.S.R., of the laboratory in Bergamo, and of the Mining Institute in Prague will probably impress the visitor when observing the processes occurring in rock masses in the course of excavation. This activity represents the trend of development in this field.

The task of referring to the third item, analytical approach, is not without some embarrassment for the General Reporter. In the course of the discussion in this Division, the question of whether still more refined and elaborate mathematical analysis does not lead us away from the true aspects of civil engineering arose. Such a comment was to be expected. Discussions in the field of rheology may appear remote from the primary interests of civil engineers. The accentuation of theoretical investigation may appear to veil the primary merit of an engineer—his capacity and will to bear responsibility for the safe and economic design or construction—as well as that of a teacher to impress these virtues upon the mind of his pupils. Nevertheless, the *raison d'être* of such comments is not apparent. The conquests of modern engineering sciences could not be accomplished without the background of theory. There is no doubt that reasoning on the problems of rheology occupies an important position in the activity of this Conference. In order to tackle the actual problems appearing in the discussion to Division 5, the importance of the two approaches should be emphasized:

1. The static computations in the field of plastic equilibrium of soil and rock masses should be revealed in a more pronounced manner with respect to the true properties of actual materials.

2. Research in the analysis of partial safety factors is needed, with regard to the actual conditions in the field. The investigation of the problems of safety factors should be appreciated as a mark of scientific character and fostered in the activity of graduate students at the universities.

## DIVISION 6: D. MOHAN (INDIA)*

It was evident from the discussions during this Session that considerable progress has been made since the last conference in connection with the stability of slopes and the design and construction of earth and rockfill dams.

In the domain of theory we now have solutions, not simple but at least workable, for the method of slices where the surface of sliding is not circular and where the forces between the slices can be taken into consideration. These solutions will permit more reliable evaluation of the stability of many natural slopes and dams in which the surface of sliding is quite obviously far from circular.

In the general area that might be termed rational analysis of slopes and dams, in contrast to theory as such, the discussions in the last few days have revealed an increasing recognition of the significance of strains in stability problems. We have considered, for instance, the influence of strain on the structure of sensitive, saturated, normally loaded clays. We have discussed the influence of large strains on the shearing strength of stiff materials and on the long-term stability and ultimate strength of slopes. We have given considerable attention to the compatibility of strains among the various strata involved in slides and particularly among the various constituents of earth and rockfill dams. Recognition is certainly growing that, in the last analysis, cracking and the difficulties associated with cracking are caused by deformations rather than by stresses *per se*.

In the last four years, vastly improved means have become available for increasing our knowledge of the properties of rock fill. Some of the results from newly developed large triaxial and compressibility testing equipment for rock fill have been presented, and we have considered their influence on the design of several recent structures. There appears to be a trend, a very desirable one, to match the compressibility of the core and the shells of composite dams, particularly if the core has a nearly vertical attitude. The core materials of some of the dams that have been described are considerably more compressible than the shells; we have learned of some of the problems of arching that this disparity may introduce. In North America, from Canada into Mexico, it appears that most of the large dams fall into the opposite category in which the core materials are considerably less compressible than the shells; this situation also leads to possibilities of cracking.

The last four years have also brought us very greatly improved, more elaborate, more refined, and more frequent field observations in major dams. The results have included some surprises. They have indicated that the types and even the directions of some of the deformations were not always anticipated. They have confirmed that the cores of some of the largest dams are quite stiff elements as compared to the flanking rock fills.

Because of the relatively high compressibility of dumped rock fill, there is a continuing trend toward the use of rock fill compacted in layers. Improvements in compaction equipment, such as large vibratory rollers, are making this trend possible.

The problem of piping is still of vital importance in connection with dams and there have been interesting studies of the mechanism of the behaviour of filters. These studies are contributing to our understanding of the filter problem. Some of them are based on statistical approaches; these have not led to design procedures as yet because the statistical methods are based on the premise that the materials are homogeneous. These investigations are of fundamental interest and will undoubtedly continue. Yet, we must recognize that the real problems with filters are problems of segregation. We cannot yet place either filter materials or the materials that are to be protected in such a way that we do not get segregation. Studies are needed to improve the vital sections of dams where filters and drainage zones are located. There seem to be contrasting trends in this respect. On the one hand, some engineers prefer rigidly enforced filter specifications and, because such filters are expensive, narrow filter zones. On the other hand, other engineers prefer broader zones, that might more properly be called transition zones, in which the filter requirements are not necessarily so closely satisfied but where the advantage of having a considerable thickness of material obviates some of the problems associated with the segregation that seems to be inevitable. These differences of opinion need to be resolved on the basis of better data and a more fundamental appreciation of the real action of filters.

In connection with seismic problems, it appears that we are just entering a phase of rational analysis and genuine understanding of the behaviour of slopes and dams under seismic forces. There will doubtless be a great deal of interest in this subject, and by the time we meet in Mexico we may have had a considerable advance in this area.

