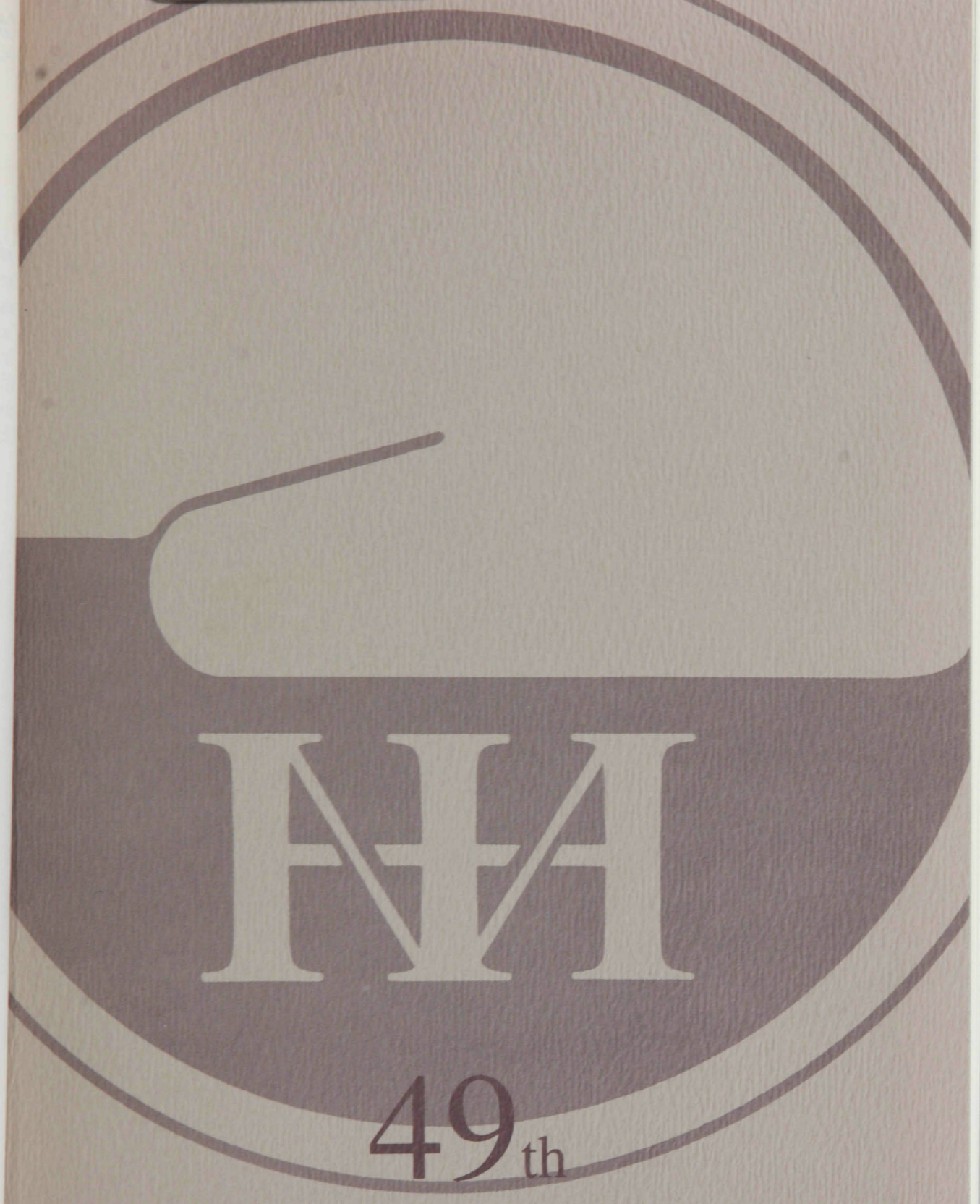

49th ANNUAL REPORT 1983/1984

Montreal Neurological Hospital
Montreal Neurological Institute

49th Annual Report

Montreal Neurological Hospital

Montreal Neurological Institute

1983-1984

(Version française disponible sur demande.)

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President, Board of Directors, Montreal Neurological Hospital

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Director General, Montreal Neurological Hospital

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Dean of Medicine, McGill University

Roméo Éthier, BA, MD
Neuroradiologist-in-chief, Montreal Neurological Hospital

Yves Fortier, QC, BCL, BLitt

David Lloyd Johnston, BA, LLB*°
Principal and Vice-Chancellor, McGill University

Colin Webster, BA, LLD
Governor Emeritus, McGill University

* Executive Committee member
° *Ex officio* member

Board of Directors
March 31, 1984

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Colin Webster, BA, LLD*
Elected by the Corporation

Ex officio member
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Director General and Director of Professional Services, Montreal Neurological Hospital

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Laughlin Taylor, BEd, MSc
Neuropsychologist, Montreal Neurological Hospital

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Storekeeper, Montreal Neurological Hospital
Elected by non-clinical staff

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Director of Social Work Department, Montreal Neurological Hospital
(Representing the Social Service Centres)

Richard Cruess, BA, MD, FRCS(C)
Dean of Medicine, McGill University
Appointed by McGill University

Yves Fortier, QC, BCL, BLitt
Elected by the Corporation

Jacques Laurent, BCL
Appointed by the Lieutenant-Governor of Quebec
(Representing Socio-Economic Groups)

Jacques Lorion
(Representing the CLSC)

Raymond Matte
Appointed by the Lieutenant-Governor of Quebec
(Representing Socio-Economic Groups)

Sonja Newman
Elected by voluntary organizations

Alan Gibb Thompson, MD, DABS, FACS, FRCS(C)
Elected by the Corporation

Jean-Guy Villemure, BA, MD, FRCS(C)
Neurosurgeon, Montreal Neurological Hospital
Elected by the Council of Physicians

Curtis Worthington, MD
Elected by interns and residents

Nancy Wright
Elected by the beneficiaries

Caroline Robertson, N, BN, MScA
Director of Nursing, Montreal Neurological Hospital
By invitation

Membership as of September, 1984
Robert Birkett
Verna Bound
Richard Cruess, MD
William Feindel, MD
Yves Fortier
Jacques Laurent
Richard Leblanc, MD
Peter Leggat
Jacques Lorion
Raymond Matte
Lawrence McDougall
Sonja Newman
Laughlin Taylor
Alan G. Thompson, MD
Jean-Guy Villemure, MD
Curtis Worthington, MD
Nancy Wright
Caroline Robertson *(by invitation)*
Joy Shannon *(by invitation)*
Colin Webster *(by invitation)*

* Executive Committee member

Council of Physicians Executive

Executive Committee, 1983-1984
Chairman, Denis Melanson, MD
Vice-Chairman, Jean-Guy Villemure, MD

Members
William Feindel, MD *(ex officio)*
Michel Aubé, MD
Gilles Bertrand, MD
Irving Heller, MD
Jean-Guy Villemure, MD

Committee Chairmen
Admission and Duration of Stay
Serge Gauthier, MD

Infection Control
Jean-Guy Villemure, MD

Library
Stirling Carpenter, MD

Medical Evaluation
Michel Aubé, MD

Medical Records
Bernard Graham, MD

Nursing (Patient Care)
Allan Sherwin, MD

OR-ICU
Gilles Bertrand, MD

Out-patient
Antoine Hakim, MD

Pharmacology
Allan Sherwin, MD

Research Evaluation
Ivan Woods, MD

Representative to the Board of Directors
Jean-Guy Villemure, MD

Representative to the Board of the Corporation
Roméo Éthier, MD

Executive Committee, 1984-1985
Chairman, Denis Melanson, MD
Vice-Chairman, Jean-Guy Villemure, MD

Members
Michel Aubé, MD
Gilles Bertrand, MD
William Feindel, MD *(ex officio)*
Irving Heller, MD
Richard Leblanc, MD

Director General and Director of Professional Services
William Feindel, OC, BA, MSc, MDCM, DPhil, DSc, LLD, FRCS(C), FACS, FRSC

Biomedical Engineering
Biomedical Engineer
Fernando Lebron, MASc

Brain-Scanning Laboratory
Director
Lucas Yamamoto, BSc, MD, PhD

Electroencephalography
Electroencephalographer and Neurophysiologist
Pierre Gloor, MD, PhD, FRCP(C)

Associate Electroencephalographers
Frederick Andermann, BA, BSc, MD, FRCP(C)
Luis Felipe Quesney, BSc, MD, PhD

Assistant Electroencephalographers
Eva Andermann, BSc, MD, MSc, PhD, FCCMG
Michel Aubé, BA, MD, FRCP(C)
Rachel Ochs, BSc, MD
Ivan (John) Woods, MB, BAO, MSc, FRCP(C)

Electromyography
Acting Electromyographer
Daniel Gendron, MD, FRCP(C)

Neuroanesthesiology
Neuroanesthesiologist-in-chief
Davy Trop, MA, MD, MSc, FRCP(C), FACA

Associate Neuroanesthesiologist
Mounir Abou-Madi, MB, DA, FRCP(C), DABA, FACA

Assistant Neuroanesthesiologists
David Archer, BSc, MD
Klaus-Peter Karsunky, MD*
Lise Morin, MD, FRCP(C)
Patrick Ravussin, MD, MSc, FMH

Neurochemistry
Neurochemist and Medical Research Council Career Investigator
Leonhard Wolfe, BSc, MSc, PhD, MD, FRCP(C), ScD, FRSC

Neurochemist
Hanna Pappius, BSc, MSc, PhD

Neurogenetics
Neurogeneticist
Eva Andermann, BSc, MD, MSc, PhD, FCCMG

Neurology
Senior Consultants in Neurology
Francis McNaughton, BA, MSc, MD, FRCP(C)
J. Preston Robb, MSc, MD, FRCP(C)

Neurologist-in-chief
Donald Baxter, MD, MSc, FRCP(C)

Neurologists
Frederick Andermann, BA, BSc, MD, FRCP(C)
James B.R. Cosgrove, MD, MSc, MSc, FRCP(C)**
Irving Heller, BSc, MD, MSc, PhD, FRCP(C)
George Karpati, MD, FRCP(C)
Allan Sherwin, BSc, MD, PhD, FRCP(C)

Associate Neurologists
Michel Aubé, BA, MD, FRCP(C)
David Caplan, BS, PhD, MD, FRCP(C)
Serge Gauthier, BA, MD, FRCP(C)
Bernard Graham, BA, BSc, MD
Antoine Hakim, BS, MS, PhD, MD, FRCP(C)
Ivan (John) Woods, MB, BAO, MSc, FRCP(C)

Assistant Neurologists
Gordon Francis, MD, FRCP(C)
Daniel Gendron, MD, FRCP(C)
Elizabeth Matthew, MBBS, FRCP(C)

Neuro-ophthalmology
Neuro-ophthalmologist
Trevor Kirkham, MBChB, DO, FRCS

Ne
Ne
Stirling Carpenter, AB, MD

Associate Neuropathologist
Yvon Robitaille, BA, MD, FACP

Assistant Neuropathologist
Kathleen Meagher-Villemure, BA, MD

Neurophotography
Neurophotographer
Charles Hodge, RBP, FBPA, AIMBI

Assistant Neurophotographer
Marcus Arts
André Claude

Neuropsychology
Neuropsychologist and Medical Research Council Career Investigator
Brenda Milner, BA, MA, PhD, ScD, FRSC, FRS

Associate Neuropsychologist
Laughlin Taylor, BSc, BEd, MSc

Assistant Neuropsychologists
Marilyn Jones-Gotman, BA, MA, PhD
Michael Petrides, BSc, MSc, PhD
Robert Zatorre, BA, MSc, PhD

Clinical Assistants
Bessie Alivisatos, BA, MA, PhD
Alain Ptito, MA
Mary Lou Smith, BSc, MSc

Neuroradiology
Neuroradiologist-in-chief
Roméo Éthier, BA, MD

Associate Neuroradiologists
Denis Melanson, BA, MD
Jacques Théron, MD

Assistant Neuroradiologists
Guy Breton, BA, MD***
Pierre Charles Milette, BA, MD***

Medical Physicist
Terence Peters, FCCPM, BE, PhD

Neurosurgery
Honorary Consultant in Neurosurgery
Theodore Rasmussen, BS, MB, MD, MS, FRCS(C), Hon DM

Neurosurgeon-in-chief
Gilles Bertrand, BA, MD, MSc, FRCS(C)

Neurosurgeons
William Feindel, OC, BA, MSc, MDCM, DPhil, DSc, LLD, FRCS(C), FACS, FRSC
André Olivier, BA, MD, PhD, FRCS(C)

Assistant Neurosurgeons
Richard Leblanc, BA, MD, FRCS(C)
Jean-Guy Villemure, BA, MD, FRCS(C)

Psychiatry
Psychiatrists
Louise Demers-Desrosiers, BA, MD, FRCP(C)
Ghislaine Savard, MD, FRCP(C)

Assistant Psychiatrist
Robert Bull, AB, BMSc, MDCM, FRCP(C)

Radiochemistry
Radiochemist
Mirko Diksic, BSc, MSc, PhD

Research Computing
Computer Systems Engineer
Christopher Thompson, BSc, MSc

Associate Computer Systems Engineer
Jean Gotman, ESE, MEng, PhD

* Resigned July 1984
** Died May 1984
*** Resigned September 1983

Administrative Consultants
Stephen Herbert, BSc, MHA
François Schubert, BSc (Pharm), DPH

Physiology
Kresimir Krnjevic, BSc, MB, PhD, FRCP

Veterinary Medicine
Richard Latt, DVM

Dr. Peter Bailey
Dr. Léo Berger
Dr. François Bertrand
Dr. Christine Bradley
Dr. Carlo Brogna
Dr. Scott Brown
Dr. Denis Brunet
Dr. Enrique Cardenas Molina
Dr. Jean-Louis Caron
Dr. Howard Chertkow
Dr. Andrew Cole
Dr. Rees Cosgrove
Dr. Alain de Lotbinière
Dr. Marc De Smet
Dr. Sandra Donnelly
Dr. Rachel Doody
Dr. Gary Dvorkin
Dr. Joseph Emrich
Dr. Susan Fox
Dr. Robert Foxford
Dr. Jacques Genest
Dr. Domingo Hipola Gonzalez
Dr. Dave Hollander
Dr. Robert Ikeman
Dr. Mimi Israel
Dr. Rubin Kuzniecky
Dr. Denis Ladouceur
Dr. Michel Levesque
Dr. Erich Marchand
Dr. François Marcotte
Dr. John Milton
Dr. Marie-José Monette
Dr. Johanne Morin
Dr. Donald Penney
Dr. Patricia Perl
Dr. Charles Posternack
Dr. Ricardo Reisin
Dr. José Rivas
Dr. Guy Rouleau
Dr. Jean-Pierre Roy
Dr. Allan Ryder-Cook
Dr. Jean Saint-Louis
Dr. Philippe Saltiel
Dr. Jeffrey Winfield
Dr. Curtis Worthington
Dr. Yonas Zegeye

Electroencephalography Laboratory
Dr. Scott Brown (McGill University)
Dr. Leslie Huszar (Semmelweiss University)
Dr. Michael Okogbo (University of Lagos)
Dr. Sharon Parnes (Brown University)
Dr. Philippe Saltiel (McGill University)
Dr. Michele Sammaritano (McGill University)
Dr. Myra Sourkes (McGill University)
Dr. Yonas Zegeye (Hahnemann Medical College)

Electromyography Laboratory
Dr. Denis Brunet (Laval University)
Dr. Jean-Louis Caron (University of Ottawa)
Dr. Rick Holmberg (University of Alberta)
Dr. Marie-Hélène Saint-Hilaire (University of Montreal)
Dr. Michele Sammaritano (McGill University)

Neuroanesthesiology
Dr. Alain Briand (University of Montreal)
Dr. Simeha Kleiman (University of Manitoba)
Dr. Simon Lucy (University of Manitoba)
Dr. Jocelyne McKenna (University of Ottawa)
Dr. Morris Siu-Chong (University of West Indies)
Dr. Paul Sloan (McGill University)

Neuro-ophthalmology
Dr. Gary Dvorkin (University of Alberta)
Dr. Israelian Gaspar (University of London)
Dr. Rami Morcos (University of Sherbrooke)
Dr. Marie-Hélène Saint-Hilaire (University of Montreal)
Dr. Brian Schmidt (University of Manitoba)

Neuropathology
Dr. Denis Brunet (Laval University)
Dr. Howard Chertkow (University of Western Ontario)
Dr. Rees Cosgrove (Queen's University)
Dr. Jean-Yves Delattre (University of Paris)
Dr. Gary Dvorkin (University of Alberta)
Dr. Joseph Emrich (McGill University)
Dr. Michael Leahy (University of Massachusetts)
Dr. José Rivas (University of Puerto Rico)
Dr. Allan Ryder-Cook (McGill University)
Dr. Michele Sammaritano (McGill University)
Dr. Brian Schmidt (University of Manitoba)
Dr. Curtis Worthington (Medical University of South Carolina)

Neuroradiology
Dr. Richard Cadotte (University of Montreal)
Dr. Jean-Louis Caron (University of Ottawa)
Dr. Howard Chertkow (University of Western Ontario)
Dr. Andrew Common (McGill University)
Dr. Benvon Cramer (National University of Ireland)
Dr. Françoise Dion (University of Montreal)
Dr. Donald Edde (McGill University)
Dr. Robert Filion (University of Montreal)
Dr. Erich Marchand (University of New Mexico)
Dr. Christel Mathis (McGill University)
Dr. Rami Morcos (University of Sherbrooke)
Dr. Viviane Nicolet (University of Montreal)
Dr. Jean Raymond (McGill University)
Dr. Ursula Roch (McGill University)
Dr. Karen Roche (McGill University)
Dr. Brian Schmidt (University of Manitoba)
Dr. Donald Smith (University of Vermont)
Dr. Despina Stavrakakis (University of Athens)
Dr. Marie Vanier (University of Montreal)
Dr. Brian Vickar (McGill University)
Dr. Curtis Worthington (Medical University of South Carolina)

Director of Nursing and Assistant Professor, School of Nursing, McGill University
Caroline Robertson, N, BN, MScA

Assistant Director of Nursing
M. Irene MacMillan, BA, N, MScA

Nursing Coordinators
Emily Andrews, N, BScN
Felicia Skretkowicz-Benarroch, N, BN
Joan Boucaud, N
Anne Carney, N, BN
Melencia de Guzman, N, BScN
Linda Maruska, N
Catherine Negus, N
Susan Panicker, N*
Margaret Smeaton, N*

Nurse Clinician and Lecturer, School of Nursing, McGill University
Linda Norman-Robbins, N, BN

Operating Room Supervisor
Norma Isaacs, N, BN

Head Nurses
Lucy Dalicandro, N
Marion Everett, N
Kimiko Hinenoya-Worsley, BA, N
Georgette Jotic, N
Cecilia Largo, BScN, N
Frances Murphy, N
Barbara Petrin, N
Ursula Steiner, N
Winsome Wason, N

Consultant in Nursing
Florence Mackenzie, N, BN, MScA

Assistant Director, Post Basic Program in Neurological and Neurosurgical Nursing and Lecturer, School of Nursing, McGill University
Ginette Imbeault, N, BN, MScA

Nurse Clinician Teachers, Post Basic Program in Neurological and Neurosurgical Nursing
Lise Desbiens, N, BScN
Geraldine Fitzgerald, N, BN

* Part-time coordinators

September 1983-February 1984
Maria Dufresne (Silliman University, College of Nursing, Dumaguete, Philippines)
Marta Cecilia Faccini (University of Pontifica, Bogota, Colombia)
Mary-Ann Jakubiak (Royal Victoria Hospital, Montreal, Quebec)
Elaine James (Lambeth Hospital, Kensington, London)
Mary Lou Moddison King (Toronto Western Hospital, Toronto, Ontario)
Ramona Kinnear (Jeffrey Hale's Hospital, Quebec, Quebec)
Patricia Sewell (Credit Valley School of Nursing, Mississauga, Ontario)
Ann Thorne (Dawson College, Montreal, Quebec)
Lorraine Weisenberger (Vanier College, St. Laurent, Quebec)

March 1984-August 1984
Ana Duque (Université Nationale de Colombia, Bogota, Columbia)
Céline Gauvreau (Collège Édouard-Montpetit, Longueuil, Quebec)
Pierre Redo (Lasalle Condal, Barcelone, Spain)

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Director of Auxiliary Services
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Director of Nursing
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Director of Social Work
Verna Bound

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Admitting
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Oresta Podgurny

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Rita Lacombe

Librarian
Marina Boski

Medical Records
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Roman Catholic
Father Francis Donnelly

Montreal Neurological Institute

Montreal Neurological Institute and Hospital
1933

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Director, National Institute for Medical Research
Medical Research Council of Great Britain

Ronald Christie, MSc, MB, MD, DSc, FRCP, FRCP(C), FACP
Emeritus Dean of Medicine, McGill University

Marc Colonnier, BA, BPh, MSc, MD, PhD, FRS
Director, Department of Anatomy, University of Ottawa

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Former Deputy Chairman, Board of Directors
Pulp and Paper Research Institute of Canada

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Emeritus Professor of Physiology, McGill University

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Professor of Neurosurgery, Duke University

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Professor, Departments of Biochemistry and Psychiatry, McGill University
Director, Laboratory of Neurochemistry, Allan Memorial Institute

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Former Director, National Institute of Neurological and Communicative Disorders and Stroke
US Department of Health and Human Services

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Governor Emeritus, McGill University

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Chairman, Department of Neurology and Neurosurgery, McGill University
Appointed by the Board of Governors, McGill University

Gilles Bertrand, BA, MD, MSc, FRCS(C)*
Associate Director (Neurosurgery), Montreal Neurological Institute
Elected by the staff of the Montreal Neurological Institute

Richard Cruess, BA, MD, FRCS(C)*
Dean of Medicine, McGill University
Appointed by the Principal, McGill University

Samuel Freedman, BSc, MD, FRCP(C), FACP, FRSC*
Vice-Principal (Academic), McGill University
Appointed by the Principal, McGill University

Yves Fortier, QC, BCL, BLitt
Governor, McGill University
Appointed by the Board of Governors, McGill University

Pierre Gloor, MD, PhD, FRCP(C)
Associate Director (Neurosciences), Montreal Neurological Institute
Elected by the staff of the Montreal Neurological Institute

Francis Glorieux, MSc, MD, PhD
Associate Dean (Graduate Studies and Research)
Faculty of Medicine, McGill University
Appointed by the Principal, McGill University

Lawrence McDougall, BA, BCL
Governor, McGill University
Appointed by the Board of Governors, McGill University

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Vice-Principal (Research), McGill University
Appointed by the Principal, McGill University

Alan Gibb Thompson, MD, DABS, FACS, FRCS(C)
Governor, McGill University
Appointed by the Board of Governors, McGill University

Member-at-large
Donald Byers, QC, LLD
Trustee, Estate of Dorothy Killam
Elected by the staff of the Montreal Neurological Institute from nominations by the Director

* Executive Committee member
° *Ex officio* member

Honorary Neuroscientists
K.A.C. Elliott, MSc, PhD, ScD, FRSC, *Neurochemistry*
Herbert Jasper, OC, PhD, DèsSc, MD, FRSC, DSc, *Neurophysiology*
Francis McNaughton, BA, MSc, MD, FRCP(C), *Neuroanatomy*
Theodore Rasmussen, BS, MB, MD, MS, FRCS(C), Hon DM, *Neurosurgery*
J. Preston Robb, MSc, MD, FRCP(C), *Neurology*

Neuroscientists
Pierre Gloor, MD, PhD, FRCP(C), *Neurophysiology*
Brenda Milner, BA, MA, PhD, ScD, FRSC, FRS, *Neuropsychology*
Hanna Pappius, BSc, MSc, PhD, *Neurochemistry*
Leonhard Wolfe, BSc, MSc, PhD, MD, FRCP(C), ScD, FRSC, *Neurochemistry*
Lucas Yamamoto, BSc, MD, PhD, *Brain-Scanning*

Associate Neuroscientists
Massimo Avoli, MD, PhD, *Neurophysiology*
Alain Beaudet, BA, MD, PhD, *Neuroanatomy*
Mirko Diksic, BSc, MSc, PhD, *Radiochemistry*
Heather Durham, BSc, MSc, PhD, *Neurotoxicology*
Robert Dykes, BA, PhD, *Neurophysiology*
Alan Evans, BSc, MSc, PhD, *Biophysics*
Jean Gotman, ESE, MEng, PhD, *Computer Systems Engineering*
Daniel Guitton, BEng, MEng, PhD, PhD, *Neurophysiology*
Kenneth Hastings, BSc, PhD, *Molecular Genetics*
Charles Hodge, RBP, FBPA, AIMBI, *Neurophotography*
Paul Holland, BA, PhD, *Biochemistry*
Barbara Jones, BA, MA, PhD, *Neuroanatomy*
Marilyn Jones-Gotman, BA, MA, PhD, *Neuropsychology*
Donald Lawrence, BSc, MD, FRCP(C), *Neuroanatomy*
Fernando Lebron, EE, MASc, *Biomedical Engineering*
N.M.K. Ng Ying Kin, BSc, PhD, *Neurochemistry**
Yogesh Patel, MD, PhD, FRACP, *Neuroendocrinology*
Terence Peters, BE, PhD, *Computer Systems Engineering*
Michael Petrides, BSc, MSc, PhD, *Neuropsychology*
Justine Sergent, BA, MSc, PhD, *Psychology*
Laughlin Taylor, BSc, BEd, MSc, *Neuropsychology*
Christopher Thompson, BSc, MSc, *Computer Systems Engineering*
Robert Zatorre, BA, MSc, PhD, *Neuropsychology*

Clinical Neuroscientists
Frederick Andermann, BA, BSc, MD, FRCP(C), *Electroencephalography*
Donald Baxter, MD, MSc, FRCP(C), *Neurology*
Gilles Bertrand, BA, MD, MSc, FRCS(C), *Neurosurgery*
Stirling Carpenter, AB, MD, *Neuropathology*
Roméo Éthier, BA, MD, *Neuroradiology*

William Feindel, OC, BA, MSc, MDCM, DPhil, LLD, DSc, FRCS(C), FACS, FRSC, *Neurosurgery*
George Karpati, MD, FRCP(C), *Neurology*
André Olivier, BA, MD, PhD, FRCS(C), Dip ABNS, *Neurosurgery*
Allan Sherwin, BSc, MD, PhD, FRCP(C), *Neuropharmacology*
Davy Trop, MA, MD, FRCP(C), FACA, *Neuroanesthesiology*

Associate Clinical Neuroscientists
Mounir Abou-Madi, MB, DA, FRCP(C), DABA, FACA, *Neuroanesthesiology*
Eva Andermann, BSc, MD, MSc, PhD, FCCMG, *Neurogenetics*
David Archer, BSc, MD, *Neuroanesthesiology*
Michel Aubé, BA, MD, FRCP(C), *Electroencephalography*
Robert Bull, AB, BMSc, MDCM, FRCP(C), *Psychiatry*
David Caplan, BS, MD, PhD, FRCP(C), *Neurolinguistics*
J.B.R. Cosgrove, MD, MSc, MSc, FRCP(C), *Neurology***
Louise Demers-Desrosiers, BA, MD, FRCP(C), *Psychiatry*
Gordon Francis, MD, FRCP(C), *Neurology*
Serge Gauthier, BA, MD, FRCP(C), *Neuroanatomy*
Daniel Gendron, MD, FRCP(C), *Electromyography*
Bernard Graham, BA, BSc, MD, *Neurology*
Antoine Hakim, BS, MS, PhD, MD, FRCP(C), DABPN, *Neurochemistry*
Irving Heller, BSc, MD, MSc, PhD, FRCP(C), *Neurology*
Klaus Karsunky, MD, *Neuroanesthesiology****
Trevor Kirkham, MBChB, DO, FRCS, *Neuro-ophthalmology*
Richard Leblanc, BA, MD, FRCS(C), *Neurosurgery*
Elizabeth Matthew, MBBS, FRCP(C), *Neurobiology*
Kathleen Meagher-Villemure, BA, MD, *Neuropathology*
Denis Melanson, BA, MD, *Neuroradiology*
Lise Morin, MD, FRCP(C), *Neuroanesthesiology*
Rachel Ochs, BSc, MD, *Electroencephalography*
Ronald Pokrupa, MD, FRCS(C), *Neurosurgery*
Luis Felipe Quesney, BSc, MD, PhD, *Electroencephalography*
Patrick Ravussin, MD, MSc, FMH, *Neuroanesthesiology*
Yvon Robitaille, BA, MD, FACP, *Neuropathology*
Ghislaine Savard, MD, FRCP(C), *Psychiatry*
Jacques Théron, MD, *Neuroradiology*
Jean-Guy Villemure, BA, MD, FRCS(C), *Neurosurgery*
Ivan (John) Woods, MB, BAO, MSc, FRCP(C), *Electroencephalography*

* Resigned June 1984
** Died May 1984
*** Resigned July 1984

MNI/MNH Academic Appointments
Department of Neurology and Neurosurgery
McGill University

(Brackets denote joint appointments.)

Chairman
Donald Baxter

Neurology
Emeritus Professors
Francis McNaughton
J. Preston Robb

Professors
Frederick Andermann
Donald Baxter
Irving Heller
George Karpati (Pediatrics)
Donald Lawrence (Anatomy)
Allan Sherwin

Associate Professors
Eva Andermann
Michel Aubé
David Caplan
J.B.R. Cosgrove*
Serge Gauthier
Bernard Graham
Antoine Hakim
Ivan (John) Woods

Assistant Professors
Gordon Francis
Daniel Gendron
Elizabeth Matthew
Rachel Ochs

Lecturers
Douglas Arnold
Heather Durham

Neurosurgery
Emeritus Professor
Theodore Rasmussen

William Cone Professor
William Feindel

Professors
Gilles Bertrand
André Olivier

Assistant Professors
Richard Leblanc
Ronald Pokrupa
Jean-Guy Villemure

Neurosurgical Research
Professor
Lucas Yamamoto

Neurophysiology
Professor
Pierre Gloor

Associate Professors
Robert Dykes (Surgery, Physiology)
Daniel Guitton
Luis Felipe Quesney

Assistant Professor
Massimo Avoli

Neurochemistry
Emeritus Professor
K.A.C. Elliott (Biochemistry)

Professors
Hanna Pappius (Biochemistry)
Leonhard Wolfe (Biochemistry)

Assistant Professor
N.M.K. Ng Ying Kin**

Associate Member
Nico van Gelder

Radiochemistry
Assistant Professor
Mirko Diksic (Chemistry)

Neuroradiology
Professor
Roméo Éthier (Radiology)

Associate Professors
Denis Melanson (Radiology)
Jacques Théron

Neuroanesthesiology
Associate Professors
Mounir Abou-Madi (Anesthesia)
Davy Trop (Anesthesia)

Assistant Professors
David Archer
Lise Morin

Visiting Assistant Professor
Patrick Ravussin

Lecturer
Klaus Karsunky (Anesthesia)***

Neuropathology
Professor
Stirling Carpenter (Pathology)

Associate Professor
Yvon Robitaille (Pathology)

Assistant Professor
Kathleen Meagher-Villemure (Pathology)

Neuropsychology
Professor
Brenda Milner (Psychology)

Assistant Professors
Marilyn Jones-Gotman
Laughlin Taylor
Michael Petrides (Psychology)

Lecturer
Robert Zatorre

Psychology
Lecturer
Justine Sergent

Biochemistry
Associate Professor
Paul Holland

Neuroanatomy
Professor
Donald Lawrence (Anatomy)

Associate Professor
Barbara Jones (Psychology)

Assistant Professor
Alain Beaudet

Biomedical Engineering
Associate Professors
Jean Gotman
Fernando Lebron
Christopher Thompson

Assistant Professor
Terence Peters (Radiology)

Biophysics
Assistant Professor
Alan Evans

Molecular Genetics
Assistant Professor
Kenneth Hastings

Neuro-ophthalmology
Associate Professor
Trevor Kirkham (Ophthalmology)

Neuroendocrinology
Professor
Yogesh Patel (Medicine)

Neuropsychiatry
Assistant Professors
Louise Demers-Desrosiers (Psychiatry)
Ghislaine Savard

Lecturer
Robert Bull

* Died May 1984
** Resigned June 1984
*** Resigned July 1984

Executive Committee of the Montreal Neurological Institute

Director
William Feindel, MD

Director Emeritus
Theodore Rasmussen, MD

Associate Director (Administration)
Joy Shannon, BA

Associate Director (Finance)
Norman Bleakley, FCMA

Associate Director (Neurology)
Donald Baxter, MD

Associate Director (Neurosciences)
Pierre Gloor, MD

Associate Director (Neurosurgery)
Gilles Bertrand, MD

Associate Director (Nursing Research and Education)
Caroline Robertson, MScA

Associate Director (Publications)
Victoria Lees, PhD

Associate Director (Research)
Leonhard Wolfe, MD

Associate Director (Research Evaluation)
Francis McNaughton, MD*
Ivan Woods, MD**

Senior Executive Secretary
Sophie Malecka, BSc

Assistant Executive Secretary
Linda Kandestin, BA

* To September 1, 1983
** From September 1, 1983

Research Fellows
July 1, 1983 to June 30, 1984

Cone Laboratory for Neurosurgical Research
Dr. Rees Cosgrove (Queen's University)
Dr. Pat Diladdo (McGill University)
Dr. Simin Farrokhzad (University of Cologne)
Dr. Amami Kato (Osaka University)
Dr. Michihiro Kirikae (Iwate Medical University)
Dr. Shin Kitamura (Nippon Medical School)
Dr. Keitaro Kobatake (Keio University)
Dr. Richard Leblanc (University of Ottawa)
Dr. Kirofumi Nakai (Asahikawa Medical College)
Dr. Kazuhiro Sako (Hokkaido University)
Stephen Strother (Auckland University)
Dr. Jane Tyler (Georgetown University)

Donner Laboratory of Experimental Neurochemistry
Dr. David Archer (McGill University)
Dr. Reynold Gold (visiting scientist, University of Toronto)
Dr. Ronald Pokrupa (University of Western Ontario)

Experimental Neurophysiology Laboratory
Paola Diadori (McGill University)
Dr. Daniele Giaretta (University of Padua)
Francis Jean (McGill University)
Dr. Itsuki Jibiki (University of Kanazawa, Japan)
Debbie Koffler (McGill University)
Dr. Maria Gracia Marciani (visiting scientist, University of Rome)
Douglas Munoz (McGill University)
Dr. Virginia Tancredi (University of Rome)
Nicole Tremblay (University of Quebec)
Michel Volle (University of Quebec at Three Rivers)

Neuroanatomy Laboratory
Raffi Balian (Yerevan State Medical Institute, USSR)
Dr. Olivier Bosler (visiting scientist, Centre national de la recherche scientifique, Marseille)
Dr. Edith Hamel (University of Montreal)
Dr. Emmanuel Moyse (École normale supérieure, Paris)
Michael Paré (McGill University)
Harry Webster (McGill University)
Kiran Yashpal (McGill University)

Neurogenetics
Kathleen Clark (Concordia University)
Linda Dansky (McGill University)
Dr. Orvar Eeg-Olofsson (visiting scientist, University of Goteborg)
Dr. Najma Aslam Janjua (McGill University)
Richard Nagy (McGill University)

Neuromuscular Research Group
Dr. Shashikant Champaneria (University of Newcastle-upon-Tyne)
Jeffrey Charuk (McGill University)
John D'Argenzio (McGill University)
Dr. Pierre Jacob (Laval University)
Brenda Joy (McGill University)
Dr. Anat Lev (Ben Gurion University of the Negev)
Dr. Marco Soza (visiting scientist, Catholic University of Chile)

Neuropsychology
Dr. Bessie Alivisatos (University of London)
Nicole Beaulieu (Concordia University)
Julien Doyon (Laval University)
Virginia Frisk (University of Waterloo)
Antonio Incisa della Rocchetta (University of Rome)
Gabriel Leonard (McGill University)
Laurie Miller (Westminster College)
Dr. Etienne Perret (visiting scientist, University of Zurich)
Mary Louise Smith (McGill University)
Dr. Robert Zatorre (Brown University)

Social Work
Judith Ripley (McGill University)

Director General's Report

Montreal Neurological Institute and Hospital
1935

Report of the Director General

This 49th Annual Report for the year 1983/84 records the activities of the Montreal Neurological Hospital summarized at the annual public meeting in June 1984 and outlines the work of the institute reviewed in the same month by the research staff at the annual Penfield Day. It includes reference also to the 50th anniversary celebrations held at the end of September, 1984, after which the administrative responsibilities were taken over by Dr. Donald Baxter as the new director of the institute, by Mrs. Joy Shannon as director-general of the hospital, and by Dr. Ivan Woods as director of Professional Services. These changes were made without losing any momentum in our teaching, research, and clinical activities, despite major ongoing projects that included the arrival and installation here of Quebec's first magnetic resonance imaging unit, the construction program to complete the Webster Pavilion and renovate the two older buildings, and rapid developments in brain imaging and neuroscientific research.

The report of the hospital is directed to our Board of Directors, the Conseil de la santé et des services sociaux de la région de Montréal métropolitain, and the Ministry of Social Affairs of Québec. The research work and postgraduate teaching at the institute is catalogued for the Principal and the Board of Governors of McGill University. This review also provides an opportunity to thank individuals in the hospital and institute and supporters at large for the generosity and interest that have made it possible for this integrated hospital and research institute to maintain its international standing in the world of neurology.

Highlights of 1983-1984

1. The development program, begun in 1972, is now in the final phase of renovation in the Rockefeller and McConnell Pavilions.

2. Progress on the Webster Pavilion continued steadily with completion of the entire shell of the structure, renovation and expansion of the EEG laboratories, and preparation of the ground floor for the installation of the Philips magnetic resonance imaging unit.

3. Plans are under way to complete the remainder of the Webster Pavilion to provide for NMR spectroscopy and chemical imaging research (PET), clinical and teaching office areas, and an auditorium and foyer space for use as a brain science display centre.

4. Funding to the institute from external grants increased over the previous year to peak in December, 1984 at almost $3 million. Careful control brought the annual expenditures on the institute side within the budget estimates that had been approved for basic research operations in 1983-84.

5. As this report is being completed, Dr. Baxter and the scientific staff are submitting a fourth annual detailed presentation to the Fonds de la recherche en santé du Québec (FRSQ) to substantiate again our request for increased support in line with that assigned to other Quebec hospital research institutes.

6. A deficit was created in our hospital operations, due partly to a closure of beds during our major renovations and partly to the severe constraints imposed by budget reductions from the Ministry over the previous three years.

7. Negotiations, begun in 1983, are still under way with the Ministry of Social Affairs to provide an operating budget for the magnetic resonance imaging unit as well as for the increased work load generated by the new techniques of interventional radiology. The capital cost has again been requested for a new CT scanner to replace the original 1973 model, which was one of the first units installed in North America.

8. Long-awaited new laboratories are being completed for molecular biology, neurotoxicology, evoked potential studies, and electromyography. In the Penfield Pavilion, the neurophysiology laboratory has been named for Dr. Herbert Jasper and the neuroanatomy laboratory for Dr. Francis McNaughton.

9. In September an MRC scientific team evaluated our PET research project. This resulted in a three-year extension with funding of just over $1,000,000, the largest competitive grant so far awarded for research at the institute.

10. Synapse-50, the celebration of our 50th anniversary, was held September 21-27, with the official opening of the Webster Pavilion featuring an international television linkage with other research centres, conferences organized by our social work and nursing departments, a special convocation provided by McGill University, and a series of distinguished lectures in neurology, neurosurgery, and the neurosciences.

Development Program

The hospital and institute have been supported by McGill's Board of Governors in assigning space for our expansion program over the past decade. In 1973 the former fieldhouse was demolished but its basement retained as the site of the cyclotron and radiochemistry unit for PET and for maintenance shops of the hospital and institute. From 1976-1978 the nine-storey Penfield Pavilion was built in space assigned between the Neuro and the Pathology Institute to meet urgent needs for neuroscience research and to provide modern resources for operating rooms, intensive care, nursing education, administration, and teaching.

The latest expansion, the Webster Pavilion, was assigned space in the north corner of Molson Stadium. Extensive excavation of bedrock gave an almost ideal location for the powerful new magnetic resonance unit designed for brain and body imaging. The second level of this pavilion will be used to house the positron emission tomography research unit closer to the cyclotron and radiochemistry laboratory. The third and fourth levels, already partly occupied by the EEG laboratory, will also provide space for research and clinical offices. On the top two storeys, the 350-seat auditorium will provide the only large conference centre in the entire RVH-Pathology Institute-Neuro complex. The foyer space on two levels has been designed as a centre for displays on the normal and disordered brain. The footings and columns of this pavilion are designed to support, in the future, an additional four levels.

Thus over the past decade the space of the hospital and institute increased, with the Penfield Pavilion, from 19,000 to 28,000 square metres. Taken with the houses provided on long-term loan by the university and the 4,500 square metres of the Webster Pavilion, the total now runs to some 33,000 square metres. Our size has almost doubled in the past ten years.

Building Program

In 1972, our building program began with an estimated budget of just over $3,000,000. Following negotiations with the governments in Quebec and Ottawa, the program was expanded to include construction of the Penfield Pavilion and renovation of the Rockefeller and McConnell Pavilions. Additional support awarded from a section of the Health Resources Fund designated for projects of national interest brought the total to $15,000,000. This included $2,300,000 in government grants for scientific and hospital equipment. For the additional cost of operating the Penfield Pavilion, a supplement to the hospital's annual operating budget of $1,000,000 was provided by the Ministry of Social Affairs of Quebec. We were fortunate in obtaining from the Canada Works Project a credit of $1,600,000 that made Phase IV possible. We are grateful to the Hon. Donald Johnston and his staff for his support in this effort and to the Hon. Pierre-Marc Johnson for the final negotiations on this arrangement. The phase IV renovations, necessarily carried out piecemeal in various parts of the two older buildings, have placed a great strain on patients and staff. Nevertheless, when this program is completed, toward the end of 1985, the entire hospital and institute will be a modern updated physical plant well equipped to continue its mission of treatment, research, and teaching.

Phase IV renovations updated the original operating theatre used for so many years by Dr. Penfield for the surgical treatment of epilepsy, completely renewed the research laboratories on the sixth and seventh floors, expanded the photographic department, and provided two new laboratory units for neurotoxicology and molecular biology. These areas will be air-conditioned or ventilated for the first time in over twenty years. Safety and security measures will include fire doors, a new fire detection and signalling system, and replacement of obsolete services. The former No.4 operating room in the McConnell Pavilion has been changed to provide facilities for the central supply area and a new brain scanning suite. The wards on 4 North and East, aside from being bright, spacious, and air-conditioned, will be serviced with medical gases and other supplies to ensure safe medical and nursing treatment for our patients. The plans call for similar changes on the second and third clinical levels. Alterations have been made in the administrative and nursing areas on the first floor. An adequate medical records areas has now been completed. All these improvements will provide not only efficient and coordinated clinical support areas but also more effective scientific laboratory resources to accommodate new techniques.

Finances

On the hospital side, the financial operations are reported by our Director of Finance, Mrs. Gean Pwu, and detailed statements will be found at the end of this volume. In view of the successive cuts imposed during the past three years by the Ministry, our position remains reasonably satisfactory. Much effort has been put into the constraint of expenditures by every department of the hospital and by the Audit Committee.We are particularly grateful to Peter Leggat, the chairman of the audit committee for the past ten years, Lawrence McDougall, president of the Board, and Colin Webster, honorary president, for their devoted help and advice. The fiscal situations of the Quebec hospitals are well known following restrictive budgetary impositions during the past few years. I pass on to our readers a statement by the financial officer of another organization faced with a similar problem: "The overexpenditures were due not to overspending but to underbudgeting." The administrators of Quebec hospitals will sympathize with this comment.

On the institute side, we have been encouraged by an increase this past year in grants obtained externally in competition. Our external grants at the end of 1984 total just under $3,000,000, representing a six-fold increase over the past decade. Thanks to the cooperation of the directors of the research laboratories and to the restraining, avuncular hand of Norman Bleakley, our Associate Director (Finance), the expenditures for the year 1983-84 were contained within the institute's budget estimates. A detailed financial statement appears at the end of this annual report.

Some 75 per cent of the external awards are derived from the competitive grant system funded by the Medical Research Council of Canada. We have had support also from the Fonds de la recherche en santé du Québec, but the level of this support does not match the institute's research productivity. Over the past four years detailed presentations have been made of the institute's research activities, including the number of scientific staff, students, extent of external grants, number of publications, and profiles of the neuroscientific research to support our request for a more appropriate allotment of research funds. Many of our research units, such as human neuropsychology, brain imaging, and neuromuscular research, are dominant if not unique in Quebec. We are grateful to three FRSQ presidents, Dr. Louis Poirier, Dr. Jean-Gil Joly, and Dr. Serge Carrière for their recognition of the need to correct the MNI's anomalous position among the Quebec hospital research institutes. Over the past year, with an allotment of just over $100,000, the Neuro placed 21st on a list of 23 such institutes in FRSQ funding, the highest grant on this list amounting to $5,000,000. Fortunately, as a result of a fresh approach in 1984, a new formula based on the amount of externally awarded competitive grants can be expected to bring the MNI up to the level that its research deserves. It will be a great satisfaction to both the retiring and the incoming director to see this fruition of our presentations and discussions.

Neuro Imaging

With the past decade's advances in computer and x-ray technology, remarkable imaging of the brain and spinal cord has become possible. Extensive capital investment was needed to keep the hospital and institute in the forefront of this field. CT scanning was introduced in Canada in 1973 when we installed one of the first half-dozen units in the world. This was made possible by the generous support of Howard Webster, together with the help of the Ministry of Social Affairs of Quebec.Within the next year a computerized tomography body scanner was provided through the support of many generous donors and the untiring efforts of Colin Webster. An advanced CT scanner from Technicare will be installed shortly. Our scientific staff will work closely with the design engineers on an evaluation program.

A third scanning technique derives from methods used by chemists for the past thirty years to identify molecular structure of chemical compounds. Nuclear magnetic resonance is based on the presence of certain atoms such as hydrogen, phosphorus or sodium which, having an unstable atomic structure, act like tiny magnets when placed in an electromagnetic field. The display of anatomical detail of brain structures by NMR is superior to CT scanning, and imaged cuts of the brain, or indeed any part of the body, can be obtained at any plane. The absence of radiation makes it possible to carry out imaging of children and to perform sequential studies to investigate the clinical course of neurological disorders. Certain lesions such as those of multiple sclerosis and tumors show up more selectively than on CT scans. With NMR there is the added component of spectroscopy, which allows non-invasive probing of the brain's chemical activity. A correlation between data from magnetic resonance and from the PET system offers our scientists and physicians an exciting prospect for future study.