Finally, I should like to comment on a thought that has forced itself into my mind several times during our discussions. It was expressed in much more detail by Professor Casagrande in his Terzaghi lecture last year. Possibly we are becoming overly specialized. All too recently, we have been confronted with examples of failures of water-retaining facilities caused by slides in the reservoirs, with an accident caused by the descent of ice from a glacier into the construction area, and with several other accidents not directly related to soil mechanics or to the activities of the soil mechanics specialist associated with the project. As Professor Casagrande pointed out, it is the duty even of the specialists to make sure that they are not divorced from the whole picture and that they are not deprived of the necessary intercourse with the specialists of other disciplines who are involved in the project. In this way, no vital item will be overlooked, even if it happens not to fall in the field of any of the specialists. True enough, some of the recent failures have not been failures of soil mechanics, but they are failures all the same; they are failures of the projects. In our trend and quest for increased knowledge in our specialty, we must be increasingly alert to avoid the narrowness that may lead to increasing frequency of engineering failures in the broad sense.

*Presented in his absence by R. B. Peck (U.S.A.).

# Report from the Organizing Committee

CANADA WAS SELECTED as the location for the Sixth Conference during the meetings of the Executive Committee held during the Paris Conference. With the authority of the National Research Council of Canada, and under the auspices of the Canadian National Committee (the NRC Associate Committee on Soil and Snow Mechanics), an Organizing Committee was established late in 1961 with Dr. R. F. Legget as Chairman, President Arthur Casagrande being an *ex-officio* member. Membership on the Committee was from all parts of Canada. The accompanying diagram shows how the Committee was organized, and how its work was divided.

It was possible to have a preliminary discussion about general plans for the Sixth Conference with Dr. Terzaghi, at his home in Winchester, Massachusetts, together with Dr. Casagrande. The Canadian Committee were especially glad that the Conference, as it finally took shape, followed the lines agreed to so definitely by Dr. Terzaghi. Following his death, it was natural and logical to mark his passing in a special way at the Opening Session, and this was a pivot around which the detailed planning of the Conference eventually developed.

The first meeting of the Organizing Committee was held in June, 1962. The location of the Conference was determined as Montreal. The Place des Arts was selected as the meeting place for the Conference, even though its foundations were only then being placed. The dates of 8–15 September 1965 were chosen, so as to span a weekend, in order to give two three-day working periods separated by a period for travel and relaxation.

### DETAILED PLANNING

The Committee had received from Canadians and others an excellent collection of valuable suggestions, arising out of experience at the Paris and earlier conferences. Although the Committee considered the adoption of some of these suggestions, they felt constrained to follow the "guide-lines" set up in the discussions of the Executive Committee at the Paris meeting. These made quite clear that the Executive Committee wished to have the Sixth Conference in the same general form as that at Paris, that is, with one main working session, preprinted papers, panel discussions based upon reports from General Reporters, and a similar grouping of main subjects.

Correspondingly, the Executive gave clear direction that the Organizing Committee was to take a firm line with regard to the number of papers from each member country and to

# Compte rendu du Comité d'organisation

LE CANADA A ÉTÉ CHOISI comme lieu de réunion du Sixième Congrès au cours des réunions du Comité exécutif qui ont eu lieu pendant le Congrès de Paris. Un Comité d'organisation a été institué vers la fin de 1961 avec l'autorisation du Conseil national de recherches du Canada et sous les auspices du Comité national canadien (Comité associé du NRC de mécanique des sols et de la neige). Le Dr R. F. Legget a été nommé président; le président Arthur Casagrande était membre de droit. Les autres membres du Comité provenaient de toutes les parties du Canada. L'organigramme ci-joint explique la création du Comité et la répartition de ses travaux.