At the Neuro, our experience with automatic brain scanning began in 1960 with gamma emitting radioisotopes, followed by CT scanning in 1973 and PET in 1975.We have built up a talented multi-disciplinary team of radiologists, physicists, computer engineers, radiochemists, neurologists, and neurosurgeons engaged in diagnosis and research in these fields. Generous grants from the McConnell Foundation provided the means of acquiring a magnetic resonance system from Philips International.The constraints of placing a powerful magnetic instrument in a hospital complex are considerable. Moving metal parts (such as auto engines) or radiofrequency broadcast bands can seriously disturb the homogenous stable magnetic field and distort the imaging system.Vice versa, a powerful magnetic field extending some twenty to thirty feet can demagnetize computer tapes, cardiac pacemakers, and of course attract small metal objects (keys, tools, money, or surgical instruments) which then become dangerous flying missiles. The space provided in the Webster Pavilion on the ground level, well removed from the car park and electronic instruments, proved ideal.

In addition to this 1.5 Tesla imaging and spectroscopy unit, we plan a smaller NMR instrument for the study of muscle diseases and living tissues. Dr. Douglas Arnold, a neurologist with an MRC fellowship, and Dr. Eric Shoubridge, a research biologist and former student at McGill, who have been working at Oxford with Dr. George Radda, will be returning to develop this project. Collaboration is planned with Dr. Patrick Vinay of the department of physiology at the University of Montreal, the chemical team at McGill including Dr. Brian Sanctuary and Dr. Françoise Sauriol, Dr. Charles Rossos in the Meakins-Christie Respiratory Research Unit, and Dr. Gerrard Price in the McGill Cancer Centre. We will thus have a powerful system for neurodiagnosis and for extending our knowledge of the application of NMR to living tissues. An added advantage will be the juxtaposition of the NMR and PET units. Comparison of these two systems will provide an unusual opportunity for examining the structure and function of the brain at the human as well as the experimental level.

Cone Laboratory for Neurosurgical Research

Twenty-five years ago, with the support of Dr. Penfield and Dr. Rasmussen, I began to work on the application of radioactive tracers for diagnosis and research of brain tumors and the study of cerebral circulation. From the beginning, we engaged engineers, mathematicians, and medical physicists to develop the technological aspects of this work. In 1962, Dr. Lucas Yamamoto joined the team with a background in neurosurgery and radiation biology. His enthusiastic work, especially in the experimental laboratory and in developing brain scanning, has been invaluable. With the photographic talents of Charles Hodge, we developed fluorescein angiography to display the cerebral vessels in a dynamic mode, a method now used extensively both in our experimental laboratories and the surgical treatment of vascular lesions. The experience with radioisotopes led us to develop in 1975 one of the earliest systems of positron emission tomography. This method, by which we can now image the brain's chemical activity in relation to a wide range of different chemical compounds as well as measure the oxygen utilization and blood flow, provides a multifactorial avenue for research at the human level for neurological disorders and for the normal functioning of the brain. The PET research team, having completed three years on a special project supported by the Medical Research Council of Canada, has been granted $1,000,000 for another three years to June 1987. During 1985, we will transfer most of the PET activities into the second level of the Webster Pavilion so that coordination with the computer and other imaging systems can be more effective.

Synapse-50

After two years of planning, we welcomed many former fellows, nurses, and friends of the institute to a celebration running from September 21 to 27. This latter date marked, to the day, the fiftieth anniversary of the opening of the institute. The celebrations included conferences, lectures, the official opening of the Webster Pavilion, and social gatherings.

The first conference, organized by the director of Social Work, Verna Bound, and her colleagues, was followed on Saturday by the Neuro staff day. Presentations were made to the stewards of the employees' union. A unique happening was the presence of all four of the hospital's directors of Nursing, Eileen Flanagan, Bertha Cameron, Joy Hackwell, and our present director, Caroline Robertson. A full program devoted to special lectures, workshops, and discussions on neurological and neurosurgical nursing was arranged by Miss Robertson and her committee.

The first plenary session of the celebrations was opened by McGill's new Chancellor, Jean de Grandpré (who served so expertly as president of our hospital Board from 1973 to 1977) and Principal and Vice-chancellor David Johnston. We were pleased to welcome Dr. Pierre Bois, president of the Medical Research Council of Canada and Dr. Serge Carrière, president of the FRSQ, at the Webster Pavilion opening. These two government organizations provide critical support to the Neuro's ongoing research programs.

The Webster Pavilion was officially dedicated by Colin Webster and Howard Webster with many members of their families and a large number of friends in attendance. A feature of this event was Tele-Neuro, an international television linkage with brain research centres in Washington; London; Paris; Santiago, Chile; Belgrade, Yugoslavia; and Kyushu, Japan. The lively exchange with Dominique Comar's group in Paris on dopamine receptors and between Michael Walker in Washington and our own group here on recent advances in the chemical treatment of brain tumors epitomized the value of the video linkage for rapid communication of scientific findings. The project was supported by Bell Canada, Teleglobe, the Ministry of Communications, and those in the centres involved. The entire production was made possible through the expert leadership of a CBC production team headed by Guy Robillard, who coordinated the various centres, organized the satellite facilities, and transformed our bare auditorium into an exciting live theatre. Although planned specifically for our anniversary celebration, many aspects of this internuncial linkage could be used as a basis for scientific and medical communication. Canadians have one of the most well organized satellite communications systems in the world and unbooked satellite time could well be devoted to educational and scientific exchange. We have proposed to the federal Minister of Communications that the Neuro serve as a trial station to evaluate such a system. We are grateful to the CBC telecommunications team, which made this program possible, and to Nicole Fillion, who was responsible for the liaison work.

The Synapse-50 organizing committee invited as lecturers distinguished experts in special fields.

Hughlings Jackson Lecture:
Dr. David Kuhl, UCLA—Emission imaging: an emerging view of the functioning brain

Theodore Rasmussen Lecture:
Dr. Charles Drake, University of Western Ontario—The surgeon investigator

Francis McNaughton Lecture:
Dr. Stanley Appel, Baylor University—Neurotrophic factors in neurologic disease: an approach to neuromuscular and brain degeneration

K.A.C. Elliott Lecture:
Dr. Igor Klatzo, NINCDS—Reaction of the brain to injury

William Cone Lecture:
Dr. Gazi Yasargil, University of Zurich—Cerebrovascular surgery

Herbert H. Jasper Lecture:
Dr. David Prince, Stanford University—Focal epilepsy and cortical neuronal function

Thomas Willis Lecture:
Dr. Miller Fisher, Harvard University—Cerebrovascular update

Donald McRae Lecture:
Dr. George Radda, Oxford University—From molecules to man: looking into the cell with nuclear magnetic resonance

Fellows' Lecture:
Dr. Blaine Nashold, Duke University—The DREZ (dorsal root entry zone) operation for pain relief

Fellows' Prize Lecture:
Stephen Strother and Dr. Jane L. Tyler—Local cerebral metabolic rates for glucose in the normal human brain: some quantification limits for positron emission tomography

Social occasions included an elegant dinner dance organized by Joy Shannon and the Friends of the Neuro, a reception warmly hosted by Mayor Jean Drapeau on behalf of the City of Montreal, and finally, another held at the McCord Museum, where an excellent exhibit on the activities at the Neuro was on display.

The organizing committee is most appreciative also to McGill University for the special convocation to mark the institute's anniversary. Four honorary degrees were conferred by Senate. Included among the recipients were two of our distinguished former fellows, Dr. Miller Fisher of Harvard and Dr. Donald Tower, formerly Director of the National Institute for Neurological Diseases and Stroke at Bethesda. Colin Webster, one of our institute's most devoted supporters, and I were also awarded degrees.

Following the formal program, a conference was held of representatives from the Canada Council, the Neuro, and the four universities that are involved in the Killam Scholarship and Awards Program.

Many deserve our thanks for their splendid help with these celebrations. We are particularly grateful to the members of the organizing committee. The publications committee (Curtis Cecil, Charles Hodge, and Victoria Lees) helped designer Robert Reid and me to produce "A Cerebral Celebration", a picture history reviewing the highlights of the past fifty years at the institute and hospital. Oresta Podgurny and her staff in dietetics, with the cooperation of the Canadian Pacific flight kitchen, supervised the catering for the anniversary, and successfuly handled an expanding crowd as registration numbers increased week by week before the celebrations began.

We are grateful to Douglas Elliott and Stephen Joo and their staff at McGill's Physical Plant, as well as to Winston Rochette and our hard-working housekeeping staff for the remarkable dispatch with which the auditorium, the lobbies, and the outside area of the upper level of the Webster Pavilion were prepared for the opening ceremonies. Clifford Williamson, a museum designer, expertly organized the historical display generously sponsored by the Hannah Institute and helped Dr. Roméo Éthier, Dr. Terence Peters, Dr. Jane L. Tyler, and associates to mount their imaging displays.

Staff honors

Among the many distinctions awarded to members of staff, the most outstanding include the following. Charles Hodge was elected honorary fellow of the Royal Photographic Society. Dr. Antoine Hakim won the Jonathan Ballon Award of the Quebec Heart Foundation for the most promising research proposal relating to cerebrovascular diseases. Drs. Stirling Carpenter and George Karpati published their extensive studies of neuromuscular disorders in a book titled *Pathology of Skeletal Muscle*. Dr. Brenda Milner was named an officer of the Order of Canada.

Successors
My term as director of the institute and hospital was extended to September 30, 1984, which proved timely since this coincided with the anniversary celebrations. Dr. Baxter, the new director, brings to this position the advantages of having had contact with the Neuro from his postgraduate days, and more recently as neurologist-in-chief and chairman of McGill's department of neurology and neurosurgery. His conscientious dedication and his strong interest in attracting young talent have been evident as we worked closely together over these past five years.

Joy Shannon, the hospital's new director-general, can be counted upon to take over this position with style and competence, so that the operations of the hospital, as well as our renovation and development program, will be ably directed. The medical and nursing staff will also be reassured in the appointment of Dr. Ivan Woods as director of Professional Services. His experience as president of the Council of Physicians and as my assistant in Professional Services during the past year gives him valuable background for the responsibility he will now assume for the clinical activities and the quality of teaching and research carried out within the hospital precincts.

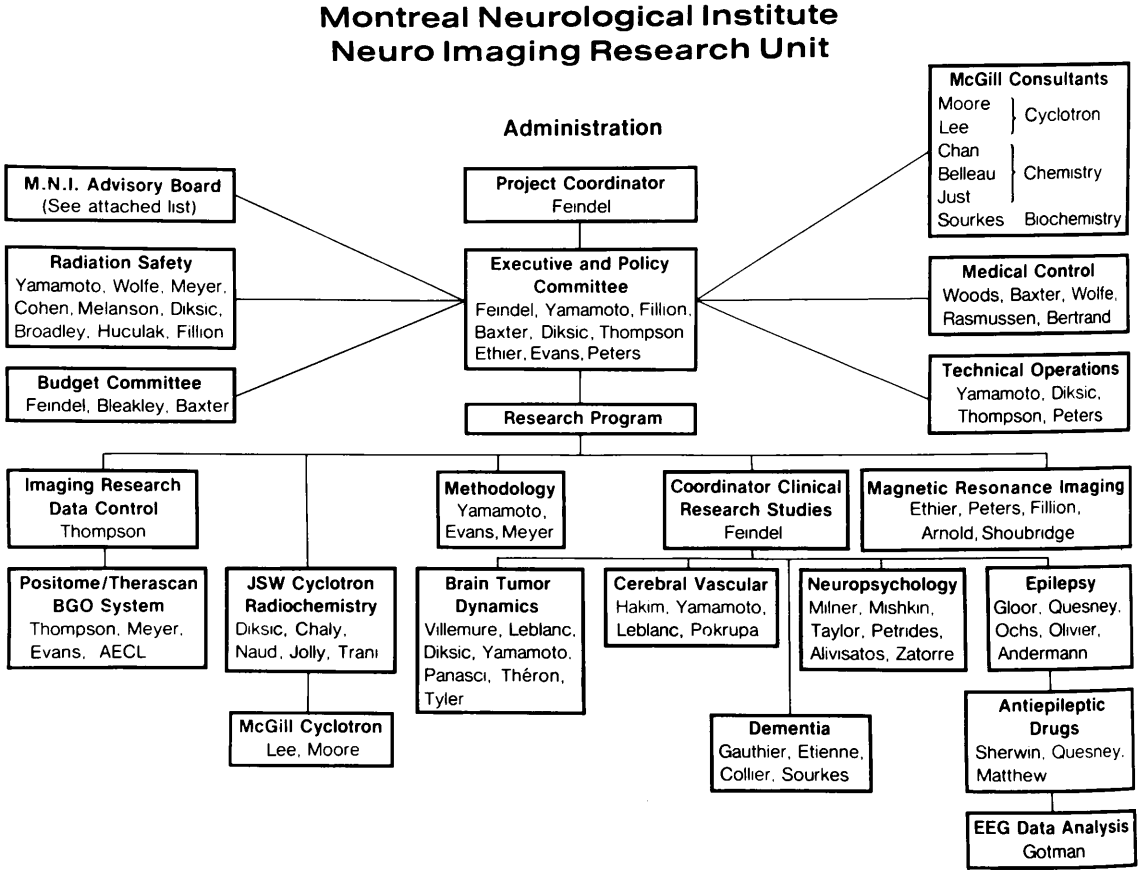
There can be no greater satisfaction for a retiring director than to realize that the future of the Neuro lies in such excellent hands. From January 1985, I will look forward to directing my attention more actively to the surgical treatment of epilepsy, and to supervising the active multi-disciplinary research team in positron emission tomography. In addition, I have accepted Dr. Baxter's request to coordinate the larger field of neuro-imaging research which encompasses PET and NMR imaging and spectroscopy, particularly during the activation of these new resources in the Webster Pavilion. I shall relish also more time for writing scientific reports, the projected history of the institute and hospital, and biographical studies on Dr. Penfield. I shall also continue as a consultant for the World Health Organization and the National Institutes of Health, USA.

Envolée
Heavy costs have been incurred for our construction and renovation programs, for the acquisition of high technology equipment to keep up to modern developments in brain imaging research, and for support of the increasing number of young scientists and physicians who have joined our team.The steady increase of our endowment funds over the past two decades, as noted in past annual reports, together with careful husbandry of these monies and a favorable increase in equity of the institute's investments have allowed us, so far, to meet these commitments. Improving the institute's grant contribution from the FRSQ is, however, critical to maintaining this financial balance. Nevertheless, the institute will continue to need substantial help of a special sort from supporters at large in order to continue its role as a world centre for study and treatment of disorders of the brain and spinal cord.

The human brain, which might well be viewed as the most complex system in the universe, remains an intriguing mystery. As Thomas Willis, the 17th century physician and founder of neurology, once wrote, "It understands all things but itself." And because many disorders affecting the brain's action are so far unsolved and untreatable, we continue to be faced with a relentless demand for research and for the modern means to carry this out.

Alan Gregg, of the Rockefeller Foundation, in his address at the institute's Second Foundation in 1954, commented, "Nothing succeeds like successors." Those of us who, like Dr. Rasmussen and myself are now predecessors, will continue to scan the scene at the Neuro with keen interest as the new team carries on this continuing cerebral celebration.

—William Feindel, OC, MD



Hospital Reports

April 1, 1983 — March 31, 1984

Montreal Neurological Institute and Hospital
1935

Neurology

The enthusiastic activities of the department of neurology during the past year were tempered in recent months by the premature and unexpected death of Dr. Bert Cosgrove. Dr. Cosgrove devoted virtually his entire professional career to this institution, and to the relief of the emotional and physical suffering of thousands of patients with chronic neurologic disease and in particular those with multiple sclerosis. His wise council is sorely missed by hundreds of patients. The residents and students have lost a teacher with unique experience and perspective in neurology, and his colleagues are the poorer without his friendship and steadying advice in times of difficulty. A second blow to the department came when ill health required Dr. Francis McNaughton to retire from active practice.

The departure of these two giants from the neurological scene at the MNH has accentuated the already hectic activities of the department. The teaching, research, and clinical activities of all three neurological services continue to increase. The year's teaching and research activities are outlined in other annual reports and need be mentioned here only briefly. The fact that members of the department have published 24 papers in addition to the book on skeletal muscle pathology by Dr. George Karpati and Dr. Stirling Carpenter, and have presented papers at eleven national and international scientific meetings is a measure of the investigative vigor of the department. Perhaps even more encouraging is the fact that nine papers were co-authored by trainees in the McGill neurology program, and that our residents have themselves presented papers at the American Neurological Association, the American Academy of Neurology, the Canadian Congress of Neurological Sciences, and the EEG Society.

In the past year over 11,000 patients were seen in our offices and clinics, over 1,200 more were seen in consultation at the Royal Victoria Hospital, and 1,020 patients were admitted to the neurological services of this hospital. Fifty patients died while under our care and autopsy studies were performed on 31. Cerebrovascular disease, epilepsy, neuromuscular disorders, tumors, multiple sclerosis, and so called degenerative CNS syndromes, in that order, were the most common conditions encountered by neurologists. It is interesting to note how the same problems occupy our research as well as our clinical interests. Dr. Frederick Andermann and Dr. Allan Sherwin have, of course, continued to make significant contributions to the much larger group at the institute studying the convulsive disorders while the closely knit research team in neuromuscular disease headed by Dr. Karpati must be the most productive in the country. The past year has seen the development of additional clinical research protocols on movement disorders and dementia by Dr. Serge Gauthier and his wife, on cerebrovascular disease by Dr. Antoine Hakim, on behavioral neurology and language by Dr. David Caplan, and now Dr. Gordon Francis is beginning to fashion a program in neuroimmunology which builds on the foundations laid by Dr. Cosgrove.

This pace of activity cannot be unaccompanied by problems and we have our share of these. None of them are new, but perhaps they bear repeating. Our office space and secretarial help are inadequate to provide the quality and efficiency of care which our patients and their referring physicians deserve, our in-hospital patient day stay is double what it should be (largely due to our inability to discharge chronic patients to proper facilities), our waiting lists for admission remain far too long, and we daily feel the need to improve the efficiency with which both our in-patients and our out-patients receive diagnostic investigations and treatment. Our department meets monthly to review all of our activities including these problems. We try to contribute as much as we can to the impressive efforts being made by our clinical colleagues, the several committees of the Council of Physicians and Surgeons, the nurses, social workers, secretaries, and many in the administration, who work so hard to try and resolve these difficulties.

Let me close by thanking all the residents in the neurology and neurosurgical training programs with whom the neurologists have worked in the past year. The competence with which they have helped us care for patients both here and in the Royal Victoria Hospital, the grace with which they have tolerated the idiosyncrasies of their supervisors, the skill with which they have organized our teaching rounds and conferences, their important contributions to the teaching of undergraduates, and their understanding in coping with the chaos of construction which added appreciably to an already heavy work load cannot be adequately acknowledged in words. Seven residents complete their clinical training this year. Two will immediately become full fledged clinical colleagues as Dr. Myra Sourkes joins the division of neurology at the Montreal General Hospital and Dr. Rami Morcos becomes a member of the neurological group at Hôpital du Sacré-Coeur. The other five, Drs. Philippe Saltiel, Brian Schmidt, Gary Dvorkin, Jack Jhamandas, and Denis Brunet will embark on a further two or three years of neuroscientific training. Once they have acquired these additional skills and set the stage for careers as physician-investigators, we fully anticipate that one or more of them will find their way back to this institute to contribute to its exciting future.

—Donald Baxter, MD
Neurologist-in-chief

Neurosurgery

Each year with the arrival of summer there also arrive the surgical statistics compiled by our operating room supervisor, Norma Isaacs. We look forward to them eagerly as they monitor closely the quantity and quality of the surgical teams' activities.

Because of the vacancy in our ranks resulting from Dr. John Wells' departure for Hamilton, I feared that there might have been a considerable reduction in our volume of surgery as compared to previous years, but in fact there was only an 8 per cent reduction with a total of 724 theatre cases, 294 of which were major craniotomies. Each one of the five remaining surgeons must therefore have worked a little harder. In fact, although fewer lumbar discectomies and carotid endarterectomies were done, there were more craniotomies for epilepsy, an all-time high of 97. Operations for pituitary tumors increased and we noticed many more stereotactic procedures of all types. We performed more tumor biopsies, electrode implantations for epilepsy or pain, and thalamotomies for involuntary movements.

A good deal of the renewed activity in stereotaxy has been due to the efforts of Dr. André Olivier and Dr. Terence Peters in adapting the modified stereotaxic frame to the new digital angiography apparatus and to the development of excellent computer programs to generate frame coordinates from CT scans, digital angiograms, and even MRI scans in expectation of this apparatus becoming functional in 1985. We should therefore be able to use MRI also to target deep cerebral structures with enough precision to carry out functional procedures without having to resort to ventriculography and other indirect methods of visualization.

On the other hand, we are worried by a slight increase in our infection rate to 1.4 per cent. We have always been able to keep this figure less than 1 per cent, and sometimes less than 0.5 per cent. Even after studying the reports painstakingly put together by Dr. Jean-Guy Villemure's infection committee, it is difficult to pinpoint the reason for this increase. Perhaps the dust from the construction has played a role. Electrodes implanted for long periods of time through the scalp certainly increase the risk of infection. Perhaps some changes in our dressing procedures are to blame, but we must increase our vigilance and carefully check every step of our surgical and dressing techniques.

Finally, this report would not be complete without a word of thanks to the nursing staff on the wards, to Miss Isaacs and her OR staff, to our anesthesia colleagues, and to the resident staff headed by Dr. Curtis Worthington, Dr. Yonas Zegeye, Dr. Erich Marchand, and Dr. Jeffrey Winfield. Their devotion and enthusiasm have made our task easier and more rewarding. We hope we have been able to teach our residents as much as they teach us. To Dr. Scott Brown, who now finishes his training, we wish a successful career.

—Gilles Bertrand, MD
Neurosurgeon-in-chief

Council of Physicians

In the past year the Council of Physicians has focused on the assurance of quality medical care and the smooth running of tests and procedures on both in- and out-patients.

Four new members joined the medical staff of the hospital and the council in the past year: Drs. David Archer, Gordon Francis, Rachel Ochs, and Jacques Théron. Two members have resigned, Drs. George Elleker and Peter Karsunky. The council has also noted the untimely passing of one of its senior members, Dr. J.B.R. Cosgrove.

The main goal of the council is to ensure the proper medical functioning of the hospital and that this mandate be mainly carried out by the Medical Evaluations Committee. Dr. Michel Aubé, chairman of this committee, formulated a detailed questionnaire relative to the above, the object of which is to shorten the stay of patients in hospital. The report resulting from this survey recommended logical utilization of diagnostic tests to decrease hospital stay. Also, a new format for death analysis was proposed and will be set up next September.

Several ad hoc committees formulated protocols concerning patients undergoing prolonged EEG monitoring and depth electrode implantation, and delegated medical acts to nurses in x-ray.

The Quebec Corporation of Physicians surveyed the hospital in March. Comments were generally favourable, though the surveyors remarked on the lack of a medical archivist. The administration is currently seeking a candidate for this position.

The matter of consent and the role of the public curator were discussed at length. The procedure, after some initial apprehension, has been working fairly smoothly both from a medical and clerical viewpoint.

Administrative matters concerning the council have included plans for the neurodiagnostic centre and the relocalization of out-patient clinics. We hope that these plans will be successfully realized in the near future.

In regard to chronic care status, a letter has been prepared at the level of the Board of Directors by the representatives from the council and Social Service in view of justifying a special status for our hospital in relation to the Ministry and to reception at convalescent care centres.

All committees of the council are to be commended for their assiduity and activity. We thank the non-council personnel such as James Gates, Verna Bound, and Caroline Robertson who help to manage these effectively. The functions of the Credentials Committee have been assumed by the Executive. The Council no longer has a Nursing Committee but does have representatives on the Nursing Liaison Committee. The former chairman of the council, Dr. Ivan Woods, has been appointed assistant to the director of Professional Services as well as chairman of the Research and Ethics Committee; he deserves much credit for both these roles. After a lengthy search, Dr. Donald Baxter has been appointed director of the Montreal Neurological Institute by the McGill Search Committee. We wish him much success.

The Council of Physicians of the MNH is committed to maintaining an environment of quality medical care for its patients. Though the hospital enjoys a world-wide reputation for scientific and medico-surgical excellence, the Executive Committee would like to see the Neuro considered as an accessible centre of reference to patients of the immediate community.

—Denis Melanson, MD
Chairman

Nursing

Nursing continues to organize the department under the combined administrative, clinical practice, education, and research aspects of the nurses' role.

This combination does involve difficulties but it also reflects what nursing is about. It avoids tunnel vision focused on only one aspect of nursing and helps us to rely on each other as colleagues. Not all of us are expert in all activities but I wish to congratulate the coordinators and head nurses for their honest efforts to adapt and be models of the combined role.

Another part of our organization gives us great satisfaction. We really have managed to commence primary nursing over this last year. We have two self-learning modules completed and two in preparation. The head nurses as well as Nursing Practice Committee members have worked hard to set guidelines and achieve this goal.

Our research committee, meeting more frequently, worked on three small projects, including one which computerizes our 1978 study on classification of patients. Another project will, we hope, allow us to reduce incidents of falls and skin breaks.

We have once again planned within our salary budget to allow 1.8 staff members at any given time to be learning to improve care. There are still no extra funds to permit replacement for these individuals. The registration fees and small travel allowance come from the E.C. Flanagan and the McDougall Funds for which we are grateful.

At the same time it is unfortunate to report that at any given time four persons are ill in our department and there is no replacement allowance for these individuals.

In preparation for an accreditation survey, we have been occupied in revising manuals and documenting our practice. Much thought has been given to quality assurance. Our present tracer audits in areas of concern demonstrate our evaluation methods. Twenty-nine audits were completed.

Francization of our nursing forms for the patients' records was completed. Bilingual documentation continues to be a costly item in nursing time and energy. We realized more patient teaching this year and the head nurses have developed a discharge planning form for the patient and his subsequent care-giver.

We are concerned for patient and staff safety as we try to give care while the walls come tumbling down in preparation for the renovated units. Infections have increased in spite of the work being done to control them. We are attempting to control the many factors which we believe added to this increase.

The radiology nurses have contributed to the new interventional radiology methods which resulted in an increased workload. All of us have suffered through the disarray of a central supply department working out of four separate areas. I particularly wish to commend the central supply and radiology nurses.

If we did not believe in the future, it would have been impossible for us to work through the present during this past year. However we have visions of new medical gases for each patient, a central supply that really can supply us, and patients safely nursed in bright and well-equipped surroundings. In the meantime, the Royal Victoria Hospital Auxiliary supplied us with funds for teaching aids, air mattresses for the bath boards, and wheelchair trays. We thank them for this help. Volunteer McGill students also helped promote much-needed patient diversional activities.

Recruitment plans for the post basic program in neurological and neurosurgical nursing have been increased. A coordinated package of brochure, stationery, and application forms helps us to show what we have to offer. A part-time option was provided for staff nurses which was so well accepted that six joined the regular post basic group.

This report gives me the opportunity to speak out on behalf of our nursing staff. Every day nursing exercises influence in this hospital. We belong to four joint-practice committees and organize five clinical working committees for the improvement of patient care. We also have an administrative committee of our own and organize two problem-solving committees for equipment and supply. We would like to expand the multidisciplinary approach to improve patient care and look forward to further collaboration. When we no longer have wards to move, dust and traffic to control, staff, patients, and relatives to reassure, just think of all the nursing time we will have for development and improvement of patient care. As it is, Synapse-50, our fiftieth anniversary celebration, looms on the horizon and we intend to make it a joyful one. To those who helped us to carry on in spite of the disruptions and who help to create a climate for learning and development we are indeed grateful.

I particularly wish to acknowledge Dr. Feindel's help to the Nursing Department. He has never discouraged us in our effort to hang on to quality; he always has a new suggestion for improvement. We will miss greatly his morning visit to enquire how everything is going. When there is a problem he encouraged us to "sort it out". Like Drs. Penfield and Rasmussen before him, he has high expectations of nurses as problem solvers and as managers of the twenty-four hour service to patients. We wish him and Mrs. Feindel continuing good health and enjoyment of their work. They are both models we can emulate.

—Caroline E. Robertson, N, BN, MScA
Director of Nursing

Administration

At a recent hospital conference the theme was "Who Cares?"

The answer, of course, is that many care. Health is so central to our ability as individuals to lead productive and rewarding lives that health services must be viewed as essential human needs.

1983-1984 has been a year of change. We have a new minister and financial representative. We have said good-bye to many colleagues who after years of loyal service have left to enjoy retirement. We recently bade a sadder farewell to Dr. J.B.R. Cosgrove. New faces have appeared on the scene; we welcome them and look forward to working with them. We are also in the midst of physical change. Extensive renovations have created and are creating inconvenience, and in some cases, actual discomfort to a large number of staff. Change is often uncomfortable, but without it there can be no growth.

Last year I mentioned that financial concerns dominate our thinking, our planning, and ultimately our decisions. You have heard the report of our director of finance and we are not displeased with our stewardship. Now, however, the Montreal Neurological Hospital, along with other hospitals in our region, has protested further cuts. We have trimmed, we have cut back, we have said no when we should have said yes, we have patched and repaired when we should have replaced. In spite of this we have, thanks to dedicated medical, nursing, and support staff, maintained a reasonable degree of quality patient care. However, we tread a fine line and further budgetary constraints would jeopardize our patient services. We find the modifications made to the 1984-85 budgets encouraging, but the Montreal hospitals are ready to act in unison if we are pushed to the point that patient safety is threatened.

Both the board and staff of the hospital have heard about the problems of our construction program. However within the foreseeable future we will have a building of which we can be proud. Bright and clean, it will house improved facilities including quiet and recreational areas for our patients. We will have a central kitchen permitting us to be innovative in the preparation and serving of meals. In September we hope to unveil two art projects in accordance with regulations requiring that 1 per cent of the construction budget of public buildings be spent on some form of decorative art conceived and executed by Québec artists. Three artists are chosen by committee for each project and the winning submissions are selected by jury.

The Montreal Neurological Hospital endorses the concept of shared services whenever and wherever these can result in increased efficiency with decreased or parallel costs. When Léo Robitaille resigned for health reasons last autumn, Normand Rinfret, director of Human Resources at the Royal Victoria Hospital, reached an agreement approved by our respective boards to share personnel services. We are six months into this project, and while there are still mutual problems to be solved, we are pleased with the results and optimistic about the future.

Last year I mentioned the achievements of the "Friends of the Neuro", our volunteer group. With their diverse talents and experience, these fifteen ladies bring an added dimension to our hospital. Recently they organized a dinner-dance in honour of our 50th anniversary. It was a splendid effort, and they raised $28,500. I thank them all, in particular Jill Price, who chaired the organization committee. The group is now actively involved in our preparations for the 50th anniversary celebrations next September. They are valued colleagues and friends in the truest sense of the word.

Who cares? We do, but let us take note that care is not an emotion, it is an action word. It has always been the theme of the Neuro, and will continue to be so.

—Joy Shannon, BA
Associate Director-General

Finance

For the third consecutive year the ministry has imposed budgetary restraints on our establishment. Altogether, $641,000 has been cut from the last two annual budgets. The department heads, well aware of these cutbacks, have been extremely cooperative about coping with them.

The admission statistics are as follows:

Number of admissions	1,779
Patient days	42,764
Number of patients discharged	1,777
Total days stay	41,186
Average days stay	23.18
Occupancy rate	86.55

In purchasing, we processed 2,709 hospital orders and 697 institute orders. Stores handled 7,169 deliveries from suppliers, and filled 3,451 requisitions to both hospital and institute.

The administrative wheels for the phase IV construction project were set in motion in November 1982. We received official approval from the ministry in December 1983, and contractors then began work on our building. Our department has been heavily involved in the financial arrangements for these badly needed renovations.

In May 1983, Maria Tarsitano joined us in Purchasing, and in January 1984, Guy Lambert left to take up a post with the World Health Organization in Africa. Blair Coyle was given the task of overseeing Stores.

—Gean-yuan Pwu, BCom
Director of Finance

Social Work

A serious concern in our annual report this year is not the lack of activities in the department but the persistent, nagging problem of increasing numbers of long-term patients. Because social workers have the mandate to assess patients and arrange for their discharge to alternative care facilities, the pressure on the department increases with the number of patients.

This pressure is the result of hospital staff expectations as well as social workers' own feelings of powerlessness to affect the system. We are caught in a complex, problematic situation which must be shared by the hospital, staff, families, and community. The Regional Council has made it very clear that people requiring chronic care and living in the community will be given priority. Patients requiring heavy nursing care will remain in the acute care hospitals. Our social workers spend many tedious hours completing and coordinating the paper work involved in the current "système d'admission". To say it is frustrating and a poor use of highly trained staff is an understatement.

The type of neurological disorders in our hospital is second in length of stay only to psychiatry, as identified in ministry statistics. Solutions to continuing care following acute treatment must be sought both within and outside our hospital. In the meantime, our screening of patients at high risk for social and discharge problems has been successful in reaching patients at an early stage in their hospitalization and of great benefit to patients and their families. Social Work departments in many other hospitals are requesting consultation in implementing this type of outreach program.

Judith Ripley and I reported on our service delivery systems to the annual conference of the Canadian Association of Social Work Administrators in Health Facilities in Winnipeg, and to the Quebec Health Practitioners Association. Mrs. Ripley's two-year analysis of our five-year research project on the "psycho-social aspects of seizure surgery" has yielded some interesting findings. Although we were unable to provide supervision to social work interns because of lack of space, we lectured at McGill and taught a health and welfare course at Collège Marie-Victorin.

Students from the Faculty of Commerce completed a field study on the use of computers in our department and we continue to coordinate the McGill student volunteer program. The students add a vital component to the patients and hospital by providing social activities, friendly visits, and stimulation.

Kathleen MacDonald attended the annual conference on head injury held at the Braintree Hospital, Massachusetts, and reported some fascinating work being done in the field.

This September the Neuro celebrates its 50th anniversary. The department's first full-day Neuro Social Work Colloquium is being planned for this occasion. We are also documenting the history of the department since its founding in March 1938.

One event that had a major impact on all of us was the untimely death of Dr. J.B.R. Cosgrove. He was very much part of the Social Work Department because of his deep concern with the psycho-social aspects of his many patients with multiple sclerosis. He consulted frequently and involved social workers in his MS Clinic from its very beginnings in 1947. The reduction of social work services for this population disturbed him greatly. He will be missed by all who came in contact with him.

—Verna Bound, PSW
Director of Social Work

Institute Research Reports

June 1, 1983—May 31, 1984

Montreal Neurological Institute and Hospital
1952

Comments of the Director

Each year in the history of the institute, we have reviewed the work of the research teams to see how we are progressing, where we are planning to go in the future, and why we are doing all this. Traditionally, in the earlier days of the institute, this review took place at the spring meeting along with the hospital reports. But as the clinical and scientific staff grew in numbers, it became convenient to have the statutory meeting of the hospital as soon as the audited financial report became available. The research reviews were then taken up on another date which recently became known as Penfield Day.

Major symposia on institute activities were held at Hovey Manor in 1972 and 1973 to cover research as well as the teaching and hospital organization. These sessions informed the staff members on the variety of projects going on within the institute. They were most helpful also in providing the new director with a profile of the research underway and particularly of resources that would be needed for future work.

In 1983, a two-day workshop at Château Montebello was organized to give each investigator a chance to report research in progress and (where appropriate) to review activities for the previous ten years in the various research units. These reports have now been assembled in a working manual that is available as a record to the staff. It was of interest that at the Hovey Manor Symposium the purchase of the first CAT scanner in Canada was announced, while at the Montebello atelier, a decade later, the plans to develop magnetic resonance imaging and spectroscopy were reported.

By 1984, the increase in our scientific community made it necessary to program the research reviews over two days. The abstracts of these talks, printed here, give a summary of the range of projects going on in the various research units. They identify especially the exciting approaches being made by our young neuroscientists. And they emphasize again the significance of team work in studying the major neurological problems such as epilepsy, stroke, neuromuscular disorders, brain tumors, and neurogenetic problems as well as the more scientific aspects of brain function. The teams themselves interact, for example when highly technical resources, such as the positron emission tomography facility, are utilized by a number of different disciplines. The same may be expected of the nuclear magnetic resonance systems which are just now being installed. The 1.5 Tesla cryogenic imaging instrument is planned as a regional centre for diagnostic as well as spectroscopic capabilities. A smaller spectroscopic unit being requested from the Medical Research Council has already engaged the early collaboration of scientists from different fields: from the institute, for studies on neuromuscular problems and cerebral ischemia, from the Meakins-Christie laboratory, to investigate muscle fatigue, from the McGill Cancer Research Unit to test the effects on tumors of liposomes used as carriers of anti-tumor agents, and from the department of physiology of the Université de Montréal to examine mechanisms of acidosis in the kidney.

It is worth noting that scientific publications from the staff for 1983-1984 increased by about 20 per cent over the previous year. A preliminary tally at the end of 1984 indicates an additional increase of the same order. Providing the quality of these reports is maintained, this count indicates a substantial improvement in productivity. But some of our staff evidently have a calamus scriptorious less active than others. They might take a hint to increase their literary efforts if they find their names infrequently listed in the published bibliography at the end of this report.

—William Feindel, OC, MD

Developmental Neurobiology

Dr. Elizabeth Matthew

Neuropeptides play an important role in the transmission of signals between cells within and outside the nervous system. However, it has been difficult to study the effects of these substances at the cellular level because of complex cellular interrelationships.

In vitro preparations provide functioning, differentiated components of the central system, easily accessible to morphological, physiological, and biochemical probes and are ideal for studies of cellular function under controlled conditions. We first studied a well-characterized system, the spinal cord and dorsal root ganglion, which contain a variety of peptides implicated in the transmission of pain.

Dissociated cell co-culture preparations of embryonic mouse spinal cord and dorsal root ganglion were used to study interactions between putative 'nociceptive' substances, such as Substance P and vasoactive intestinal polypeptide, and 'analgesic' substances, such as enkephalin and neurotensin. The peroxidase-antiperoxidase (PAP) technique and the avidin-biotin system were used for morphological studies. We have also initiated studies to co-localize these substances by means of sequential staining techniques and have quantitated these peptides in the cultures by radioimmunoassay. We propose also to carry out studies of peptide receptors, and to determine their role in neuronal function.

To study peptide receptors in these *in vitro* preparations, we carried out binding assays using several radio-labelled benzodiazepines, and demonstrated multiple binding sites for each of these radioligands. We plan to characterize these binding sites further with receptor autoradiography. In addition, we have used a photoaffinity-labelling technique which results in covalent linkage of receptor and ligand. We are now carrying out two-dimensional gel electrophoresis on these photoaffinity-labelled cells. The receptor can then be identified on the gel by autoradiography. An alternate method, using anti-idiotype antibodies, has been used to identify the beta-adrenergic receptor, and more recently, the acetylcholine receptor. Solubilized receptors will be subjected to photoaffinity labelling; the covalently linked receptor-ligand complex will be used to generate polyclonal antisera. This antisera will be used to develop monoclonal anti-idiotype antibodies, that will greatly facilitate the identification of the receptors.

Subsequently, these *in vitro* preparations will be used to identify and correlate peptide substances and their receptors with specific physiological, pharmacological, and biochemical events. They can also be used for studies of neuronal morphogenesis and synaptogenesis and in studies of the role of non-neuronal and other inductive influences on neuronal development. Eventually we propose to develop other *in vitro* models such as co-cultures of the hypothalamus and brainstem, particularly the locus coeruleus, and to extend the studies described above into these systems.

Through these studies we hope to understand the role of peptides in the function, growth, and development of the nervous system. The information derived from these studies will increase our knowledge of some of the basic mechanisms in the nervous system, and it will eventually lead to a better understanding of the alterations in brain function that cause disease.

Muscle Biochemistry

Dr. Paul Holland

Studies on the skeletal myoblast cell-surface have continued. In view of recent evidence suggesting that plasma membrane glycoproteins may play a role in myoblast fusion, we have studied the developmental regulation of cell-surface glycoproteins in myogenic cultures of the rat L_6 myoblast cell line. Specifically, we have used the membrane-impermeable enzyme, neuraminidase, to modify selectively sialic acid-containing glycoproteins exposed at the myoblast and myotube cell surface. Such modification exposes sugar moieties terminal to sialic acid, which were previously cryptic to lectins. This then allows the identification of cell-surface glycoproteins, which are now reactive with these lectins. In brief, we have identified a number of myoblast-specific glycoproteins which disappear or are markedly reduced in myotubes. These are likely to be adhesive glycoproteins involved in myoblast-substratum, or in myoblast-myoblast adhesion. There is some evidence of subtle post-translational modification of at least one of these glycoproteins at the time of myoblast fusion, and this may indicate a specific role for this protein in the fusion process. Using the drug 5-bromo-2'-deoxyuridine to inhibit myogenesis, we have demonstrated that the large increase in fibronectin, which occurs at the time of myoblast fusion, is not directly relevant to the fusion process. Most recently we have followed up on these published findings by: 1) establishing that the major lectin-binding proteins are true cellular products rather than absorbed serum components; 2) purifying the lectin-binding glycoproteins by lectin-affinity chromatography; 3) initiating immunizations to raise monoclonal and polyclonal antisera to these proteins, to be used to probe their subcellular distribution and biological activity further.

In studies on the biosynthesis of the sarcoplasmic reticulum, we have examined the relationship between the contractile activity of cultured muscle and the accumulation of the sarcoplasmic reticulum ATPase and certain other muscle proteins. Inhibition of the contractile activity of myotubes inhibits the accumulation of the sarcoplasmic reticulum ATPase before effects on other proteins, such as myosin heavy chain, are apparent. Importantly, the effects of contraction-inhibition on the accumulation of muscle-specific proteins are selective. For example, accumulation of the MM isoenzyme of creatine kinase is totally unaffected by such treatment, indicating a selective effect of contractile activity on the maintenance of the adult skeletal muscle phenotype.

The early and marked effect of inhibition of myotube contraction on the accumulation of functional sarcoplasmic reticulum suggested that the free $[Ca^{2+}]$ may be raised in myotubes deficient in sarcoplasmic reticulum. Measurement of the $[Ca^{2+}]$ of control and contraction-inhibited cells suggests that there may indeed be a higher cytosolic $[Ca^{2+}]$ in tetrodotoxin-treated cells. Experiments to gain a more accurate measure of cytosolic free $[Ca^{2+}]$ are in progress. It is known that elevated intracellular $[Ca^{2+}]$ can cause increased proteolysis by stimulating the production of prostaglandin E_2. We have obtained evidence to suggest that increased production of prostaglandins via the cyclooxygenase pathway is, at least in part, responsible for the increased degradation of myosin heavy chain observed in contraction-inhibited cultures. Thus, treatment of contraction-inhibited cultures with inhibitors of the

cyclooxygenase pathway restores myosin heavy chain accumulation to within 70 per cent of control values. This effect is mediated via a decrease in the rate of degradation of the protein.

We have also produced several different hybridomas, secreting monoclonal antibody against the chick skeletal muscle sarcoplasmic reticulum ATPase. These antibodies are being used to extend our studies to the biosynthesis of the ATPase in control and contraction-inhibited cultures, and to probe for isoenzymes of this protein. In a collaborative study with Drs. Stirling Carpenter and George Karpati we have been able to demonstrate, using these monoclonal antibodies, a lack of immunoreactive sarcoplasmic reticulum ATPase in type 2 fibers of a patient with impaired muscle relaxation.

Neuroanatomy

Dr. Donald Lawrence

Corticomotoneuronal synapses: light microscopic localization upon motoneurons of intrinsic hand muscles in the monkey

Preterminal and terminal axonal arborizations of individual corticospinal neurons have been visualized in cats and monkeys using intra-axonal injection of horseradish peroxidase (HRP). The arborizations ramified in laminae V, VI, and VII, and in the monkey additional collaterals extended into lamina IX where cell bodies and proximal dendrites of motoneurons (MN) with axons in major forelimb nerves had been retrogradely labelled with HRP. It was concluded that a single corticospinal axon could ramify in up to four motor nuclei and that the corticomotoneuronal (CM) terminals made "apparent contacts with proximal dendrites or distal dendrites of the motoneurons". Intracellular injection of HRP permits virtually complete visualization of a neuron and in the present study this enabled the location of intra-axonally stained CM synapses to be demonstrated upon intracellularly stained MN of intrinsic hand muscles in the monkey.

Corticospinal axons activated by low threshold stimulation of the "hand" area of the precentral gyrus were impaled in the lateral funiculus at C_7-C_8. Following injection of 1 to 9 such axons, MN activated antidromically from the median or ulnar nerves at the wrist were filled by intracellular injection of HRP. Connections between CM fibers and MN were reconstructed from parasagittal 100 μm sections reacted by the cobalt-enhanced DAB method.

Fifty-six corticospinal axons and 71 MN were injected in 14 monkeys (M. fascicularis). Stem axons in the lateral funiculus gave rise to main collaterals which provided an extensive arborization within the gray matter, and single or clustered groups of terminal boutons arose from shorter, finer preterminal branches of these arbors. Seven light microscopically identified CM contacts (0.6x3 μm to 2.4 x 3.6 μm) were found upon the dendrites of stained MN in two of the animals. The results indicate that each main collateral of a CM axon establishes very few synaptic contacts, and possibly only one, with the dendrites of recipient MN. The targets for the numerous other synapses could not be established but they provide the substrate for a wide divergence of influence to MN as well as to interneurons which could have excitatory or inhibitory effects upon MN.

Collaborators: R. Porter, S. J. Redman

Dr. Barbara Jones
Having established that neurons within the dorsolateral pontine tegmentum are integrally involved in the generation of paradoxical sleep and the motor inhibition that accompanies that state, we have been studying the efferent projections and chemical neurotransmitters of the neurons in this region. By application of both anterograde and retrograde transport techniques, we have found that neurons in the dorsolateral pontine tegmentum project rostrally into the forebrain and also caudally into the lower brainstem and spinal cord. Transections of the descending fiber pathway by knife cuts through the ventral tegmentum at the pontomedullary junction eliminated the motor inhibition of paradoxical sleep. By applying retrograde transport of ^{3}H-choline, we determined that some cells in the dorsolateral pontine tegmentum which project to the spinal cord may be cholinergic. Most recently, using a specific monoclonal antibody to choline acetyltransferase, we have identified cholinergic neurons in the dorsolateral pontine tegmentum. By application of specific neurotoxins, we hope to destroy these cholinergic cells selectively in order to examine the effect of their selective elimination on paradoxical sleep and the muscle atonia of that state.