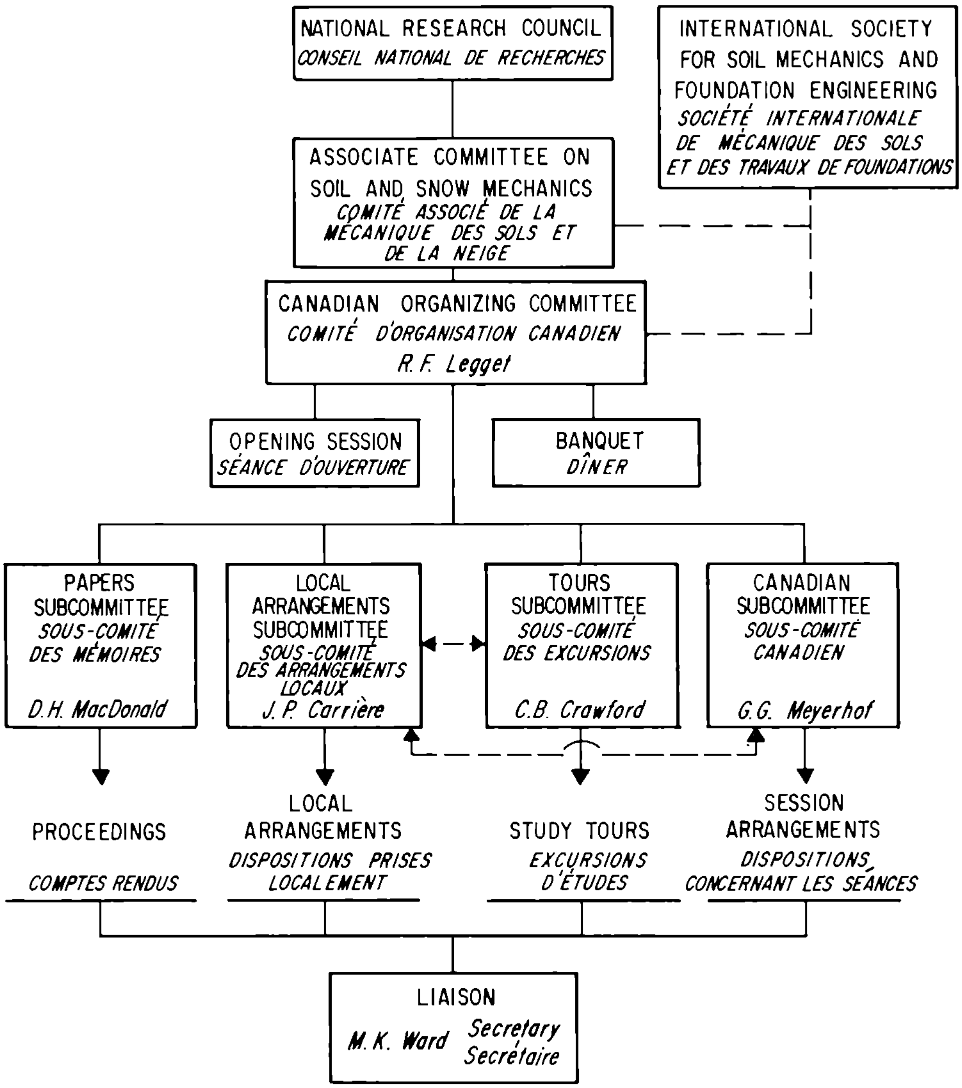
Il a été possible de mener à bien une discussion préliminaire au sujet des plans généraux du Sixième Congrès. Cette discussion s'est déroulée au domicile du Dr Terzaghi, à Winchester, Massachusetts, avec la participation de ce dernier et du Dr Casagrande. Le Comité canadien a été particulièrement satisfait du fait que le Congrès, dans sa forme finale, ait suivi les lignes que le Dr Terzaghi avait formellement acceptées. A la suite de la mort de ce dernier, il n'était que naturel et logique de commémorer sa disparition à la séance d'ouverture. C'est principalement en tenant compte de cette commémoration que le plan du Congrès a été finalement mis au point.

La première réunion du Comité d'organisation s'est tenue en juin 1962. Montréal a été choisi comme lieu de réunion du Congrès, et la Place des Arts pour la tenue des séances, bien qu'à ce moment cet édifice n'en fût qu'à la mise en place des fondations. La période du 8 au 15 septembre fut choisie de façon qu'une fin de semaine consacrée aux déplacements et au repos la sépare en deux sessions de travail de trois jours.

### DÉTAILS DE L'ORGANISATION

Des Canadiens et d'autres personnes ont fait parvenir au Comité de nombreuses et excellentes propositions suggérées par l'expérience du Congrès de Paris et des congrès précédents. Bien que le Comité ait pensé adopter quelques-unes de ces propositions, les membres se sont sentis dans l'obligation de suivre le schéma établi lors des discussion du Comité exécutif, au Congrès de Paris. Il en découlait clairement que le Comité exécutif souhaitait avoir pour le Sixième Congrès une organisation semblable à celle du Congrès de Paris, comprenant une série principale de séances de travail, des mémoires imprimées au préalable, des débats en groupe de travail basés sur les comptes rendus des Rapporteurs généraux et une répartition similaire des sujets principaux.

De même, le Comité exécutif a indiqué clairement que le Comité d'organisation devrait prendre une position ferme au




the length of papers when printed. This was done, with the result that no published paper exceeded five printed pages in length. Further to the instructions of the Executive Committee, abstracts of papers were prepared in three languages, those in Russian being made available to the Russian-speaking participants. Interpretation arrangements were made available for five languages. The Russian and German delegations took advantage of this facility at their own cost, as had been suggested at the Paris meetings.

These detailed matters gave the Organizing Committee much concern. They are mentioned here for record purposes and in answer to some criticisms that were voiced about the arrangements in Montreal. Reference to the expressed wishes of the Executive Committee will be found in Volume III of the Paris *Proceedings* (especially pp. 59–83). The Canadian Committee records its strong opinion that some of the procedures that it had to follow will not be suitable for future conferences. A detailed report upon all aspects of the Montreal meeting has been prepared and will be available for the guidance of those responsible for future conferences.

sujet du nombre de mémoires présentés par chaque nation membre et de la longueur des mémoires imprimés. Ces indications ont été suivies et aucune publication n'a dépassé les cinq pages imprimées. Toujours selon les instructions du Comité exécutif, on a préparé des analyses des mémoires présentés en trois langues. Les congressistes de langue russe ont ainsi disposé des analyses dans leur langue. Des dispositions ont été prises pour l'interprétation en cinq langues différentes des communications orales. Les délégations russe et allemande ont utilisé à leurs frais le système d'interprétation prévu, comme il en avait été décidé au Congrès de Paris.

Ces détails d'organisation ont causé bien des soucis au Comité pertinent. Nous les mentionnons ici afin que le fait soit connu et qu'il serve de réponse aux critiques exprimées au sujet des dispositions prises à Montréal. Le lecteur trouvera dans le III[e] volume des *Comptes rendus* du Congrès de Paris (plus particulièrement de la page 59 à la page 83) la liste des directives exprimés par le Comité exécutif. Le Comité canadien exprime nettement son opinion au sujet de quelques-unes des méthodes qu'il a dû suivre, et qu'il trouve mal adaptées pour les congrès futurs. On a préparé un rapport qui sera disponible pour la gouverne des personnes responsables de l'organisation des congrès à venir.