Dr. Alain Beaudet
Localization of opioid receptors in rat brain by electron microscopic radioautography
The distribution of specifically labeled opioid binding sites was examined by electron microscopic radioautography in sections of rat striatum labeled *in vitro* with the met-enkephalin analog FK-33824 (FK; Sandoz). Brains were pre-fixed by intra-aortic arch perfusion, and prepared by a histoprocessing sequence found to ensure regionally proportional retention of more than 50 per cent of the bound radioactivity. Film radioautographs from sections incubated with ^{125}I-FK alone revealed a patch-like distribution of bound ligand molecules similar to that previously reported for opioid receptors in rat striatum. In contrast, in sections incubated in the presence of 1μM naloxone, the labeling was sparse and evenly distributed. The vast majority of silver grains corresponding to specifically bound ^{125}I-FK originated from radioactive sources associated with neuronal membrane interfaces. Fifty-three per cent of the grains were ascribed to axodendritic, 18 per cent to axoaxonic, and 3 per cent to axosomatic appositions. Only 7 per cent of the grains, however, were associated with synaptic junctions. This distribution was significantly different from that of uniformly distributed hypothetical grains and also from that of non specifically bound ^{125}I-FK molecules, as analysed in sections incubated in the presence of 1μM naloxone. These results suggest that endogenous as well as exogenous opioids act primarily at non-junctional interfaces on the dendrites, axons, and soma of neurons in the neostriatum.

Collaborators: Dr. Edith Hamel, Dr. Emmanuel Moyse, Dr. Raffi Balian

Interactions between monoaminergic and peptidergic neurons in rat brain
This multi-faceted project is based on the combination of radioautographic and immunocytochemical methods for visualizing, at electron microscopic level, cellular relationships between transmitter-identified neurons.

We are currently studying the following interactions:
1. Serotonin innervation of catecholamine neurons in the arcuate nucleus and the medial zone incerta;
2. Relationships between dopamine and serotonin neurons in the dorsal raphe nucleus;
3. Interactions between serotonin fibers and dopamine neurons in the ventral tegmental area;
4. Interactions between serotonin axons and VIP-containing neurons in the suprachiasmatic nucleus.

Collaborators: Dr. Virginia Pickel, Dr. Denis Hervé, Dr. Olivier Bosler

Dr. Serge G. Gauthier
A study of cerebral metabolic activity in Alzheimer's disease has been started, using positron emission tomography. Besides mapping cerebral blood flow and glucose consumption, we are studying cerebral cholinergic function using ^{11}C-choline. Preliminary results in aged subjects show that deep-seated structures such as the thalamus and caudate have early and persistant uptake of ^{11}C-choline, whereas the cerebral cortex gives low uptakes. It remains to be established whether the areas apparently rich in ^{11}C-choline reflect high-affinity specific uptake of the precursor in cholinergic terminals.

In another study, substance P (SP) injected in the spinal subarachnoid space of rats has significantly increased blood pressure, heart rate, and plasma free catecholamines. This effect is blocked by prior intraspinal injection of an SP antagonist. Further pharmacological work using SP fragments and homologues is planned, as well as autoradiographic studies to define further the site of action of SP.

Five studies are in progress on idiopathic Parkinson's disease.

Neuroanesthesiology

Dr. Mounir Abou-Madi

Effect of changing $PaCO_2$ on ICP response to bolus infusion of mannitol in dogs

Mannitol is often used to lower intracranial pressure (ICP) in man. Transient initial increases in cerebral blood volume and ICP have been shown to follow its use in experimental and clinical situations. With Dr. Davy Trop and Dr. Jean-Guy Villemure I studied the ICP response to bolus injection of mannitol in dogs at different levels of $PaCO_2$: (20, 30, 40, and 50 torr). In order to build up the greatest possible osmotic gradient, mannitol must be infused rapidly. This initially expands the circulating blood volume, increases the cardiac output, causes arterial hypertension, and dilates the cerebral blood vessels. An increase in cerebral blood flow follows and ICP rises. Hyperventilation is often used to reduce cerebral blood flow and intracranial hypertension. Our study confirmed the protective effect of inducing hyperventilation before the rapid infusion of mannitol. It has also demonstrated the deleterious effects of hypoventilation and CO_2 retention on the ICP response to mannitol infusion.

Drs. Davy Trop, Lise Morin, André Olivier, and I studied the cardiovascular effects of percutaneous radiofrequency coagulation of the trigeminal ganglion, performed under neuroleptanalgesia and intermittent ultrashort-acting barbiturate anesthesia. In twelve patients, highly significant increases in mean heart rate and arterial blood pressure followed the insertion of the cannula electrode into the trigeminal ganglion ($p<0.001$). In six patients severe tachycardia and hypertension also accompanied the progress of the thermal lesion ($p<0.0001$). Three patients developed premature ventricular contractions, and two developed significant ST segment depression. Intravenous nitroglycerine, used during current generation, successfully controlled the hypertensive response in the other six patients. Patients with coronary artery disease should be adequately monitored during this procedure.

Neurochemistry

Dr. Leonhard Wolfe

Collaborative biochemical studies in inherited neurological disease

Over the past few years we have concentrated our efforts on the basic biochemical defect in the neuronal ceroid lipofuscinoses, two forms of which are commonly referred to as Batten's disease. It is now generally recognized that this is the most common cerebromacular degeneration and storage disease of childhood seen by pediatric neurologists. Depending on the country or region, frequency varies between 10-20 cases per 100,000 of the population including all clinical forms. We have isolated in purified form the storage material from the brains of all three major types and made a number of findings.

1. The polyisoprenologues of the dolichol type are greatly increased in the isolated cytosomes and are a distinctive marker of the disease.
2. Dolichols are greatly increased in the brain of patients compared to age-matched controls.
3. We have developed a diagnostic test on dolichol in the urinary sediment and performed it on close to 200 patients and controls. The results are subjected to bivariate discriminative statistical analysis for determination of probabilities, and recommendations concerning skin biopsy are made to referring clinicians.
4. The insoluble autofluorescent compounds appear to contain retinoid-protein complexes.
5. The ultrastructural membranous forms of the storage material appear to derive from the lysosomal membrane.
6. The lysosomal membrane contains the highest amounts of dolichols as the free alcohols and these lipids are a distinctive part of the membrane.
7. Our hypothesis is that the storage material in NCL derives from the lysosomal membrane because of its failure to be recycled adequately, catabolized or exocytosed.
8. We have been successful in isolating pure lysosomes and staining them with acridine orange and fusing them by polyethylene glycol 1000 to cultured fibroblasts of normal and Batten's disease cell lines.
9. Plans are in action to study differences in the kinetics of disappearance of the fused lysosomes in normal and mutant lines in fetal calf free media.
10. We suspect a specific thiol protease defect and are looking into these specific hydrolytic enzymes as prime candidates for the primary enzymatic defect. The fusion of lysosomes into fibroblast cell lines is new and of course there are numerous new questions arising from this which we will attempt to solve in the next few years.
11. Studies continue on hexosaminidase defects in late onset subjects with unusual clinical presentations.
12. The capillary column method for long chain fatty acid measurements (C24/C26, C22/C26) ratios has been set up to diagnose adrenoleuko-dystrophy, adrenomyeloleukodystrophy, and unusual cases of familial spastic paraparesis.

13. We need to develop a special procedures laboratory to assist neurologists make diagnoses with the rapidly increasing number of tests being used elsewhere.

Studies on Alzheimer's disease and aging

1. We have found that in both aging humans and aging rats dolichols increase 10-15 fold. This is the most striking increase in any brain lipid and appears to reflect lysosomal accumulation of lipofuscin.
2. Detailed analysis of many brain regions of Alzheimer's disease derived from the Canadian Brain Tissue Bank at the Clarke Institute of Psychiatry in Toronto has shown highly statistical increases in dolichols in several brain regions, principally the temporal lobe, hippocampus, and amygdala. These chemical results are being correlated with the morphology.
3. With Gwen Ivy at the University of California, Irvine, we have found that age-matched rats infused with the thiol protease inhibitor leupeptin and chloroquin for two weeks into the cerebral ventricles show highly statistical differences in increase in brain dolichols in the cortex, thalamus, and hippocampus. The serine protease inhibitor, aprotonin, has no effect. These studies are all being correlated with morphology. Again a thiol protease defect seems to be a prime cause of lipofuscin formation, indicating alteration in normal cell cycling of lysosomes, endosomes, and phagosomes.

Studies on brain eicosanoids

1. Brain pieces stimulated with calcium ionophores produce, besides prostaglandins, lipoxygenase products identified by HPLC. With the new radioactivity detector combined with the UV monitor set-up, funded by MRC, we are in an excellent position to advance the basic biochemistry of eicosanoid synthesis in brain.
2. With Dr. Hanna Pappius, we carry out the analyses of arachidonic acid release and eicosanoid formation following brain injury and the effects of steroid and non-steroidal anti-inflammatory drugs in ameliorating the widespread decrease in local cerebral glucose utilization.
3. Similar studies are planned with Dr. Antoine Hakim's model of middle cerebral artery occlusion and the development of a cerebral infarct.
4. We have advised Dr. Antoine Hakim on the development of the clinical trials and experimental studies on the effect of prostanoids on the development or resolution of cerebral infarction.
5. We have provided Dr. Mirko Diksic with chemical advice and assistance on the PET program to develop new chemical metabolic markers in brain.

We have developed a program to study the genetic control of cell organelle targeting and disposition and the changes that occur in aging cells, Alzheimer's disease, and Down's syndrome.

Dr. Reynold J.M. Gold of the Department of Medical Genetics, University of Toronto joined us as visiting scientist on sabbatical leave.

Dr. Hanna M. Pappius

Studies on neurochemical sequelae of brain damage and their role in functional disturbances

As a result of studies carried out during the last few years with the freezing lesion model of brain trauma we have developed a working hypothesis according to which prostaglandins, serotonin, and catecholamines, released as a consequence of injury, induce activation of ionic, possibly calcium channels, causing functional depression. The major goal of my current and projected work is the further elucidation of mechanisms underlying cerebral functional disturbances associated with injury, including damage induced by ischemia.

The following aspects of the problem are being investigated.

1. The occurrence of widespread functional depression as a result of a focal freezing lesion has been inferred from the demonstration of drastic decrease in cortical glucose utilization throughout the injured and, to a lesser extent, in the contralateral hemisphere. To validate the assumption that the demonstrated metabolic depression reflects a functional one, behavioral status of the lesioned rats is being correlated with local cerebral glucose utilization. Preliminary results indicate that lesioned rats are, in fact, significantly behaviorally affected.

   Collaborators: L. Holmes, L. Colle

2. Earlier studies have clearly indicated that activation of both serotonergic and catecholaminergic systems mediates in some way functional disturbances associated with brain injury. Measurement of the implicated neurotransmitters and their metabolites with time after lesion is seen as an important next step in elucidation of the mechanisms involved.

   With funds from an MRC major equipment grant a new high performance liquid chromatography system has been purchased and we are developing methods for the determination of norepinephrine, epinephrine, dopamine, and serotonin, as well as their major metabolites.

   Preliminary results indicate that not only serotonin, as shown earlier, and norepinephrine, as was anticipated, but also dopamine metabolism are perturbed in injured brain.

3. To determine if Ca^{++} entry into cells in brain parenchyma plays a role in the sequence of events leading from a focal cortical lesion to the widespread disturbances of cerebral function, as postulated in our working hypothesis, effects of Ca^{++} modulators of the dihydropyridine type are being tested in the freezing lesion model of brain injury.

Dr. Antoine Hakim

In a study of the cerebral effects of thiamine deficiency the role of focal acidosis in the selective, limited distribution of histological lesions in this deficiency model has now been clarified by autoradiography that permits measurement of cerebral pH. Predictions made using 14C-deoxyglucose autoradiography were supported by pH measurements. The relationship of blood flow to acidosis and changes in glucose utilization will be studied in thiamine deficiency.

Our study of cerebral ischemia includes animal and human models. The effect of middle cerebral artery occlusion produced in the rat is being investigated metabolically and histologically to define what areas of the brain are permanently injured or affected reversibly. We study autoradiography conditions known to worsen the effects of cerebral ischemia and therapeutic modalities likely to moderate or lessen such effects.

With Dr. Ronald Pokrupa and the team of the PET unit I am studying the time-sequence of metabolic, perfusion, and acid-base events occurring in human brain following a stroke, and how infusions of prostacyclin in the acute phase change these processes. The intent is to study the possibility that therapy following the appearance of clinical deficits due to a cerebral ischemic event may modify the natural history of a stroke.

Neurogenetics

Dr. Eva Andermann

GENETICS OF THE EPILEPSIES

In the past year, three studies on the genetics of partial epilepsy have been completed and prepared for publication: increased prevalence of generalized spike-wave EEGs in relatives, a study of photosensitivity in relatives as an indicator of genetic predisposition, and a comparative study of EEG findings in relatives of patients with various forms of partial epilepsy. These studies were carried out with Marina Straszak and Drs. Frederick Andermann and Pierre Gloor.

A study of immunoglobulins and HLA in primary generalized epilepsy was carried out with Drs. Orvar Eeg-Olofsson, Najma Janjua, and Ronald Guttman. Ig A and Ig M tended to be low in patients and relatives, whereas no significant differences in the distribution of HLA genotypes or haplotypes could be determined.

With Drs. Najma Janjua and Roberta Palmour, we began a study of plasma amino acids in patients with generalized and partial epilepsy, and in their near relatives. The amino acid profiles will be compared with normal age- and sex-matched controls, and correlated with the presence of the spike-wave EEG trait. If significant differences are found, then amino acids might be employed as markers for genetic predisposition to epilepsy.

OUTCOME OF PREGNANCY IN EPILEPTIC WOMEN

The prospective study on outcome of pregnancy in epileptic women was continued. Over 100 patients and their offspring have now been documented. In the past year, emphasis was placed on assessing somatic growth parameters and psychomotor development in the offspring, as well as carrying out various studies on mechanisms of teratogenesis. These included maternal folic acid levels during pregnancy: correlation with pregnancy outcome (with Linda Dansky, Susan Wisebord, and Dr. David Rosenblatt); growth factor receptors in placentas of epileptic mothers (with Drs. Harvey Guyda and Eeg-Olofsson); hormonal changes in pregnancies of epileptic women: comparison with fetal alcohol syndrome (with Drs. Bev Murphy and Eeg-Olofsson, and Rose Carriero); thyroid function in epileptic mothers and their infants (with the same collaborators); histopathological findings in placentas of epileptic women (with Drs. Moy-fung Chen and Eeg-Olofsson); and *in vitro* toxicity of anticonvulsants (with Linda Dansky, Susan Deeks, and Dr. Stephen Spielberg of the University of Toronto).

On October 2-5, 1983, an International Workshop on Outcome of Pregnancy in Epileptic Women was organized in Ste-Adèle following the Epilepsy International Symposium in Washington, the proceedings to be published as a special supplement of the Canadian Journal of Neurological Sciences.

GENETIC DISEASES

New syndromes

The following studies of new syndromes have been published in the past year: the hemi-3 syndrome: hemihypertrophy, hemihypaesthesia, hemiareflexia, and scoliosis (with Drs. Kenneth Nudleman, Frederick Andermann, Gilles Bertrand, and the late Eugene Rogala), and juvenile progressive dystonia: a new phenotype of G_{M2}-gangliosidosis, with Drs. Meek, Leonhard Wolfe, and Frederick Andermann.

Two papers were presented at the International Symposium on Myoclonus held at Arden House, New York: startle diseases of man: startle disease, jumping, and startle epilepsy (with Dr. F. Andermann), and the action myoclonus-renal failure syndrome: a previously unrecognized neurological disorder unmasked by advances in nephrology (with Drs. Frederick Andermann, Stirling Carpenter, Leonhard Wolfe, Robert Nelson, Georges Patry, and Frederick Boileau).

The study on familial collagen vascular disease, spasticity, and mental retardation with Dr. Ilo Leppik has also been completed.

Other syndromes still being studied are: ataxia-ocular motor apraxia (with Dr. Rami Morcos); and a new syndrome of severe familial encephalopathy in Cree infants with white matter degeneration and immunological abnormalities in cerebrospinal fluid (with Dr. Deborah Black).

Continuing Studies

The following studies are continuing: Tay-Sachs screening program in the French-Canadian population and linkage studies; familial cavernous hemangioma, an autosomal dominant disorder presenting with epilepsy; familial agenesis of the corpus callosum with sensorimotor neuronopathy: clinical, genetic, and epidemiological studies.

There has been much activity in the field of cerebromacular degeneration (Batten's disease). In view of the finding of increased dolichols in the urine of these patients, an attempt was made to detect carriers by this method. During a field trip to Newfoundland in 1983, 55 urine samples were obtained from family members. Despite a slight increase in urinary dolichols in obligate heterozygotes, the differences are unfortunately not sufficient to allow discrimination of carriers. In the past year, we have had an opportunity to carry out prenatal diagnosis in a patient with a previously affected child. No characteristic inclusions were seen in the amniocytes by Dr. Carpenter, and the skin biopsy of the infant soon after birth was also negative. This is in contrast to one previously diagnosed case in which both the amniotic cells and the skin biopsy were positive for curvilinear bodies. This constitutes a significant advance in genetic counselling for these disorders.

Studies of glucose tolerance and insulin receptors in Friedreich's ataxia patients and relatives are continuing with Dr. Fantus. Catecholamines in obligate heterozygotes are being studied with Drs. Pasternac and de Champlain, and somatosensory evoked potentials in heterozygtoes with Dr. Daniel Gendron.

PLANS FOR THE FUTURE

We hope to continue the studies outlined above, and to look for new approaches to these diseases.

In the field of genetics of the epilepsies, studies on plasma amino acids, immunoglobulins and HLA in various types of epilepsy will be continued in an attempt to detect genetic markers. It is also planned to carry out formal segregation analyses and linkage studies, employing blood group and enzyme markers, as well as DNA markers.

The genetics of different types of partial epilepsy will be further examined, and seizures and EEG abnormalities in relatives will be analyzed according to the specific EEG abnormalities in the probands. Prospective studies in patients with head trauma and brain tumors may elucidate the relative importance of genetic and environmental factors in the development of epilepsy. A genetic study of febrile convulsions in relation to temporal lobe epilepsy is also planned. A longitudinal follow-up of the series of families studied by the Metrakoses will be carried out as well as a re-analysis of the Lennox twin data. A further attempt will be made to improve the prognostic index for candidates for temporal lobe surgery, employing genetic criteria as well as newer diagnostic techniques.

In the field of epilepsy and pregnancy, further placental studies with morphological, metabolic, and endocrine analyses will be carried out. Endocrine studies will also be performed in pregnant epileptic women and in their offspring. Zinc metabolism in pregnant epileptic females and their offspring will be studied, since this has important implications for growth and development. Psychological testing will be carried out in older offspring to detect any minor cognitive deficits or learning problems, and these results will be correlated with the IQs of the parents. In this way we hope to obtain further information regarding the mechanisms of teratogenesis, and the possible effects of epilepsy and/or anticonvulsant drugs on mental development. To obtain statistically significant answers to some of these questions, collaborative studies will be required.

In the study of inherited neurological disorders, the most significant advance in the past year has been the localization of the gene for Huntington's chorea by recombinant DNA techniques by the Harvard group. It is important that this should now be extended to many other single-gene disorders, such as tuberous sclerosis and neurofibromatosis, and we plan to participate in these studies on a collaborative basis. We hope to expand the screening programs presently carried out, and develop new screening programs as soon as genetic markers become available. These markers could be used for carrier detection, screening for asymptomatic individuals, and prenatal diagnosis. For rare degenerative diseases, it would be important to establish a national registry in order to find such markers, and we plan to do this for the cerebromacular degenerations. At the same time, we will continue to cooperate in the search for the basic biochemical defects in these diseases.

Neurolinguistics

Dr. David Caplan

My research has been designed to determine whether and how syntactic structure determines sentence comprehension in aphasia. In 1983-1984 I constructed a "Syntax Battery" and carried out a pilot experiment with 58 patients. The battery was designed to require the ability to interpret different word-orders in sentences, the ability to interpret hierarchical as well as linear organization of nodes in sentences, the ability to use verb structure to determine sentential meaning, the ability to use the "function word vocabulary" to determine sentence form and aspects of sentence meaning. The battery requires the manipulation of toy animals to indicate thematic roles of NPs in nine sentence types: active transitive, passive; cleft-object; cleft-subject; dative, passive dative; conjoined clauses; subject-object relative clauses; object-subject relative clauses.

Results show robust effects of sentence type. Clustering of sentences according to number of correct interpretations yields groups of sentences which correlate highly with the initial sentence types. Clustering of patients reveals four stable groups, whether the clustering is done over all forty-five sentences as independent binary variables (correct-incorrect). The importance of sentence type is illustrated by the fact that the same clusters are found on both hierarchical and non-hierarchical analyses when the algorithms are run over numeric variables consisting of the number of sentences of each sentence type correctly interpreted by each patient. The hierarchy of difficulty of sentence types found in this study is: active and cleft-subject; passive; dative; cleft-object; object-subject relatives; dative passives; conjoined; subject-object relatives.

This hierarchy and the principle component analysis of the pattern of correct responses by sentence-type show that the reversal of thematic roles from the usual agent-theme-goal sequence, the existence of more than two thematic roles to be assigned around a single verb, and the linear sequences of nodes in a string, separately contribute to the complexity of a sentence.

Error analyses show that, for the group as a whole, correct responses outnumber errors of any single type for all sentence types. However, this pattern is due to the performance of the 18 patients in the first cluster. In cluster 2, errors whereby agent-theme-goal is assigned to nouns linearly around each verb outnumber correct responses wherever such a response is not correct; this linear interpretive strategy is the most frequent type of error. Group 3 consists of patients who could only interpret two-place verb sentences, and this group also shows this interpretive pattern. (Group 4 consists of 6 cases who could not do the test.)

There is some overlap between memory performance on the pretest and grouping of patients into the four groups (which reflect severity on the test), but there is considerable scatter and some patients with excellent memory performances fall into the more severe groups. Correlational matrices show poor correlation of clusters with aphasia type and lesion site, and no correlation with age or language of testing. The failure of aphasia subtype to correlate with clusters, especially in the Broca's and conduction groups, may be due to heterogeneity of patients within these groups, but it casts doubt on the specificity of comprehension deficits in

purer groups within these categories, such as agrammatic or STM-type conduction patients. The failure of clusters to correlate with lesion site within the perisylvian area suggests that this area is locally equipotential for this function (''syntactic comprehension'').

Overall, the results indicate the importance of syntactic structure in determining sentential semantic functions such as thematic roles. Parameters of syntactic structure, such as the need to reverse thematic roles from a usual canonical sequence and the need to interpret sequences of the form N-N-V, as well as parameters likely related to the number of verbs in a sentence and the number of thematic roles around each verb, are shown to be contributors to sentence complexity. The use of interpretive strategies based on these normal parameters is shown to characterize certain groups of patients but not other, more affected, patients, whose interpretations make use of more elementary structural assignments and interpretive rules. Other patients may be limited by memory or more severe parsing/interpretation problems to only the simplest sentences of the language. The failure of groups found in this test to correlate with aphasic subtypes raises serious questions about the specificity of syntax comprehension failures in specific aphasic subgroups, and the lack of correlation of groups on this test with lesion site questions the existence of very local areas responsible for aspects of syntactic comprehension within Sylvian cortex.

Neuromuscular Research

Dr. George Karpati

EXPERIMENTAL PROJECTS

Mitigation of skeletal muscle fiber damage in dystrophic hamsters by hypophysectomy

In immature muscle fibers of hypophysectomized animals, the necrotizing effect of the dystrophic gene is suppressed, possibly by the persistence of an immature isoenzyme or isoprotein which may be coded at a different locus from the site of mutation.

Calcium paradox in skeletal muscle

By depleting calcium from the extracellular space and sarcolemma, the surface membrane will lose its ability to control subsequently the massive influx of calcium when the normal extracellular level is re-established. The result is necrosis of muscle fibers. Depletion of calcium from the sarcolemma causes damage to the sarcolemmal calcium channels. Calcium channel blockers can mitigate or suppress the calcium-induced cell death occasioned by calcium depletion of the sarcolemma. Calcium-induced cell death provoked by calcium paradox bears some resemblance to the muscle cell destruction that occurs in Duchenne dystrophy.

Skeletal muscle fatigue

In rat hemidiaphragm, massive accumulation of neutral lipid droplets occurs after 48 hours of fasting. This can provide readily available long chain fatty acid fuel for muscle fibers. The readily available fuel and the resultant oxidative energy appears to have a beneficial effect on short term and intermediate term fatigue resistence of rat hemidiaphragm *in vitro* at 37°C.

DISEASE-ORIENTED PROJECTS

Reducing body myopathy

Very abundant reducing bodies in muscle fibers of a child with progressive myopathy enabled us to characterize the cytochemical and electronmicroscopic features of reducing bodies and partially to isolate them. Their nature is consistent with their being viral particles.

SR ATPase deficiency myopathy

We have studied four patients from two families with a peculiar metabolic myopathy due to deficiency of immunoreactive sarcoplasmic reticulum ATPase, demonstrated by immunocytochemical techniques, using monoclonal antibodies. As a result of this metabolic defect, the calcium accumulating capacity of sarcoplasmic reticulum is impaired.

T-lymphocyte subsets in skeletal muscles in inflammatory myopathies

Using specific monoclonal antibodies against different subsets of T-lymphocytes (cytotoxic-suppressor, helper-inducer), we could characterize the nature of infiltrating inflammatory cells in the various forms of inflammatory myopathies, and correlate them with the pathophysiology of muscle cell damage.

Phenotypical variability in hexosaminidase deficiency
In juvenile-onset hexosaminidase A deficiency, a syndrome similar to Kugelberg-Welander disease can arise. We have characterized the clinical features of this syndrome.

Phenotypical variability of adult polyglucosan body disease
While the clinical core of this disease presents as a progressive peripheral neuropathy with prominent autonomic involvement, other CNS involvements can occur as was demonstrated in three patients additional to the original four patients described. This represents by far the largest series in the literature.

Malignant hyperthermia screening
We have now established malignant hyperthermia screening by the *in vitro* caffeine-induced contracture of isolated muscle strips *in vitro* at 22°C. Increasing numbers of patients are being referred to us for this test.

Neuro-otology

Dr. Athanasios Katsarkas

Gain (eye velocity/head velocity) fluctuation in vestibular nystagmus

The eye movement that occurs in the dark during head movement is widely used as a measurement of vestibular function and, consequently, in the study of dizziness and related phenomena. However, unexplained fluctuations in the response often occur despite efforts to maintain mental arousal known to influence the quality and the magnitude of this response. Imagining stationary or moving visual scenes influences the magnitude of the vestibulo-ocular reflex response. This has been shown in a more dramatic way during experiments in normal subjects at McGill's Aviation Medical Resarch Unit, when a sustained change of the vestibulo-ocular reflex response occurred after the subjects imagined a stationary visual scene continuously for a few hours. Our work examines the hypothesis that fluctuations occur because the subject, lacking visual input, sporadically imagines stationary or moving visual scenes, and that better results may be obtained if the subject imagines a particular scene.

Collaborator: Dr. J. S. Outerbridge

Compensation following unilateral vestibular sensory loss

Sudden loss of unilateral vestibular function leads to violent dizziness and nausea, especially on head movement. The nervous system slowly compensates for the loss, but there is unexplained intra- and inter-subject variability in the rate and extent of compensation. We studied responses to imposed head movements with particular imagined scenes during sinusoidal and pseudo-random oscillations in these patients tested repeatedly during compensation.

Collaborator: Dr. J. S. Outerbridge

Ocular motor disturbances in Parkinson's disease

The akinesia and bradykinesia known to occur in Parkinson's disease have their counterparts in eye movements. The ocular motor system is capable of very rapid movements and the reaction time, the movement time, and the fractionation of these movements may be accurately measured with simple, commonly available apparatus. We expect these experiments to be valuable in the diagnosis of early doubtful cases and to provide a simple method for accurately assessing the condition of the parkinsonian patient and the efficacy of the anti-parkinsonian drugs.

Collaborator: Dr. J. S. Outberbridge

Neuropathology

Dr. Stirling Carpenter

The first of two major projects carried out in the past year with Dr. George Karpati was a study of necrosis in skeletal muscle fibers. Puncturing the exposed gastrocnemius muscles of anesthetized rats by a 10μm wire results in virtually all of the punctured fibers undergoing segmental necrosis. For a period of up to 6 1/4 hours in most fibers the necrotic and surviving segments are not demarcated. We have now identified the demarcating membrane in the stage of formation at 6 hours. It forms in the region of necrotic breakdown distant from ribosomes or preserved mitochondria as an irregular membrane with a free edge and fine 4nm filaments tending to align themselves next to it. Further studies are planned to determine the source of this new membrane and its molecular composition. Since most cell membranes are made by insertion of molecules into preexisting membranes, it is highly unusual to see a membrane forming with a free edge. Teleologically, if this membrane forms promptly and efficiently, the necrotic segment will be small in extent, and regeneration to bridge the gap will be less uncertain. We hope to identify factors that facilitate formation of the membrane.

A second major project concerns calcium paradox in skeletal muscle, which we think may be the closest model for the injury to muscle fibers that occurs in Duchenne dystrophy.

A comprehensive study of a case of reducing body myopathy, in its histochemical, electron microscopic, and biochemical aspects has been prepared for publication with Drs. George Karpati and Paul Holland. I have also studied a syndrome of impaired relaxation associated with a defective sarcoplasmic reticulum ATPase activity. We have been able to confirm our previously published method for diagnosis of Lafora's disease from biopsy of the skin, and confirmation has also come from four published cases from Marseille. I am preparing a general review of the usefulness of skin biopsy in the diagnosis of genetic metabolic disease since not every pathologist understands the criteria which must be followed for accurate diagnosis. Dr. Karpati and I incorporated many insights derived from research in this laboratory in a book titled *The Pathology of Skeletal Muscle*.

Dr. Yvon Robitaille

A morphometric study of basal cholinergic nuclei in Alzheimer's disease (AD) and senile dementia of the Alzheimer type (SDAT) was done in a joint MNI and Douglas Hospital Research Centre project. The study involved neuronal counts of the nucleus basalis of Meynert and diagonal band of Broca sampled between the rostral edge of the anterior commissure and mammillary bodies on 10 representative cresyl violet-stained coronal sections in 10 demented patients and 10 control specimens. Counts were made on neurons 30μ or more in diameter verified to be cholinergic on acetyl cholinesterase-stained sections. In AD/SDAT brains, counts were significantly lower ($p<0.001$) when compared to controls, and the loss was diffuse without statistically significant difference between pre-senile subjects. Like many recently published studies on this topic, our results emphasized the vulnerability of the basal cholinergic nuclei in Alzheimer's disease.

Iron chloride-induced focal epilepsy, an experimental model morphologically similar to human post-traumatic epilepsy, was further investigated, using β-alanine as a representative neutral amino acid of low molecular weight, and 3-mercaptopropionic acid, a convulsant selectively decreasing GABA synthesis in the pre-ictal phase.The study involved intraperitoneal injections of ^{14}C-β-alanine in 15-day-old models densitometrically evaluated on representative rat brain autoradiographs. Significant uptake increase was recorded around cerebral scars and correlated well with the distribution of reactive astrocytes as seen on Cajal stains. Models treated with the GABA-blocker revealed markedly enhanced uptake densities extensively involving cortical regions ipsilateral to the scars as well as thalamic nuclei bilaterally. These results supported the concept that endogenous GABA could regulate astrocytic uptake of small neutral amino acids through competitive inhibition for glial membrane receptors and uptake. Since Evans blue intravenous perfusion tests done on these models failed to reach scarified brain tissues, the possibility of a glial influence on blood brain barrier amino acid transport systems in focal epilepsy is thus raised.

Neuropharmacology

Dr. Allan L. Sherwin

Research in our laboratory is primarily directed to the study of catecholaminergic receptors in human focal epileptic brain. The catecholamines modulate the activity of neuronal networks, with norepinephrine exerting a predominantly inhibitory effect in the cerebral cortex. Norepinephrine also interacts with various inhibitory neurotransmitters such as GABA to enhance their effectiveness. The clinical significance of these neurotransmitters in human epilepsy was established by early observations of the adverse effects of high dose reserpine treatment employed some years ago for mental illness. This potent drug depletes brain catecholamine stores causing breakthrough seizures or status epilepticus. It lowers the threshold for electroconvulsive seizures and gives rise to clinical epilepsy in patients with a past history of brain injury. Anticonvulsants are no longer efficacious at the usual doses under such circumstances.

We view with considerable excitement our findings that there is a significant decrease in the number of alpha-1 postsynaptic receptor binding sites (Bmax) in human epileptic spike foci as compared to surrounding non-spiking cortex. This data, derived from radio-receptor binding assays, is precisely in keeping with our earlier observation that active epileptic spiking was accompanied by a 58 per cent increase in the activity of the enzyme tyrosine hydroxylase, the rate-limiting enzyme in catecholamine synthesis. The density of the alpha-2 and beta receptor sites, however, was not altered in spiking cortex nor were the activities of certain enzymes involved in glutamic acid and GABA metabolism. Our findings are also compatible with an earlier report of a localized decrease in the activity of Na^+K^+ATPase in actively spiking human cortex as compared to an adjacent gyrus. This enzyme, which is essential in the regulation of univalent cation transport and activity-dependent energy utilization in nervous tissue, is stimulated by the binding of norepinephrine to alpha-1 receptors.

We suggest that there may be a localized defect in catecholamine metabolism and the adrenoceptors at sites of active focal epileptic discharge in human epileptic cortex. This may impair the action of inhibitory neurotransmitters as well as certain key enzymes involved in ionic conductance and energy metabolism. This hypothesis is supported by a large body of experimental evidence derived from studies of animal models of epilepsy. For example, there is a reduction in the number of alpha receptor sites and an elevation of tyrosine hydroxylase activity following electroconvulsive seizures in rats. The activity of tyrosine hydroxylase is also increased following acute or chronic administration of the alpha-1 blocking drug, Prazosin. This is the same specific ligand we employed in our studies of human focal epileptic tissues. Chauvel et al recently showed that the norepinephrine content of the cortex drops at the onset of focal spiking in cobalt epilepsy in the rat. Of particular clinical interest are recent reports that certain alpha agonist and beta antagonist drugs are effective in preventing seizures in both *in vivo* and *in vitro* animal models. Enhancement of natural inhibitory mechanisms by the use of appropriate receptor blocking agents promises to be a new approach to the medical therapy of resistant focal epilepsy.

Our present clinical neuropharmacological research attempts to characterize the pharmacokinetic profile of the benzodiazepine antiepileptic drug, nitrazepam (Mogadon). We have developed a sensitive liquid chromatographic assay for this drug, which is one of the few agents useful in myoclonic epilepsy, but we have found that it is also effective as an adjunct in the control of refractory partial seizures. In collaboration with our sister hospitals (Montreal Children's and Hôpital Ste-Justine) we have one of the world's largest series of patients treated with this drug. We will determine the incidence of drug-drug interactions, the degree and management of tolerance, and the effective range for plasma levels. Our laboratory previously established the now internationally accepted therapeutic range of the anti-petit mal drug, ethosuximide (Zarontin). In addition, our laboratory carries out a number of collaborative studies and is also interested in the active epoxide metabolite of carbamazepine and the treatment of status epilepticus with lorazepam.

Neurophysiology

Dr. Pierre Gloor

ELECTROENCEPHALOGRAPHY AND CLINICAL NEUROPHYSIOLOGY

Volume conductor theory as applied to the problem of localization in electroencephalography

The problem of localization of the sources of EEG potentials is best approached by applying the solid angle theorem of volume conductor theory to electroencephalography. If a critical evaluation of the data in terms of the geometry of cortical gyri and sulci is not made, erroneous conclusions may be drawn from intracerebral depth electrode recordings.

A theoretical review article dealing with the application of volume conductor theory to localization in scalp EEG was completed.

Secondary epileptogenesis in patients with verified temporal lobe tumors

A study was undertaken with Drs. Frank Morrell, Leyla Toledo-Morrell, and Theodore Rasmussen to determine whether mirror foci occur in human epilepsy. Evidence was found that such mirror foci do develop in patients with brain tumor and that, to some extent, this is a function of the duration of the epileptic illness.

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EXPERIMENTAL NEUROPHYSIOLOGY

Generalized spike and wave discharge in feline generalized penicillin epilepsy

i. Thalamic mechanisms in generalized spike and wave discharge

Earlier work had shown that during generalized spike and wave (SW) discharge specific thalamic nuclei such as nucleus lateralis posterior may intensely participate in SW discharge by showing a neuronal firing pattern very similar to that of cortical neurons, namely excitation during the spike and "inhibition" during the slow wave component.

In experiments carried out with Drs. Richard McLachlan and Massimo Avoli, we extended these studies to include the midline and intralaminar nuclei. This was a logical step, since it is from these structures that generalized SW discharge can most easily be elicited by single shock and low frequency stimulation. It was therefore commonly assumed that these nuclei were the main thalamic structure involved in the genesis of generalized SW discharge. To our surprise we found that the neurons of these nuclei were less involved in SW activity than those of specific thalamic nuclei. Only about half the neurons of nucleus centralis medialis participated in SW discharge. In other intralaminar nuclei, participation was somewhat more prominent, but the alternating pattern was never as well developed there as in specific nuclei.

Work is presently being undertaken to try to explain this paradox. It is possible that stimulation in the intralaminar and midline nuclei elicits SW discharge because fibers passing through these regions are stimulated rather than the cell bodies located there.

With Drs. McLachlan and Avoli we also performed a microphysiological study of the activity of thalamic neurons during the transition from normal activity, usually characterized by spindles, to generalized SW discharge after intramuscular injection of penicillin. It was found that the SW pattern, both in the EEG and microphysiologically in the form of the characteristic alternation between excitation and inhibition, never occurred in the thalamus before it was developed in the cortex. In the intralaminar and midline nuclei the development of this pattern is often quite late, again underlining the paradoxical finding that at the cellular level the participation of the midline and intralaminar nuclei in spike and wave discharge is much less pronounced than that of the specific thalamic nuclei.

ii. Inhibition of cortical neurons during the slow wave of the spike and wave complex

With Drs. Daniele Giaretta and Massimo Avoli we studied the inhibitory phenomenon underlying the slow wave component of SW discharge in the cerebral cortex. In extracellular microelectrode studies it was shown that not only recurrent inhibition elicited by antidromic stimulation of pyramidal tract fibers, but also the inhibition following direct cortical stimulation is unaffected by penicillin in doses that produce generalized SW discharge.

Intracellular recordings demonstrated that in response to antidromic stimulation of the pyramidal tract and direct cortical shocks, inhibition is characterized by a long-lasting membrane hyperpolarization which, in its early phase, can be reversed by intracellular chloride injection, thus identifying it as a classical post-synaptic potential. The ability to reverse this early part of the hyperpolarizing potential is not reduced after intramuscular injection of penicillin in amounts sufficient to induce SW discharge. Furthermore, during spontaneous SW bursts the excitatory post-synaptic potentials are increased during the spike, while during the slow wave a membrane hyperpolarization occurs of which the early phase is chloride-sensitive.

These findings demonstrate that with small tissue concentrations of penicillin as they exist in feline generalized penicillin epilepsy, penicillin does not interfere with chloride-sensitive phasic postsynaptic inhibition at the level of the soma of neurons.

Cortical and thalamic single neuron activity during spindles
With Drs. Richard McLachlan and Massimo Avoli we studied the activity of single cortical and thalamic neurons during spindles. We observed that within a given thalamocortical sector the activities of some neurons are highly correlated, but that the firing of only a fraction of cortical and thalamic neurons shows such a close mutual correlation or exhibits a close relationship to the cortical and thalamic EEGs. Thus, at any one time only a fraction of thalamic and cortical neurons are involved in generating spindle activity. We conclude that the synchronized activity of these neurons, even if some of it is subliminal for action potential discharge, suffices to produce a recordable EEG signal.

Thalamocortical and intrathalamic interactions during recruiting responses elicited by stimulation of nucleus centralis lateralis
This work was carried out with Dr. Itsuki Jibiki, Dr. Massimo Avoli, Dr. Daniele Giaretta, and Dr. Richard McLachlan, who reinvestigated, at the cellular level, the mechanism whereby stimulation of an intralaminar nucleus, such as centralis lateralis, produces cortical recruiting responses. The incremental responses underlying recruiting in both cortex and thalamus seem to result from a common mechanism, namely a period of secondary excitation which is dependent upon the temporal relation of stimuli delivered to nucleus centralis lateralis. They reconfirmed earlier work by Jasper and Hanbery that the nucleus ventralis anterior is an important link in the thalamocrotical recruiting system.

Dr. Rachel Ochs
In 24 patients with focal epileptic activity, positron emission tomography (PET) was used to measure the regional metabolic rate for glucose (rCMRG1) using ^{18}F-labelled 2-fluoro-2-deoxy-D-glucose (FDG). In 16 of these patients regional cerebral blood flow (rCBF), blood volume (rCBV), oxygen extraction rate (rOER), and regional metabolic rate for oxygen ($rCMRO_2$) were measured using oxygen-15 labelled $C^{15}O_2$ and $C^{15}O$. All studies were done in the interictal state with surface EEG recordings compared to the PET scan.

An additional 10 patients were studied with surface depth EEG recording as well as with FDG-PET.

Of the 24 patients with focal epilepsy, 17 had a unilateral epileptic focus, 4 had bilateral independent foci with a clear unilateral predominance, 1 had bilateral independent foci with no lateralization, and in 1 the focus was generalized with a focal maximum.

PET showed a significant reduction of rCMRG1 in the same region as the epileptic activity in 17 patients (71 per cent). However, in 2 the hypometabolism seen in PET was somewhat more extensive than the EEG focus while in 3 the epileptiform focus was more extensive than the region of hypometabolism seen in PET. Five cases (21 per cent) showed non-specific findings; in 3 PET showed generalized hypometabolism while the EEG showed a clear focus and in 2 PET was normal. In 2 cases the EEG focus did not correlate with a depression of rCMRG1.

A reduction of $rCMRO_2$ was seen in the same region as the decrease in rCMRG1 but the findings were less prominent and less reliable in the 16 patients studied with oxygen.

Of the 10 patients evaluated with depth electrodes (D-EEG), the D-EEG and PET showed the same focus in 4 where the surface EEG (S-EEG) was ambiguous. In 1 case of generalized epilepsy the D-EEG, S-EEG, and PET showed similar findings. In 2 cases the PET showed diffuse findings, the S-EEG was ambiguous, and the epileptic focus identified by D-EEG. In 2 cases a similar focus (interictal) was identified by S-EEG and PET, while the D-EEG identified the site of the seizure focus prior to surgery. One case was complicated by the presence of a destructive lesion and the other case showed frontal lobe seizure onset with D-EEG recording and more temporal lobe features with S-EEG and PET studies. In the final case, multiple sites of epileptic activity were seen in the PET, S-EEG, and D-EEG. The decision regarding the site for surgery was based on the clinical severity of one type of seizure (left temporal) which was identified by D-EEG recording.

Dr. Luis F. Quesney

Previous experimental observations led us to postulate that generalized photosensitive epilepsy is dependent upon a pre-synaptic deficit in cortical dopaminergic neurotransmission which results in denervation supersensitivity of post-synaptic dopaminergic receptors. Currently Dr. Thomas Reader from the University of Montreal is testing this hypothesis, measuring the binding capacity of alpha-1 and alpha-2 noradrenergic cortical receptors in cats submitted to topical administration of 6-OH dopamine to the cerebral cortex.

A considerable improvement in the recording and localization of interictal and ictal abnormalities arising from the orbital surface of the frontal lobe has been achieved by the development of nasoethmoidal and supraorbital electrodes. The latter are conventional scalp electrodes placed on the supraorbital ridges 1.5 cm from each other. They perform as well as the nasoethmoidal electrodes in terms of EEG localizational effectiveness, with the added advantage that they produce no discomfort to the patient. Over the past year supraorbital electrodes have been routinely used in the EEG investigation of patients with suspected frontal lobe seizures.

A retrospective review of 30 patients with poorly controlled partial and complex-partial seizures of frontal lobe origin who underwent cortical excision at the MNH has permitted a better understanding of the frontal lobe epilepsy syndrome. In agreement with others studies in the literature, a strong male predominance was noticed and the most common etiologic factor was post-traumatic brain injury. Partial motor seizures were the most common ictal manifestations of frontal lobe epilepsy. Partial motor-clinic ictal manifestations provide reliable lateralization of seizure onset to the contralateral frontal lobe. Partial motor- clinic seizures as well as ictal head turning were less reliable in terms of lateralization of the seizure focus.

Approximately 60 per cent of the seizures recorded in patients with frontal lobe epilepsy corresponded to complex partial seizures with automatic behavior. Only 5 per cent of these ictal automatisms occurred while the ictal electro-encephalographic discharge was confined to the frontal lobe (frontal lobe automatisms). The majority of ictal automatisms (55 per cent) occurred as a result of seizure spread from the frontal to the temporal lobe. The two main pathways providing an anatomical substrate for seizure spread between the frontal and temporal lobes or vice versa include the gyrus cingulum and the uncinate fasciculus.

During the past year we have developed a technique that we hope will permit an electrophysiological identification of preferential pathways of seizure spread from an epileptic focus to ipsilateral or contralateral brain regions. This technique has been used in patients submitted to EEG investigation with chronically implanted depth electrodes. Electrical stimulation of a depth electrode site is performed using an intensity of 1-1.5 mA and a frequency of 7 Hz. The evoked potential activity from homologous contralateral brain regions or from other areas ipsilaterally to the site of stimulation is recorded with a CA 1000 Nicolet averager. In 6 patients our preliminary results have been the following.

1. For lateralization of the area of maximum brain damage in patients with bitemporal independent epileptic foci: electrical stimulation of these areas correlates with absence or poorly developed evoked potential activity recorded locally or from homologous contralateral brain regions. This is very likely due to hypoexcitability of selectively damaged brain tissue.
2. For electrophysiological identification of preferential pathways of seizure spread in patients with epileptic foci located in the amygdala and/or hippocampus: our preliminary results are compatible with preferential seizure propagation from hippocampal foci through the gyrus cingulum as opposed to the uncinate fasciculus. Electrical stimulation of the amygdala is associated with prominent evoked potential activity recorded from the supplementary motor region, a finding that could explain some of the motor manifestations associated with complex partial seizures of temporal lobe origin.

Dr. Massimo Avoli
Extra and intracellular recordings of brain slices *in vitro* were studied.