BULLETINS

As has been customary at previous conferences, a preliminary information bulletin, No. 1, was published in July, 1963. Twenty-five hundred copies were printed and multiple copies were despatched to the National Secretaries with the request that they be distributed to their members.

This bulletin was devoted to a general outline of the programme and, most important, gave specific instructions regarding the submission of papers. For each country, responsibility for the choice of papers was placed in the hands of the National Committees, as directed by the Executive Committee.

Bulletin No. 2 was published in January, 1965, and multiple copies were despatched to all National Committees early in February for distribution to their members. This bulletin contained the programme of the Conference and application forms for registration, accommodation, and the mid-Conference cruise.

Since it was agreed that a separate detailed Study Tours Bulletin would be airmailed to those who registered for the Conference upon receipt of their application form, a general outline only was included in Bulletin No. 2 together with a preliminary notice form. To facilitate the final planning of the proposed tours, registrants were asked to complete the form and submit it to the Secretary with their official registration.

PROCEEDINGS

The Organizing Committee entered into an agreement with the University of Toronto Press to produce the three volumes of the *Proceedings* and their willing and helpful co-operation has enabled the publication programme to be carried out smoothly and satisfactorily.

Volumes I and II were issued in July, 1965, as promised in Paris, and contained 218 papers from 40 countries. Table I shows the number of papers allocated to, and submitted by, each member country and the number of discussions submitted and accepted.

CONFERENCE PARTICIPATION

Table II gives details of registrations made by members from the various countries.

EXECUTIVE COMMITTEE

The Executive Committee met five times during the Conference, under the chairmanship of Dr. A. Casagrande. (A report of their meetings is given on pp. 55–60 of this volume.)

CONFERENCE SESSIONS

All Conference Sessions were held in the Grande Salle, Place des Arts, Montreal, Canada. The Conference was organized into six technical divisions with the complete technical programme being presented in nine consecutive sessions. All technical sessions began with a 50-minute general lecture.

Discussions at each session were opened by the General Reporter for the Division under discussion. He introduced those points which he considered worthy of comment and the sessions were then open to discussion, first by a panel of experts and then by individual members of the Conference. The procedure for the discussions, and the subjects to be treated, were outlined on pages 8, 9, and 11 to 14 respectively in Bulletin No. 2.

BULLETINS

Selon la pratique des congrès précédents, un bulletin de renseignements préliminaires portant le No. 1 a été publié en juillet 1963. Deux mille cinq cents copies ont été tirées et de nombreux exemplaires ont été envoyés aux secrétaires des Comités nationaux pour être distribués à leurs membres.

Ce Bulletin se consacrait à donner un aperçu du programme et pardessus tout à répandre les instructions particulières concernant la présentation des mémoires. Les Comités nationaux avaient la responsabilité du choix des mémoires présentés par leurs membres, selon les instructions du Comité exécutif.

Le Bulletin No. 2 a été publié en janvier 1965, et de nombreux exemplaires ont été envoyés aux Comités nationaux vers le début de février pour distribution à leurs membres. Ce bulletin contenait le programme du Congrès et des formules de demande concernant l'inscription, le logement et la croisière qui devait avoir lieu entre les deux sessions du Congrès.

Comme il avait été entendu qu'un bulletin séparé concernant les excursions scientifiques serait envoyé par courrier aérien aux personnes s'inscrivant pour le Congrès dès réception de leur formule de demande, seul un aperçu général était inclus dans le Bulletin No. 2, ainsi qu'une formule d'inscription préliminaire. Les personnes s'inscrivant officiellement étaient priées de remplir cette formule en vue de faciliter l'organisation des excursions prévues.

COMPTES RENDUS

Le Comité d'organisation a conclu une entente avec l'University of Toronto Press en vue de l'édition des trois volumes de *Comptes rendus*. La bonne volonté de cet organisme et son utile collaboration ont permis la réalisation satisfaisante et sans heurts du programme de publication.

Les volumes I et II ont été publiés en juillet 1965, comme il avait été annoncé à Paris. Ils contiennent 218 mémoires provenant de quarante nations. Le tableau I indique le nombre de mémoires alloué à chaque pays, le nombre de mémoires présentés et le nombre de dissertations orales proposées et acceptées.

PARTICIPATION AU CONGRÈS

Le tableau II donne le détail des inscriptions concernant les membres des divers pays.

COMITÉ EXÉCUTIF

Le Comité exécutif s'est réuni cinq fois au cours du Congrès, sous la présidence du Dr A. Casagrande. (Un compte rendu des réunions est donné aux pp. 55–60 du présent volume.)

SÉANCES DU CONGRÈS

Toutes les séances du Congrès se sont tenues dans la Grande Salle de la Place des Arts, à Montréal. Le plan du Congrès comprenait six divisions techniques et le programme technique complet a été présenté au cours de neuf séances consécutives. Toutes les séances consacrées aux questions techniques ont débuté par un exposé général de 50 minutes.

Le Rapporteur général de la division concernée ouvrait le débat à chaque séance. Il mentionnait les points intéressants qu'il considérait dignes d'être débattus; un groupe d'experts entamait ensuite le débat, suivis par des membres du Congrès, agissant individuellement. Le Bulletin No. 2, aux pages 8, 9 et 11 à 14, expose à grands traits les méthodes suivies lors des débats et les sujets traités.

La méthode détaillée à suivre lors des débats avait été

TABLE I. PAPERS AND DISCUSSIONS IN VOLUMES I–III/TABLEAU I. MÉMOIRES ET DISSERTATIONS DANS LES VOLUMES I–III

| Country/Pays | Original allocation/ Nombre alloué | Papers received and accepted/Mémoires reçus et acceptés | Number of discussions/ Nombre de dissertations |
|---|---|---|---|
| Argentina/Argentine | 2 | 1 | 2 |
| Australia/Australie | 5 | 5 | — |
| Austria/Autriche | 2 | 1 | 1 |
| Belgium/Belgique | 8 | 6 | 2 |
| Brazil/Brésil | 5 | 5 | 6 |
| Bulgaria/Bulgarie | 3 | 3 | — |
| Canada/Canada | 7 | 7 | 13 |
| Ceylon/Ceylan | 1 | 0 | — |
| China/Chine | 2 | 2 | — |
| Colombia/Colombie | 1 | 1 | 1 |
| Czechoslovakia/Tchécoslovaquie | 5 | 5 | 3 |
| Denmark/Danemark | 3 | 3 | 1 |
| Egypt/Egypte | 2 | 1 | — |
| Finland/Finlande | 1 | 1 | 2 |
| France/France | 17 | 17 | 8 |
| Germany/Allemagne | 8 | 7 | 11 |
| Great Britain/Grande-Bretagne | 21 | 21 | 14 |
| Greece/Grèce | 1 | 1 | 2 |
| Hungary/Hongrie | 5 | 5 | 1 |
| India/Inde | 6 | 5 | 3 |
| Ireland/Irlande | 1 | 1 | — |
| Israel/Israël | 5 | 5 | — |
| Italy/Italie | 6 | 6 | 5 |
| Japan/Japon | 9 | 8 | 13 |
| Lebanon/Liban | 1 | 1 | — |
| Mexico/Mexique | 4 | 2 | 3 |
| Netherlands/Pays-Bas | 8 | 8 | 1 |
| New Zealand/Nouvelle-Zélande | 1 | 1 | — |
| Norway/Norvège | 8 | 8 | 4 |
| Peru/Pérou | 1 | 0 | — |
| Poland/Pologne | 5 | 5 | 3 |
| Portugal/Portugal | 7 | 6 | 1 |
| Republic of South Africa/Republique de l'Afrique du Sud | 5 | 5 | — |
| Rhodesia/Rhodésie | 2 | 2 | — |
| Rumania/Roumanie | 3 | 2 | 1 |
| Spain/Espagne | 3 | 3 | 4 |
| Sweden/Suède | 7 | 4 | 1 |
| Switzerland/Suisse | 7 | 4 | 3 |
| Turkey/Turquie | 3 | 2 | 1 |
| U.S.S.R./U.R.S.S. | 19 | 19 | 17 |
| U.S.A./E.U.A. | 25 | 24 | 36 |
| Venezuela/Vénézuéla | 1 | 0 | — |
| Yugoslavia/Yougoslavie | 5 | 5 | 4 |
| TOTAL | 241 | 218 | 167 |

A detailed procedure to be followed at all sessions was prepared and airmailed to all Chairmen, Deputy Chairmen, General Reporters, and Panel Members on 18 May 1965. Included in these instructions was the request that all session officials should meet to discuss their own session arrangements (including panel discussions) not later than one hour before their respective sessions. Members who wished to contribute to the oral discussions were asked to submit their names on a form to be handed in to the attendants at the Discussions Desk not later than 1700 hours on the day prior to the session at which the member wished to speak.

After speaking, each contributor was asked to complete the form giving a written account of his contribution. All contributors to the oral discussions were instructed to submit their comments in writing at or subsequent to the Conference but before 15 October 1965. Technical Session Secretaries were provided by the National Research Council. Each session was staffed by six Session Stewards selected from Canadian Society members.

établie et transmise par courrier aérien le 18 mai 1965 à tous les Présidents, Présidents adjoints, Rapporteurs généraux et Membres des Groupes de discussion. Ces instructions mentionnaient également le fait que tous les organisateurs des séances devraient se réunir pour discuter des dispositions à prendre au sujet de celles-ci (y compris les débats des groupes de discussion) au moins une heure avant les séances dont ils étaient respectivement chargés. Les membres désirant intervenir dans les débats étaient priés de mentionner leur nom sur une formule et de la transmettre aux personnes en charge du bureau des débats, au plus tard à cinq heures de l'après-midi du jour précédant celui de la séance au cours de laquelle ils souhaitaient intervenir.