Effects induced by low concentrations of convulsants
In rat hippocampal neurons, after the addition of a low concentration of convulsants (e.g. penicillin, bicuculline), a decrease of dendritic feedforward inhibition can produce a state of hyperexcitability that is not associated with any apparent change in the recurrent somatic inhibition. These findings might explain how in some experimental models of epilepsy, such as feline generalized penicillin epilepsy, inhibitory mechanisms appear to be preserved.

Electrophysiological analysis of neocortical neurons
These experiments, on slices of rat motor cortex, focus on the electrophysiological properties (e.g. membrane characteristics, voltage dependent ionic currents, repetitive firing) and synaptic mechanisms of neocortical neurons. Stimulus-induced hyperpolarization, which can be disclosed in neocortical cells by depolarizing the membrane by 10-20mV, is produced by two different ionic currents associated with the early and late component of the hyperpolarization.

Studies of human in vitro neurons
Preliminary experiments carried out with Dr. André Olivier on slices of temporal and frontal neocortex excised during surgical treatment of patients with intractable seizures show that the preparation remains viable up to 10 hours after sample removal.

Electrophysiological analysis *in vitro* of the mechanism of the action of antiepileptic drugs is being started in collaboration with L. Rieb (McGill) and Dr. V. Tancredi (Rome).

Experiments with Dr. Pierre Gloor focus on the mechanisms underlying generalized epileptic discharges in the intact animal.

Dr. Robert Dykes
We have successfully transplanted the hand and forearm of two baboons to unmatched recipient animals that are immunosuppressed with cyclosporin A. Although heart and lung transplants are becoming common, this is the first successful transplant of the more antigenically active skin with composite tissues in a primate. Successful application in man would depend upon the ability of the recipient's nerves to grow into the foreign tissues and to reinnervate the foreign sensory and motor structures. Tests of neural function will be performed.

In the somatosensory cortex of the cat the receptive field of a single neuron is controlled to a great extent by intracortical inhibitory mechanisms. Although the afferent signal that excites a neuron is delivered to a wide area of cortex and comes from a large cutaneous region, the receptive field seen post-synaptically is only a small fraction of the potential receptive field because GABA-mediated inhibition prevents most of the input from being expressed. Bicuculline methiodide, a molecule that competes for GABA receptor sites on neurons thereby preventing GABA from inhibiting the neuron, was applied to cortical neurons iontophoretically. In the presence of bicuculline it was possible to show that inputs from wide expanses of skin were always available to a cortical neuron and that the normal receptive field is created by suppressing all but a subset of the total excitatory drive on the cell.

Somatosensory information processing in the cortex examined by recording simultaneously from two cells demonstrated an unexpected degree of specificity of connections between cortical neurons. If the two cells under study were both driven by the same class of sensory receptors, they displayed short latency intracortical connections. If the two cortical cells were driven by different classes of sensory receptors they showed no evidence of intracortical connections even when their receptive fields overlapped.

In intracellular studies of cortical neurons we examined the influence of callosal neurons on the activity of other cells. One of the more interesting observations from this work was the detection of excitatory callosal inputs on corticothalamic neurons. The implication of this finding is that the contralateral somatosensory cortex can directly modulate the ipsilateral output from cortex and, by affecting corticothalamic cells, may even control aspects of the arriving sensory signals in the contralateral cortex.

Dr. Daniel Guitton

Current research activities in motor control and visuo-motor transformation are designed to clarify how the brain either stabilizes or moves the eyes and head. Two distinct laboratories are devoted to studies in humans and animals.

NEUROPHYSIOLOGY STUDIES

The discharge of tecto-spinal neurons in the alert head-free cat

The superior colliculus is thought to be implicated in visuo-motor transformations whereby a visual target elicits an orienting gaze shift. Tecto-spinal neurons (TSNs) project to both eye and head motor control centres. How do they participate in the visuo-motor transformation process? We have found that TSNs discharge in relation to combined eye-head movements (gaze) rather than just to eye or head movements alone.

Collaborator: Dr. Douglas Munoz

The discharge of vestibular neurons in the alert head-free cat
Many neurons in the vestibular nuclei have complex discharges that carry information obtained from the semicircular canals and from the brainstem oculomotor circuits. We hope to determine whether such cells also carry information obtained from the head motor circuits.

Collaborator: Michel Volle

Eye-head co-ordination in the cat
Results suggest that cats use two rapid eye-movement mechanisms when orienting: one is the phylogenetically old vestibular quick phase and the other is the saccade.

Collaborators: Robert Douglas, Michel Volle

HUMAN STUDIES
Factors contributing to head stabilization in humans
We have investigated how information from the visual, vestibular, and neck reflex systems and the mental "set" act together to stabilize the head. Extremely good stabilization occurs in normal subjects without visual feedback. This is produced by mental-set-dependent vestibular information, since normals performing mental arithmetic lose this stability and patients with bilateral canal loss cannot stabilize their heads in the dark.

Collaborators: R. Kearney, B. Peterson

Eye-head co-ordination in humans
We found that humans and cats have similar eye-head co-ordination motor systems.

A quantitative comparison between the eye coil and EOG techniques for measuring eye movements in humans
We hope to determine how accurate the simple, non-invasive EOG technique is, particularly for measuring eye movements in the vertical plane where eyelid artefacts are important.

Collaborator: M. Discopola

Dr. Terence M. Peters

Digital angiography

From the outset, we have employed the Technicare DR-960 imaging system in a stereoscopic mode, using two views angulated by 7 degrees of each study. To assist in viewing these images, we have developed a stereoscopic viewing system which will not only enable the observer to view the images simply with the assistance of polarizing spectacles, but also to use the computer to generate a three-dimensional cursor for measuring distances and angles between structures within the image volume. Technicare Corp, supplier of the digital angiography system, is modifying the basic unit to our specifications.

Stereotaxic surgery

Digital angiography has opened up important new directions in stereotaxic surgery. In addition to the now routine use of the CT scanner for planning the approach to surgery and electrode implantation based on anatomical clues, we now are able to integrate these measurements with digitally processed subtracted angiograms, which allow the optimum approach to an intracranial site or lesion without encroachment on blood vessels. A new stereotaxic frame developed within the institute is compatible with both CT and digital angiographic procedures as well as magnetic resonance imaging.

Magnetic resonance imaging

We expect delivery of a 1.5 Tesla magnetic resonance imaging system this autumn. At the time of its installation, this unit will be one of the most sophisticated MR scanners in the world.

Two research programs using MR are already underway with Philips Medical Systems, suppliers of our unit. The first is the evaluaton of a proposal to allow the MR imager to collect and display data (of the cerebral cortex, for example) in the form of stereoscopic pairs.

The second project has been the evaluation of the MNI stereotaxic frame for MR imaging. Initial trials with normal volunteers wearing the frame during an MR imaging procedure have given excellent results. We plan to add this technique to our growing battery of computer imaging modalities to aid stereotaxic surgery.

We also collaborate with nuclear magnetic resonance personnel from McGill's chemistry department and expect to initiate a parallel NMR *in vivo* spectroscopy project.

We are also planning a networking of imaging systems so that images from several modalities may be viewed simultaneously and overlaid to present vascular, anatomical, and physiological information. This will be of particular relevance in comparing MR images with PET. We will also begin evaluating methods to use the MR system for flow imaging, and developing with the chemistry department models for studying the effect of potential NMR contrast media within the body.

Neurosurgery

Dr. Gilles Bertrand

Long-term follow-up on prolactin-secreting pituitary adenomas treated by a transsphenoidal microsurgical approach

A group of 79 female and 13 male patients were operated upon for prolactin-secreting pituitary tumors via a transsphenoidal approach between 1973 and December 1980. Fifty-five of these patients had their prolactinemia reduced to normal levels of 20 ng/ml or less after surgery. The percentage of cases "normalized" by surgery was around 90 per cent for the smaller tumors secreting up to 200 ng of prolactin per ml. The success rate dropped sharply for larger, more invasive tumors.

A recent report by another group indicated an immediate normalization after surgery followed by a high rate of recurrence (55 per cent) over the years. One possible cause for this high number of recurrences might be a hypothalamic influence on the pituitary gland inducing the production of new prolactin-secreting tumors.

We are therefore carefully reviewing as many of our "normalized" cases as possible. The preliminary figures for our series, slightly smaller but having a longer follow- up than the other reported series, indicate that the recurrence rate in the MNI series is 25 per cent, significantly less that reported elsewhere. Since these series are comparable regarding type and size of tumor operated upon and immediate post-operative results, differences in the technique of surgical removal must account for the significant difference in long-term results. If hypothalamic drive is responsible for some recurrences, it is certainly not the case for many of them.

Collaborators: Dr. George Tolis, Dr. Yonas Zegeye

Reconstruction of the cisterna magna and spinal subarachnoid spaces in the treatment of syringomyelia

The common denominator to some 80 cases of syringomyelia that have been operated upon seems to be a complete or partial obstruction of the subarachnoid spaces at the cisterna magna or lower along the spinal cord. This creates subarachnoid compartments that do not connect freely so that CSF pressure gradients are produced between them by straining or coughing. CSF is eventually forced into the substance of the spinal cord, either through the central canal at the obex or through some other opening, progressively dissecting the cord parenchyma and producing the familiar clinical syndrome. Our efforts have been directed to by-passing or relieving the obstruction by removing herniated cerebellar tonsils, the Chiari malformation, or dissecting band of adhesions, and by enlarging the cisterna magna or the spinal subarachnoid spaces with grafts of lyophylized dura. We resorted to drainage of the syringomyelic cavity only when extensive adhesions made our primary approach impossible.

So far, the results are encouraging: in approximately 75 per cent of patients the disease process seems to be either arrested or improved. However, 25 per cent deteriorate, either because more adhesions form or because their drainage tubes become blocked or dislodged. We plan a long-term annual follow-up review of these patients.'

Development of a stereotactic instrument with compatible CT, NMR, PET, and digital angiography
The stereotactic instrument, redesigned at the MNI and constructed by Tipal Instruments a decade ago, is being modified and rebuilt of non-magnetic material and with plastic radiolucent vertical bars so that the instrument can be used directly in the CT scanner and with the new digital angiographic equipment. A trial of the instrument in Holland indicated that it could also be used in the NMR scanner. The smaller size of the head opening of the PET scanner presents difficulties.

Very sophisticated computer programs devised by Dr. Terence Peters correct for magnification on the angiograms and provide stereotactic frame coordinates of any structure visible on scans or angiograms. Probes can then be introduced to the desired target by simply attaching the various probe-supporting guides to the diagnostic frame without having to change to a different "operating frame".

Collaborators: Dr. A. Olivier, Dr. T. Peters, Tipal Instruments Ltd.

Dr. Richard Leblanc
Cerebral amyloid angiopathy
During 1983-84 we undertook a retrospective review of cerebral amyloid angiopathy. We concluded that this disorder is a major cause of intracranial hemorrhage and significant mortality in elderly people. We found that CT scans usefully differentiated this disorder from other causes of cerebral hemorrhage in the elderly. This has direct bearing on the management of these cases. The characteristic CT findings in this condition have not previously been stressed in the literature.

Collaborators: Dr. G. Rees Cosgrove, Dr. Kathleen Meagher-Villemure, Dr. Roméo Éthier

We have continued our study of the use of calcium antagonists in cerebrovascular disease by establishing a model for a middle cerebral artery occlusion in the cat where the effects of occlusion can be measured by means of fluoroscein angiography to demonstrate retrograde flow and by krypton-85 epicerebral blood flow analysis. We hope that by using these techniques for quantifications of the effects of middle cerebral artery occlusion we can also demonstrate benefit in the ischemic penumbra with the use of calcium antagonists.

Dr. Jean-Guy Villemure

The possibility of performing labelled BCNU and positron tomography studies has stimulated a protocol for investigation and treatment of patients with high-grade gliomas consisting of super-selective catheterization of the patient's main arterial feeder to the tumor by Dr. Jacques Théron, then an intra-arterial labelled BCNU injection and positron emission tomography. Following this, the patient is given a therapeutic BCNU dosage of 125 mg/m2 of body surface. This is repeated every six weeks if the tumor responds.

We intend to study 30 patients over two years. We will be able to determine whether the intra-arterial administration of BCNU increases the survival rate and to gauge the quality of survival in high grade gliomas. As a result of the positron emission tomography study, we will be able to determine the concentration and kinetics of BCNU. We will also be able to determine some of the advantages of intra-arterial as compared to intravenous administration, from a therapeutic and kinetic point of view.

Collaborators: Dr. Roger Hand, Dr. Jacques Théron, Dr. Mirko Diksic, Dr. Lucas Yamamoto

Clinical studies of pain continue. Thalamic and spinal epidural electrodes were implanted. In this same line, we intend to study with the deoxyglucose technique glucose utilization in animals at the level of the brain and the spinal cord with Drs. Davy Trop and Hanna Pappius.

In collaboration with Dr. Paul Kelly of the Royal Victoria Hospital, tumor specimens are being cultured and measured for estrogen and progesterone receptors. After a year of this assay, some results will be extracted.

In the field of neuro-oncology, we now intend to establish a protocol for interstitial radiation.

Neurotoxicology

Dr. Heather Durham

The general interests pursued in the neurotoxicology research laboratory are the effect of industrial chemicals and drugs on the nervous system and the function, regulation, and pathology of the cytoskeleton, especially neurofilaments. Both of these aims are served by focussing our experiments on the toxic giant axonal neuropathies. Exposure to certain organic solvents (such as n-hexane, methyl n-butyl ketone (MnBK), carbon disulphide, disulfiram) may produce sensorimotor neuropathies. Pathologically, these neuropathies are characterized by the presence of large axonal swellings filled with accumulations of neurofilaments, especially in large diameter nerve fibers. We are exploiting the specific effect of these agents on neurofilament organization, using them as pharmacological tools to investigate the life of neurofilaments and intermediate-sized filaments in general within the cell, and studying their relationship to other components of the cytoskeleton and cellular organelles. These studies have relevance not only to the toxic neuropathies, but to other diseases in which there is pathology involving the cytoskeleton such as giant axonal neuropathy, amyotrophic lateral sclerosis, and Alzheimer's disease.

Our approach has been to develop tissue culture models in which we can quantitate the development of toxicity over time and relate the histopathology to changes in the cellular biochemistry. We have shown that 2,5-hexanedione (2,5-HD), the neurotoxic metabolite of n-hexane and MnBK, when added to the tissue culture medium induces aggregation of intermediate filaments (IF) in human skin fibroblasts; that is, IF form a juxtanuclear mass instead of surrounding the nucleus and radiating out to the cell membrane. The advantage of the fibroblast model over neuronal cultures is that they are easily manipulated in culture, a large number of a homogenous cell population can be subcultured for biochemical analysis, and cells can be observed easily using simple light microscopic techniques.

The first part of the year was spent verifying the model by showing that non-neurotoxic agents did not aggregate IF or were less potent than 2,5-HD, and in assessing the ability of fibroblasts to metabolize parent solvents to 2,5-HD using gas chromatography. Fibroblasts did not metabolize these solvents enough to induce IF pathology reliably. We are now studying the mechanism of IF aggregation by 2,5-HD by investigating three specific theories.

Inhibition of energy metabolism

We have found that inhibitors of glycolysis (iodoacetic acid) and oxidative (dinitrophenol) metabolism do not mimic the effects of 2,5-HD, but we are currently measuring enzyme activities in fibroblasts with IF aggregates.

Crosslinking of IF proteins and disruption of their transport

Using protein gel electrophoresis techniques, with Dr. Paul Holland and Claude Guérin we found the major protein of IF, vimentin, had normal electrophoretic mobility and was present in normal amounts in cells treated with 2,5-HD, providing no evidence for extensive covalent crosslinking of this protein. However, we have found changes in other proteins which we are investigating.

Alteration of the association of IF with microtubules

Sidearms connect neurofilaments to microtubules, and in many cell types, including neurones and fibroblasts, the normal distribution of IF depends on an intact microtubular network. Drugs such as colchicine, which disrupt microtubules, secondarily aggregate IF into nuclear caps. We hypothesize that the aggregated form is the normal distribution of these IF in the absence of other controls. In certain other cell types, such as epithelial cells, IF of the keratin type do not aggregate in the presence of colchicine. Thus if 2,5-HD aggregates IF by disrupting their sidearm associations with microtubules, the sensitivity of different IF types of aggregation by 2,5-HD should parallel their sensitivity to capping by microtubule-disrupting drugs. We are testing this premise using PTK1 cells which have both colchicine-sensitive (vimentin) filaments and colchicine-insensitive (keratin) filaments, human epithelial cells grown from skin explants compared to human skin fibroblasts, and mouse fibroblast and epithelial cells to test for species differences.

A corollary to these experiments is to compare the profile of proteins, especially cytoskeletal-associated proteins in cells sensitive to 2,5-HD, to a cell strain in which this chemical does not aggregate IF These differences can then be compared to differences in the gel patterns we have found in treated and untreated human skin fibroblast in order to identify the major target of 2,5-HD. These results will have implications not only for the cause of the toxic giant neuropathies, but for understanding the control mechanism of the IF network in non-neuronal cells and the transport of neurofilaments in neurones.

Other chemicals which are known to induce accumulations of neurofilaments in neurones include — iminodipropionitrile (IDPN, a chemical model of motor neurone disease), aluminium salts, and acrylamide (which also causes focal accumulations of other organelles). In the fibroblast model, IDPN aggregated IF, but was so cytotoxic to the cells that the effects on the cytoskeleton are not clear. Aluminum lactate did not aggregate fibroblast IF and appears to affect the transport of neurofilaments only. Acrylamide had several effects on the fibroblast cytoskeleton including IF aggregation and alteration in the distribution of contractile proteins. In September, we will begin a series of experiments using organotypic co-cultures of mouse spinal cord, and muscle and electrophysiological techniques to determine the consequences of the cytoskeletal pathology induced by these various chemicals to axonal and neuromuscular transmission.

Positron Emission Tomography Research

Dr. Lucas Yamamoto

Establishment of the method for quantitative measurement of brain pH using carbon-11 DMO

Following the establishment of a quantitative autoradiographic technique in the experimental model, we have measured brain pH using carbon-11 DMO in humans. This method has been found useful for evaluating metabolic states in patients with cerebral ischemia and other pathological conditions.

Measurement of a kinetic constant in the FDG model and in pathological states

We have developed a new method to measure rate constants of k_1-k_4 by using our PET scanner with a special infusion method. Individual measurement of kinetic constants is essential for accurate estimation of the glucose utilization rate under pathological conditions.

Oxygen-15 method

We have investigated a more reliable oxygen-15 methodology for measurement of regional cerebral blood flow, oxygen metabolic rate, and regional cerebral blood volume.

Neurotransmitter kinetics

We are establishing models for quantitative assessment of neurotransmitter kinetics with PET.

Experimental animal research

Animal research resulted, in the past year, in establishment of a quantitative autoradiographic method for assessing brain pH using carbon-14 DMO (Dr. K. Kobatake et al), development of the double tracer autoradiographic method using fluorine-18 and carbon-14 compounds (Dr. K. Sako et al), establishment of a new method to measure the rate constants in the deoxyglucose model (Dr. A. Kato et al), development of the triple-tracer autoradiographic technique (Dr. S. Kitamura et al).

Dr. Mirko Diksic

Research needs led us to build a remotely operated changer for up to five targets.

We have irradiated ^{18}O-H_2O and produced a no-carrier-added ^{18}F fluoride. This provides new possibilities for labelling with no-carrier-added ^{18}F and for preparing compounds with high specific activity. Work on the synthesis of no-carrier-added ^{18}F-haloperidol has been completed but the radiochemical yield of this synthesis needs improvement.

For novel synthetic approaches for introducing ^{18}F into organic molecules, we have used silane to prepare 4-fluoro-antipyrine, 6-fluoro-dopa, and 5-fluoro-uracil.

We developed syntheses for ^{11}C-labelled 5,5-dimethyloxazolidine-2,4-dione (DMO), choline, and for ^{18}F-labelled BFNU, making them available for neurological research. A remotely operated synthesis for ^{18}F-2-fluoro-2-deoxy-D-glucose was set up.

Fluorination with ^{18}F-F_2 in aqueous media has been applied to the synthesis of 2-FDG, 4-fluoro-antipyrine, and 6-fluoro-dopa.

Christopher J. Thompson

Last August we installed a VAX 750 computer with the intention of transferring most applications from the PDP11/60 to the VAX, which is much faster and has more memory and disk capacity. Due to higher costs the system is still largely unused.

As an interim task for this machine we have installed a word processing program, extra terminals, and a high quality printer. There are now three secretaries and several students using this. Nursing also uses it to collect data on staff requirements, and to show areas that are under- or over-staffed.

PET imaging

Stephen Strother is working on quantification. His research covers the sources of errors in data collection and how these errors are corrected in image reconstruction. If one assumes that PET is a "signal measurement" technique rather than a "signal detection" technique, a higher degree of spatial resolution and exact compensation for scattered radiation in the images is required. He has shown that demonstrating "linearity" of measured isotope concentration against "known" concentration is a rather poor way to demonstrate performance. He has shown that using a "phantom" (a cylinder filled with a low isotope concentration containing small cylinders with higher activity) and plotting the measured concentration ratio (contrast recovery) against diameter shows the effects of incomplete scatter compensation very well.

Alain Dagher is working on a new method of data collection for the Positome III. This device, coupled with mechanical modifications underway, will allow higher resolution dynamic studies. The mechanical changes allow the detectors to precess continuously while collecting data, instead of moving the patient to several points during the scan. Data from the coincidence circuit is intercepted by the "address translation register" designed by Alain Dagher and converted to points in a matrix of 64 uniformly spaced parallel projections. The resulting matrix takes up less space in memory, allowing for gated studies, and on disk, allowing for more frames in a study before the disk becomes full. We will soon be able to use the "autoradiographic" rCBF technique developed at St. Louis, which gives blood flow images in only 40 seconds and which can be repeated after 5 minutes. The revisions also included a controller for bolus injection, and infusion pump for rate constant map and rCBF studies. A physiological gate input has been provided to allow gated studies: cardiac studies from small animals, light stimulus gated CBV

studies, or gating based on the presence of epileptic activity in the EEG. Up to four phases are allowed in a gated study.

Michael Roney has succeeded in coupling 4 narrow (4.5 mm) BGO crystals to a dual photomultiplier tube and decoding the output signals. He is using the naturally occurring optical crosstalk between the halves of the PMT to distinguish between signals from the inner and outer crystal on each half of the PMT. His work has demonstrated that it is possible to use this relatively inexpensive decoding technique to identify uniquely the crystal interacting with the gamma ray with an error only 2 per cent greater than that due to the intrinsic compton scatter within the crystals. Using these detector assemblies he has demonstrated spatial resolution of 3 mm FWHM, four times better than that of the current PET imaging systems in use here now.

Dr. Ernst Meyer

Positron Emission Tomography: Methodology

Attention was focused on the methodology related to the measurement of regional cerebral blood flow (rCBF), oxygen extraction fraction (rOEF), rate of oxygen consumption ($rCMRO_2$), and cerebral blood volume (rCBV) by means of the continuous inhalation of ^{15}O-O_2, ^{15}O-CO_2, $C^{15}O$, and ^{11}CO. Of particular interest were the assessment of the error induced in the calculated value of rCBF by a variable, non-constant arterial input function of ^{15}O-labelled tracer and the question of how to achieve stable and well controlled arterial ^{15}O-levels during continuous ^{15}O-O_2 and ^{15}O-CO_2 inhalation.