TABLE II. REGISTRANTS AT THE CONFERENCE/TABLEAU II. INSCRIPTIONS POUR LE CONGRÈS

| Country/Pays | Attending/ Présent | Registered, not attending/Absent | Ladies/ Déléguées | Total |
|---|---|---|---|---|
| Algeria/Algérie | 1 | — | 1 | 2 |
| Argentina/Argentine | 11 | 1 | 3 | 15 |
| Australia/Australie | 10 | — | 1 | 11 |
| Austria/Autriche | 4 | — | — | 4 |
| Belgium/Belgique | 11 | — | 3 | 14 |
| Brazil/Brésil | 15 | 1 | 5 | 21 |
| Bulgaria/Bulgarie | 1 | — | — | 1 |
| Canada/Canada | 323 | 14 | 64 | 401 |
| Chile/Chili | 3 | — | 1 | 4 |
| China/Chine | — | 5 | — | 5 |
| Colombia/Colombie | 35 | — | 1 | 4 |
| Czechoslovakia/Tchéchoslovaquie | 2 | — | — | 2 |
| Denmark/Danemark | 9 | — | 3 | 12 |
| Egypt/Egypte | — | — | — | — |
| Ecuador/Équateur | 1 | — | — | 1 |
| Finland/Finlande | 4 | — | 2 | 6 |
| France/France | 51 | 1 | 15 | 67 |
| Germany/Allemagne | 41 | 5 | 7 | 53 |
| Great Britain/Grande-Bretagne | 81 | 3 | 17 | 101 |
| Greece/Grèce | 3 | — | — | 3 |
| Hong Kong/Hong-Kong | 2 | — | 1 | 3 |
| Hungary/Hongrie | 2 | — | — | 2 |
| India/Inde | 5 | 1 | — | 6 |
| Indonesia/Indonésie | 1 | — | — | 1 |
| Ireland/Irlande | 2 | — | — | 2 |
| Israel/Israël | 5 | 1 | 1 | 7 |
| Italy/Italie | 29 | 4 | 15 | 48 |
| Jamaica/Jamaïque | 1 | 1 | — | 2 |
| Japan/Japon | 34 | — | 1 | 35 |
| Lebanon/Liban | 1 | 1 | — | 2 |
| Madagascar/Madagascar | 1 | — | 1 | 2 |
| Mexico/Mexique | 10 | 1 | 3 | 14 |
| Morocco/Maroc | 4 | — | — | 4 |
| Mozambique/Mozambique | 1 | — | — | 1 |
| Netherlands/Pays-Bas | 15 | 1 | 3 | 19 |
| New Zealand/Nouvelle-Zélande | 1 | — | — | 1 |
| Nigeria/Nigéria | 1 | — | — | 1 |
| Norway/Norvège | 8 | — | 2 | 10 |
| Pakistan/Pakistan | 1 | 1 | 1 | 3 |
| Peru/Pérou | 3 | 1 | 1 | 5 |
| Poland/Pologne | 1 | — | — | 1 |
| Portugal/Portugal | 4 | 1 | 2 | 7 |
| Puerto Rico/Porto-Rico | 2 | — | — | 2 |
| Rhodesia/Rhodésie | 3 | — | — | 3 |
| Rumania/Roumanie | 6 | — | — | 6 |
| Republic of South Africa/République de l'Afrique du Sud | 6 | 1 | 1 | 8 |
| Spain/Espagne | 15 | 2 | 7 | 24 |
| Sweden/Suède | 27 | — | 9 | 36 |
| Switzerland/Suisse | 19 | — | 5 | 24 |
| Thailand/Thaïlande | 1 | — | 1 | 2 |
| Turkey/Turquie | 2 | — | — | 2 |
| U.S.S.R./U.R.S.S. | 9 | 1 | — | 10 |
| U.S.A./E.U.A. | 345 | 30 | 101 | 476 |
| Venezuela/Vénézuéla | 9 | 2 | 1 | 12 |
| Yugoslavia/Yougoslavie | 4 | — | — | 4 |
| TOTAL | 1154 | 79 | 279 | 1512 |

### OPENING AND CLOSING SESSIONS

A full record of the proceedings at the Opening Session, held in tribute to the memory of Dr. Terzaghi, will be found in this volume (pages 75 to 83). By kind permission of the Officer Commanding, Quebec Command, the Band of the Royal Twenty-second Regiment of Canada played both before and after the official proceedings. The Conference was honoured by the presence of His Honour the Lieutenant-Governor of Quebec, the President of the National Research Council of Canada, and Alderman J. Lynch-Staunton, representing His Worship the Mayor of Montreal, who gave to the Conference his personal interest although prevented from

### OUVERTURE ET CLÔTURE DES SÉANCES

Le présent volume donne de la page 75 à la page 83 un compte rendu complet de la Séance d'ouverture consacrée à la mémoire du Dr Terzaghi. Avec l'autorisation du commandant de la région du Québec, la fanfare du Royal Vingt-deuxième Régiment joua au début et à la fin de la cérémonie officielle. La Séance du Congrès était illustrée par la présence de Son Honneur le Lieutenant Gouverneur du Québec, du président du Conseil national de recherches du Canada, et par M. J. Lynch-Staunton, officier municipal représentant M. le maire de Montréal. Ce dernier portait un grand intérêt au Congrès, mais n'a pu, pour des raisons majeures, y assister attending in person. (The Organizing Committee records with the greatest regret that, while this volume was in preparation, the Lieutenant-Governor, the Honourable Paul Comtois, lost his life in a tragic fire in his official residence at Quebec City.)

At the Closing Session, on Wednesday morning, the General Reporters made their final reports, decisions of the Executive Committee were announced, and the new President, Dr. Laurits Bjerrum, was introduced by the retiring President, Dr. Arthur Casagrande.

### LANGUAGES AND INTERPRETATION

Simultaneous interpretation of all discussions in the two official languages was available by earphones. Multi-channel receivers were provided for reception of interpretation into German, Russian, and Spanish by special arrangement with member countries using these languages. The Canadian Organizing Committee, through the co-operation of the Department of the Secretary of State, provided the French/English interpretation at all sessions.

### STUDY TOURS

It was the decision of the Canadian Organizing Committee to sponsor two main tours—a mid-Conference weekend cruise and study tour and a post-Conference Trans-Canada Study Tour, as well as a limited number of one-day tours, if interest (as determined from advance registration) warranted them. It was emphasized that all tours would be genuine study tours and useful adjuncts to the technical sessions of the Conference.

A Tours Subcommittee was set up by the Organizing Committee in March, 1965, to plan the details of each tour. This subcommittee was composed of those who would be responsible for each day tour (including the Ladies' Tours) as well as those who would be responsible for planning details for each stop on the Trans-Canada Tour. A detailed Study Tours Bulletin was published in April, 1965, and airmailed to each participant as he registered for the Conference.

The figures of attendance on the study tours were as follows:

| | |
|---|---|
| Saguenay Cruise (10 to 13 September) | 321 |
| Trans-Canada (15 to 23 September) | 56 |
| Montreal Construction (11 September) | 107 |
| Ottawa/Seaway (11 September) | 116 |
| Niagara Falls (11 September) | 69 |
| Manicouagan (11 September) | 52 |
| St. Lawrence/Quebec (12 September) | 34 |
| Montreal Construction (15 September) | 98 |
| Montreal Construction (16 September) | 71 |
| Ottawa/Seaway (16 September) | 73 |

The figures of attendance on the special tours arranged for ladies only were as follows:

| | |
|---|---|
| L1: Ottawa (9 September) | 35 |
| L2: Upper Canada Village (9 September) | 64 |
| L3: Laurentians (14 September) | 102 |

### CONFERENCE RECEPTIONS

All those taking part in the Conference were invited to two receptions during the course of the Conference. On Wednesday, September 8, His Worship Jean Drapeau, Mayor of the City of Montreal, and his Council, invited all members to a reception at the Chalet de la Montagne. On Monday, September 13, the Hon. Jean Lesage, Premier of

en personne. (Le Comité d'organisation rappelle que l'honorable Paul Comtois, lieutenant gouverneur du Québec, périt tragiquement dans l'embrasement de sa résidence officielle à Québec, alors que le présent volume était en cours de préparation.)

A la Séance de clôture, soit le mercredi matin, les Rapporteurs généraux lurent leur rapport final, le Comité exécutif annonça les décisions prises et le Président sortant, le Dr Arthur Casagrande, présenta le nouveau Président, le Dr Laurits Bjerrum.

### INTERPRÉTATION EN DIFFÉRENTES LANGUES

Un système d'écouteurs permettait d'entendre l'interprétation simultanée de tous les débats dans les deux langues officielles. Les membres de langues allemande, russe et espagnole pouvaient écouter l'interprétation simultanée dans leur langue au moyen de récepteurs multivoies. Le Comité d'organisation canadien assurait l'interprétation française et anglaise, grâce à la collaboration des services du Secrétariat d'Etat.

### EXCURSIONS SCIENTIFIQUES

Le Comité d'organisation canadien avait pris la décision de parrainer deux excursions scientifiques: une croisière d'études au cours de la fin de semaine divisant le Congrès en deux sessions, un voyage transcanadien après ce dernier, ainsi qu'un petit nombre d'excursions d'un jour au cas où les inscriptions préliminaires en indiqueraient la nécessité. Toutes ces excursions devaient être consacrées principalement à l'étude, comme compléments utiles aux séances techniques du Congrès.

Le Comité d'organisation institua en mars 1965 un Sous-comité des excursions scientifiques pour les préparer en détail. Ce Sous-comité se composait des personnes qui seraient chargées de chacune des excursions d'un jour (y comprise les excursions réservées à l'élément féminin) et de celles qui s'occuperaient de préparer chaque halte du voyage transcanadien. Un bulletin détaillé des excursions scientifiques fut publié en avril 1965 et envoyé par courrier aérien à chaque personne s'inscrivant pour le Congrès.

Voici le nombre des participants à chaque excursion:

| | |
|---|---|
| Croisière du Saguenay (du 10 au 13 septembre) | 321 |
| Voyage transcanadien (du 15 au 23 septembre) | 56 |
| La construction à Montréal (11 septembre) | 107 |
| D'Ottawa à la Voie maritime (11 septembre) | 116 |
| Les chûtes du Niagara (11 septembre) | 69 |
| La Manicouagan (11 septembre) | 52 |
| Le Saint-Laurent et Québec (12 septembre) | 34 |
| La construction à Montréal (15 septembre) | 98 |
| La construction à Montréal (16 septembre) | 71 |
| D'Ottawa à la Voie maritime (16 septembre) | 73 |

Le nombre des participantes aux excursions réservées à l'élément féminin était le suivant:

| | |
|---|---|
| L1: Ottawa (9 septembre) | 35 |
| L2: Village du Haut-Canada (9 septembre) | 64 |
| L3: Les Laurentides (14 septembre) | 102 |

### RÉCEPTIONS AU COURS DU CONGRÈS

Toutes les personnes participant au Congrès ont été invitées à deux réceptions pendant son déroulement. Le mercredi 8 septembre Son Honneur le Maire de Montréal, Jean Drapeau, invita tous les membres du Congrès à une réception au Chalet de la Montagne. Le lundi 13 septembre, l'honorable Jean Lesage, premier ministre de la Province de the Province of Quebec, tendered a reception in the Grand Ballroom of the Windsor Hotel. Both of these receptions had capacity attendance.

CONFERENCE DINNER

Approximately 1200 persons were present at the Conference Dinner in the Grand Salon of the Queen Elizabeth Hotel, on Tuesday, September 14, at which the Honourable C. M. Drury, Chairman of the Committee on Scientific and Industrial Research of the Privy Council of Canada, was the guest of honour.

FINANCES

In addition to the registration fees, and charges for sets of the *Proceedings*, the Conference was financed by a grant from the Government of Canada, through the National Research Council, and by grants from provincial governments, industries, consulting engineers, contractors, and others throughout Canada, as listed elsewhere in this volume (pp. 11–13) where the appreciation of the Organizing Committee is recorded. The study tours were almost exactly self-liquidating, as had been planned.

SECRETARIAT

The Organizing Committee was ably served by Mr. M. K. Ward, as Secretary, from May, 1963 onwards; he was assisted by the full-time services of one secretary, and the part-time services of several members of the secretarial staff of the Division of Building Research of the National Research Council of Canada. The Soil Mechanics Section of the Division, under Mr. C. B. Crawford, assisted with contributions of time from all of its members, at a steadily increasing tempo as the Conference approached, a total of three man-years being the combined working time devoted to the meeting. Voluntary contributions of time and services were given by soil mechanics workers throughout Canada, and in particular by the main committees, the members of which are listed on page 5 of this volume. It is making no invidious distinction to single out for special mention the Local Arrangements (Montreal) Subcommittee, under Brigadier J. P. Carrière, and its many subcommittees which were responsible for all local arrangements, and the Papers Subcommittee, under Dr. D. H. MacDonald of Niagara Falls. Although the latter committee was aided by some paid assistants, the time and effort that its members devoted voluntarily to the preparation of the three volumes of the *Proceedings* far exceeded anything that the Organizing Committee had originally visualized. An approximate estimate of the contribution of voluntary time thus given well exceeds two man-years. The appearance of the three volumes is, perhaps, the best tribute to this outstanding contribution.

Québec, offrit une réception dans la Grande Salle de bal de l'hôtel Windsor. Ces deux réceptions firent salle comble.

BANQUET

Environ 1 200 personnes étaient présentes au banquet du Congrès dans le Grand Salon de l'hôtel Reine Elisabeth, le mardi 14 septembre. L'invité d'honneur était l'honorable C. M. Drury, président du Comité de la recherche scientifique et industrielle au Conseil Privé du Canada.

FINANCES

Outre les droits d'inscription et le prix de vente des volumes de *Comptes rendus*, une subvention accordée par le gouvernement du Canada, par le canal du Conseil national de recherches, et des subventions provenant des gouvernements provinciaux, de l'industrie, d'ingénieurs-conseil, d'entrepreneurs et d'autres sources, servirent à financer le déroulement du Congrès. Le Comité d'organisation remercie vivement les donateurs, dont la liste apparaît aux pp. 11–13 du présent volume. Le financement des excursions scientifiques fut presque entièrement assuré par les participants, comme il avait été prévu.

SECRÉTARIAT

Le secrétariat du Comité d'organisation a été assuré avec compétence par M. M. K. Ward, à partir de mai 1963. Il était aidé par une secrétaire travaillant à plein temps, et occasionnellement par plusieurs membres du personnel du secrétariat de la Division de la recherche en bâtiment du Conseil national de recherches du Canada. La Section de mécanique des sols de cette Division participa, sous la direction de M. C. B. Crawford, à la préparation du Congrès à un rythme s'accélérant au fur et à mesure de l'approche de celui-ci. Tous les membres de la section contribuèrent de leur temps, dont le total atteignit le montant de trois années de travail d'une personne. Des spécialistes de la mécanique des sols de tout le Canada fournirent une contribution volontaire de temps et de bons offices. En particulier, le présent volume donne en page 5 la liste des membres des principaux comités ayant ainsi prodigué leur aide. Il n'est point désobligeant pour les autres de citer particulièrement le Sous-comité des arrangements locaux (Montréal) et ses nombreux sous-comités qui, sous la direction du général de brigade J. P. Carrière, prit toutes les dispositions nécessaires à Montréal, ainsi que le Comité des mémoires, dirigé par le Dr. D. H. MacDonald de Niagara Falls. Bien que ce comité ait reçu l'aide de quelques assistants rémunérés, le temps et les efforts que ses membres ont consacré volontairement à la préparation des trois volumes de *Comptes rendus* ont très largement dépassé les prévisions du Comité d'organisation. Le temps consacré volontairement aux travaux dipasse de beaucoup deux années de travail d'une personne. La publication des trois volumes est peut-être la meilleure illustration de cet effort.