In the steady state model, rCBF is calculated as: $f = \lambda/[(Ca/Cb) = -\text{⅟}p]$ where λ is the decay constant of ^{15}O, p the tissue-blood partition coefficient of H_2O and Ca and Cb the arterial and tissue concentrations of ^{15}O, respectively. Analysis of the above equation shows that an experimental error in the input function Ca translates into a significantly larger error in rCBF. However, in addition to experimental errors, true fluctuations in Ca can be observed which mainly result from a variable breathing pattern of the subject. In this situation, the tissue concentration Cb changes in response to the arterial input function and an error analysis has to take into account the fact that Cb and Ca are related by: $Cb = T_1 \int^{T2} Ca * f \cdot e^{-kt} dt$, where "$*$" stands for the convolution operation and $k = f/p$. With this in mind, the error in rCBF can be shown to remain within $\pm$ 10 per cent for $rCBF \leq 50$ ml/min/100g and for fluctuations in Ca of $\pm$ 20 per cent (or more, depending on the exact shape of Ca(t)), provided that the input function is sampled frequently (e.g. every 1 to 3 minutes) and then averaged. Treatment of these true fluctuations as experimental errors would result in the prediction of erroneously high errors in rCBF.

The achievement of stable arterial O-15 concentrations during inhalation of ^{15}O-O_2 and ^{15}O-CO_2 depends largely on a suitable means of administering the gas to the subject. For this purpose, we have developed a face mask into which the gas plus a small amount of medical air are delivered by a small plastic tube and then breathed freely by the subject. The exhaled radioactive gas is cleared efficiently by an

exhaust duct placed over the subject's face area. This new gas administration system has not only led to more stable blood O-15 levels but has also resulted in improved image quality in general. In addition, brain sections as low as the cerebellar level can be examined without contamination of the data by exhaled tracer gas.

Another method to improve the stability of the arterial input function is presently under investigation, namely the continuous infusion of ^{15}O-labelled water. An additional advantage of this technique would be the significantly reduced radiation dose delivered to the airways of the subject as compared to the continuous inhalation method. Preliminary tests have shown that sufficiently high levels of ^{15}O-activity can be obtained in Elliott's solution by continuous bubbling with ^{15}O-CO_2.

In order to calculate rOER and $rCMRO_2$ accurately, rCBV (blood volume correction) must be known. Either ^{11}CO or $C^{15}O$ may be used to measure rCBV. The longer half-life of ^{11}C ($T_{1/2} = 20$ min) allows high resolution imaging with ^{11}CO whereas only low resolution pictures are obtained with $C^{15}O$ after a short tracer inhalation period. High resolution imaging, however, lasts ten times longer than low resolution imaging (10 minutes vs 1 minute per scan) and requires additional manipulation of the cyclotron. Also, the radiation dose to the airways is approximately ten times higher in the case of ^{11}CO due to the longer half-life of ^{11}C. In order to evaluate the applicability of a low resolution blood volume correction to the high resolution images of rOER and $rCMRO_2$, low and high resolution corrections were compared for a series of studies on subjects who had had both rCBV scans.

The three studies investigated so far indicate that of the 280 regions of interest (ROI) analyzed, 238 (85 per cent) showed a difference of less than 10 per cent between the high and low resolution corrected values of rOER or $rCMRO_2$, the mean difference being 3.3 per cent. For the same 238 ROIs, the average difference between the uncorrected and high resolution corrected values of rOER and $rCMRO_2$ was -14 per cent.

These preliminary results suggest that low resolution CBV-correction might be feasible and prove particularly useful to study subjects who become restless during prolonged imaging procedures.

Dr. Alan Evans

The most widely used application of quantitative positron emission tomography is the determination of regional cerebral glucose metabolism (rCMRglc) using F-18 labelled deoxyglucose (FDG). This glucose analogue, transported into a cell and phosphorylated in a similar way to glucose, is not metabolized further along the glycolytic pathway. Hence, the FDG accumulates in the cerebral tissue and the local F-18 concentration at any time after injection provides information about the rCMRglc.

The commonly used protocol employs an operational equation which provides rCMRglc from a single PET scan. The measured F-18 activity (Ci) is compared with that expected from normal metabolism at any time, T, as follows:

$$f = \bar{f} \times \frac{Ci(T) - \bar{B}(T)}{\bar{C}(T)}$$

where f = rCMRglc
B = F-18 in precursor pool (tissue FDG)

C = F-18 in metabolized compartment (tissue FDG-6-PO_4)
$C_i = B + C$
and ' ' denotes the value for normal metabolism.

Hence if $B = \bar{B}$ and $C = \bar{C}$ then $\bar{f} = f$. The equation is relatively insensitive to error in the choice of k-values used to calculate B and C provided that $C_i \gg B$. In hypometabolic areas this condition is not met and the equation is suspect. In addition the equation assumes that f is proportional to C over the whole range of metabolic states, an assumption open to question. Furthermore, no information on the values of the individual rate constants is available and so a detailed picture of the underlying mechanisms is missing.

An alternative protocol, developed by Kato et al (1984), allows direct evaluation of these rate constants, as well as rCMRglc and regional blood volume. A programmed infusion of FDG is designed to maintain a constant plasma F-18 level over an initial uptake phase. The use of a constant input function greatly simplifies the form of the equation for calculating total tissue activity and the observed uptake may be fitted with this equation to yield the three rate constants of Sokoloff's original model. A further refinement allows the estimation of the k_4 rate constant introduced by Phelps to account for phosphatase action on the phosphorylated FDG. This second stage requires a further 2 hours of scanning after the end of the infusion stage.

To achieve a constant plasma activity it is first necessary to establish the plasma time-activity curve after a bolus injection of a small amount of FDG (50μCi). This acts as the impulse response function of the system. A small computer is used to calculate the required input schedule for a 5 mCi FDG infusion and also to drive the infusion pump during the study. A series of PET scans is collected during infusion and the images reconstructed. A set of programs has been developed to calculate the rate constants from region-of-interest uptake curves. Work is under way to extend this to a pixel-by-pixel image analysis.

Ultimately this method will provide a greater degree of understanding of the underlying processes in diseased tissue and a more generally applicable operational equation for routine FDG scanning. Rate constant images, showing the local variations of each k-value, may also be applied to a variety of different lesions affecting the brain's chemistry.

Education

Montreal Neurological Institute and Hospital
1953

Clinical Training Opportunities

Neurology

The Montreal Neurological Hospital, with 135 in-patient beds, and the Montreal Neurological Institute, with over 25 active research laboratories, provide a concentrated training centre for neurology and neurosurgery. A three-year residency training program at McGill in adult and pediatric neurology is designed to meet the requirements of the Professional Corporation of Physicians of Quebec, the Royal College of Physicians and Surgeons of Canada, and the American Board of Psychiatry and Neurology.

The program has two major goals. The first is to develop highly skilled clinicians who have had an above-average exposure to the neurosciences. To this end the program provides a wide variety of clinical and laboratory experiences. The program is also designed to train academic physician-investigators and teachers, and with this goal in mind graduating residents are encouraged to seek further training in one of the neuroscientific disciplines.

The McGill neurology residency program is available to medical graduates who have completed an approved internship and one year of training in internal medicine, or, alternatively, an approved clinical clerkship during the final undergraduate year and one year of straight medical or pediatric internship.

The program provides two years of clinical training and one year of laboratory training. Residents are assigned to different clinical or laboratory services every three to six months. While on clinical services, the residents assume graded responsibility for patient investigation and care under the supervision of the attending staff. Weekly clinical and neuroscientific conferences in each of the McGill teaching hospitals serve as a stimulus for further study During the training program, residents may also take part in clinical research projects supervised by members of the staff. Every resident is expected to participate in the teaching of medical students and nurses.

It is usual for each resident to rotate through three hospitals in the course of his training. In one of these institutions he will spend a full year. Those in pediatric neurology will spend at least one year in the Montreal Children's Hospital.

The McGill neurology program is university-based, and includes the neurological services of four McGill teaching hospitals:

> The *Montreal Neurological Hospital*, housed in the same building as the *Montreal Neurological Institute*, has 135 beds for neurology and neurosurgery. It has excellent support facilities in neuroradiology and clinical electrophysiology. There are extensive facilities for research in all the major branches of the neurosciences available within the institute. The MNH also provides neurological and neurosurgical services for the Royal Victoria Hospital.

The 23-bed *Montreal General Hospital* has a neurology teaching unit of 15 beds in a 30-bed neurology and neurosurgery ward. A large consultation service provides the residents with experience in diagnosing and managing the neurological problems which develop on general and specialty medical and surgical services. An active neuroscience unit is located in the MGH Research Institute.

The *Montreal Children's Hospital*, a 300-bed institution, houses a 15-bed neurology unit with specially trained nurses and support staff. In addition, there is an active consultation service, and general neurology and specialty clinics are held weekly.

The *Jewish General Hospital*, a large general hospital with 650 beds, has a 23-bed neurology unit, a large consultation service, and neurology clinics.

In the laboratory year, residents are assigned to one or more of the many diagnostic or research laboratories of the teaching hospitals or research institutes. The laboratory options include, among others, electroencephalography, electromyography, neuropathology, neuroradiology, neuro-ophthalmology and neuro-otology.

Fellowships in the basic sciences and clinical laboratories offer opportunities for training and research lasting one year or more. Such research, additional to the clinical residency training program, may lead to an MSc or PhD degree awarded by the Faculty of Graduate Studies and Research of McGill University.

All inquiries should be addressed to:

Director
Neurology Training Program
Room 604
Montreal Neurological Institute
3801 University Street
Montreal, Quebec H3A 2B4

Neurosurgery

The residency training program in neurosurgery is integrated through the department of neurology and neurosurgery of the Faculty of Medicine, McGill University. Most of the basic and clinical training is carried out at the Montreal Neurological Institute and Hospital but residents rotate through the neurosurgical services at the Montreal General Hospital, the Montreal Children's Hospital, and the Jewish General Hospital for sessions of three to six months.

The neurosurgical training program at McGill University was started by Wilder Penfield and William Cone in 1928. In 1934 the Montreal Neurological Institute, a combined hospital and research centre, was opened; it now has 135 beds. In 1978, the Penfield Pavilion enlarged by 50 per cent the research and clinical areas with a new operating suite and intensive care unit. From the beginning, the neurosurgical program has had an international flavor, with McGill trainees coming from and returning to many other countries; the first modern neurosurgical units in Norway, India, and China, to mention a few, were initiated by former residents of McGill University. Many of the outstanding neurosurgical positions in the United States have continued to be filled by surgeons who took their training at McGill University.

The emphasis on academic aspects of the training is supported by a vigorous neuroscience research program closely organized with clinical activities. Special opportunities for clinical and research work in brain imaging, including CT, PET, and MRI scanning, are available. A brain imaging centre containing the latest resources in these areas will be completed in early 1985. Particular interest is centred on the surgical treatment of epilepsy and a follow-up series of over 2000 surgical cases represents the largest group study of its kind; however, a broad exposure to all neurosurgical problems is provided.

At the Montreal General Hospital, the division of neurosurgery with three full-time neurosurgeons, occupies approximately 43 beds within an 800-bed teaching hospital. Neurosurgery shares with neurology a ward that includes a completely equipped 8-bed neuro-intensive care unit. Neuroradiology facilities include DSA and two EMI 7070 CT scanners.

At the Montreal Children's Hospital, the neurosurgical service with two full-time neurosurgeons provides the pediatric neurosurgical experience in the training program. One resident rotates through the service. Clinical research facilities and brain tumor tissue culture research are available.

At the Jewish General Hospital, the division of neurosurgery is part of an integrated 44-bed department of neurosciences with a modern 6-bed neuro-intensive unit and two CT scanners. In addition, there are neuroradiology, neuroanesthesiology, and neuropathology sections. The resident has opportunities to develop special skills in microsurgery, cerebrovascular surgery, neuro-

oncology, and neuro-ophthalmology. The program provides surgical experience for a senior resident supervised by three staff neurosurgeons.

Research
At the Montreal Neurological Institute over 25 research units cover a wide range of basic and clinical neurosciences. Neurosurgical research at the Montreal General Hospital is directed towards regeneration in the spinal cord and peripheral nerves. Current projects are related to the function of Schwann cells and neurotrophic factors in regeneration. At the Jewish General Hospital research interests of the staff include neuro-oncology, tumor angiogenesis, neurophysiology, and cerebral blood flow, with laboratory facilities in the adjacent Lady Davis Research Institute. These provide ample opportunity for residents to participate in continuing research projects under the supervision of the neurosurgical or neuroscientific staff members.

General Features
The length of the program varies, depending on the resident's career goals, the qualifying specialty body for which he is preparing himself, and the individual's background of experience in medical and surgical disciplines. Residents with one year of straight surgical internship or one year of general surgery should plan a minimum of four years of neurosurgical training. Most trainees will spend six to twelve months on basic studies in one of the laboratory units. Neuropathology, neuroradiology, and neurology are considered important parts of the resident's training program.

The resident is expected to take the written examination of the American Board of Neurological Surgery, for self-assessment at any time during his training program and for credit as soon as eligible. The American Board requires 36 months of clinical neurosurgical training and the Royal College 30 months. The resident is not required, however, to pass either examination to complete his residency. A knowledge of French, verbal as well as written, will be a considerable advantage during the residency program. Many opportunities are available at the university to learn the language.

Special Features
Wilder Penfield and William Cone started the neurosurgical training program at McGill University in 1928. Six years later the Montreal Neurological Institute, a combined hospital and research centre, was opened with 50 beds. In 1954 the hospital expanded to 135 beds for neurology and neurosurgery, and in 1978 a major addition to the institute and hospital, the Penfield Pavilion, was opened with enlarged research, teaching, and clinical areas. From the beginning the neurosurgical program had an international flavour, with MNI trainees coming from, and returning to, many countries. The first modern neurosurgical units in Norway, India, and China, to name only a few, were initiated by former residents of the Montreal Neurological Institute.

A vigorous neurosciences research community at the Montreal Neurological Institute reinforces the academic excellence of the residency program. The surgical treatment of epilepsy is an area of particular interest and expertise; a follow-up series of more than 2,000 surgical cases represents the largest group study of its kind. Computerized stereotactic surgery, advanced vascular surgery, and procedures using microneurosurgical methods are well developed.

The Montreal Neurological Institute has a reputation for innovation—it was the first neurological centre in Canada and one of the first three in North America to acquire the EMI head scanner. It was one of the first to acquire a body scanner, with which a high resolution spinal scanning program has recently been developed. It was the first medical centre in Canada, and one of a half-dozen in the world, to exploit positron emission tomography. The first bismuth germanate positron camera available for clinical research, developed by the MNI's research team, has been in use since 1978. A mini-cyclotron, the first medical cyclotron in Canada, was installed in 1981 to provide tracers for a wide range of metabolic studies on brain and muscle.

A knowledge of French is important for the resident, and many opportunities are provided to learn the language. French-speaking patients and staff members mix daily with the English-speaking staff. McGill's Faculty of Medicine, under whose auspices the residency program is run, is the oldest, the most widely recognized, and the most international of all Canadian medical schools. Montreal, a cosmopolitan city of two million people, offers a wide variety of cultural activities.

All inquiries should be addressed to:

Director
Neurosurgical Training Program
Montreal Neurological Institute
Room 604
3801 University Street
Montreal, Quebec
H3A 2B4

Courses of Instruction in the Faculty of Graduate Studies and Research

In the Faculty of Graduate Studies and Research, courses are offered leading to the Master of Science and Doctor of Philosophy degrees. (See McGill booklet, "Faculty of Graduate Studies and Research.") Through the year the following elective courses are given for graduate students, fellows, and residents. They are open to undergraduates by arrangement.

Neurosciences Seminar

531-602D This is a course of weekly seminars given during the academic year and designed to present over a two-year period a concise, up-to-date review of the basic neurological disciplines. Members of the Montreal Neurological Institute, related McGill departments, and visiting neuroscientists.

Neurophysiology

531-611A Seminars and group discussion in neurophysiology. Professor Gloor and staff.

Neuroanatomy

531-610A Lectures together with medical undergraduates in Course 524-121B, "Interdisciplinary Course in the Central Nervous System."

531-621A Seminars and group discussions in neuroanatomy. By special arrangement. Professor Lawrence and staff.

Clinical Conferences

531-630H Colloquium in clinical and basic aspects of the nervous system. Professor Feindel and staff.

531-631H Seizure and EEG conference. Professors Andermann, Gloor, Olivier, Taylor, and Rasmussen.

531-632H Clinical neurology conference.

Neurochemistry

531-640H Seminars in neurochemistry additional to those provided in Course 531-602H. By special arrangement. Professors Wolfe and Pappius.

Neuropathology

531-650H Six or twelve months laboratory work in neuropathology.

531-651H Conference in neuropathology. Professor Carpenter and staff.

531-652H Slide session in neuropathology.

Neuroradiology

531-660H Practical instruction in techniques and interpretation.

531-661A Lecture demonstrations. Professor Éthier and staff.

Electroencephalography and Clinical Neurophysiology

531-670H Laboratory work in electroencephalography, minimum six months with active participation, seminars, and clinical conferences. Professor Gloor and staff.

Neuropsychology

531-680H Training in research methods for selected graduate students. Professor Milner and staff.

Post Basic Program in Neurological and Neurosurgical Nursing

This program is designed to enhance the knowledge gained in basic nursing education. Its objective is improved nursing care of patients with a variety of neurological and neurosurgical conditions. The nurse is taught to apply new knowledge to total patient care, which involves not only attending to the patients' physical needs but also teaching them about their condition and helping them adapt to the changes brought on by the disorder.

Courses begin in March and September, and are limited to sixteen students. Learning experiences include actual patient care, lectures, demonstrations, laboratory visits, seminars, multidisciplinary discussions, self-teaching projects, and preparation of special studies. A new library facilitates the program. On completion of the program requirements a certificate is granted.

Eileen Flanagan began the post basic program in neurological and neurosurgical nursing soon after the hospital opened in 1934. Since then the Montreal Neurological Hospital has had over 1,100 graduates from thirty-four countries. To become a "Neuro nurse" is to enter a colleague relationship with other nurses who can share their experience and acquired knowledge to the benefit of patient care.

Publications

Montreal Neurological Institute and Hospital
1953

Publications of the Staff of the Montreal Neurological Hospital and Institute 1983-1984

(Figures indicate Montreal Neurological Institute reprint numbers.)

1987 **Ajersch MK, Milner B:** Handwriting posture as related to cerebral speech lateralization, sex, and writing hand. Hum Neurobiol 2:143-146, 1983

2080 **Andermann F, Andermann E:** Startle disease or hyperekplexia. Ann Neurol 16(3):367-368, 1984

2020 **Armstrong DM, Miller RJ, Beaudet A, Pickel VM:** Enkephalin-like immunoreactivity in rat area postrema: ultrastructural localization and coexistence with serotonin. Brain Res 310:269-278, 1984

2032 **Avoli M, McLachlan RS, Gloor P:** Simultaneous recording of cortical and thalamic EEG and single neuron activity in the cat association system during spindles. Neurosci Lett 47:29-36, 1984

2067 **Baxter DW, Andermann F:** In memoriam: James Bert Ryal Cosgrove, MD, FRCP(C) (1920-1984). J Can Sci Neurol 11(4):483-484, 1984

2003 **Beaudet A, Descarries L:** Fine structure of monoamine axon terminals in cerebral cortex. pp. 77-93 In: Descarries L, Reader TA, Jasper H, eds. Monoamine innervation of cerebral cortex. New York, Alan R. Liss, 1984

2022 **Beaudet A, Rambourg A:** The tri-dimensional structure of Nissl bodies: a stereoscopic study in ventral horn cells of rat spinal cord. Anat Rec 207:539-546, 1983

2016 **Bosler O, Joh TH, Beaudet A:** Ultrastructural relationships between serotonin and dopamine neurons in the rat arcuate nucleus and medial zona incerta: a combined radioautographic and immunocytochemical study. Neurosci Lett 48:279-285, 1984

2018 **Carpenter S, Karpati G:** Pathology of skeletal muscle. 754 pages. Edinburgh, Churchill Livingstone, 1984

2043 **Coupland SG, Kirkham TH:** Digital subtraction of eye movement artefact from pattern ERG recordings. Neuro-ophthalmology 3(4):281-284, 1983

2066 **Dannenbaum R, Dykes RW:** Evaluation of cutaneous sensation in myelodysplastic children, using electrical stimulation. Dev Med Child Neurol 26:184-194, 1984

2049 **Diksic M, Di Raddo P:** New syntheses of fluoro-compounds by fluorination in water. Tetrahedron Letters 25(43):4885-4888, 1984

2026 **Diksic M, Farrokhzad S, Yamamoto YL, Feindel W:** A simple synthesis of ^{18}F-labelled 5-fluorouracil using acethylhypofluorite. Int J Nucl Med Biol 11(2):141-142, 1984

2000 **Diksic M, Sako K, Feindel W, Kato A, Yamamoto YL, Farrokhzad S, Thompson C:** Pharmacokinetics of positron-labeled 1,3-bis(2-chloro-ethyl)nitrosourea in human brain tumors using positron emission tomography. Cancer Res 44:3120-3124, 1984

2017 **Diksic M, Yamamoto YL, Feindel W:** Synthesis of ^{11}C-labelled choline. J Labelled Compounds Radiopharmaceuticals 21(9):815-820, 1984

2025 **Di Raddo P, Diksic M, Jolly D:** The ^{18}F radiofluorination of arylsilanes. J Chem Soc Chem Commun 159-160, 1984

2063 **Dykes RW:** Central consequences of peripheral nerve injuries. Ann Plastic Surg 13:412-422, 1984

2065 **Dykes RW, Landry P, Metherate R, Hicks TP:** Functional role of GABA in cat primary somatosensory cortex: shaping receptive fields of cortical neurons. J Neurophysiol 52(6):1066-1093, 1984

2070 **Farrokhzad S, Diksic M, Yamamoto YL, Feindel W:** Synthesis of ^{18}F-labelled 2-fluoroethyl-nitrosoureas. Can J Chem 62(11):2107-2112,1984

2057 **Feindel W:** Progress review of cyclotron medicine in neurology. pp. 173-186 In: Proceedings of the 16th Japan Conference on Radiation and Radioisotopes. December 1983. Japan Atomic Industrial Forum

2047 **Friedman L, Jones BE:** Computer graphics analysis of sleep-wakefulness state changes after pontine lesions. Brain Res Bull 13:53-68, 1984

2046 **Friedman L, Jones BE:** Study of sleep-wakefulness states by computer graphics and cluster analysis before and after lesions of the pontine tegmentum in the cat. Electroencephalogr Clin Neurophysiol 57:43-56, 1984

2068 **Gloor P:** Electroencephalography and the role of intracerebral depth electrode recordings in the selection of patients for surgical treatment of epilepsy. pp. 433-437 In: Roger J et al, eds. Advances in epileptology: XVth Epilepsy International Symposium. New York, Raven Press, 1984

2033 **Gloor P:** Electrophysiology of generalized epilepsy. pp. 107-136 In: Schwarrzkroin PA, Wheal H, eds. Electrophysiology of epilepsy. London, Academic Press, 1984

2058 **Gloor P, Yamamoto Y, Ochs R, Feindel W, Gotman J, Quesney LF, Meyer E, Thompson C:** Regional cerebral metabolism measured by positron emission tomography in patients with partial epilepsy: correlation with EEG findings. pp. 99-103
In: Roger J et al, eds. Advances in epileptology: XVth Epilepsy International Symposium. New York, Raven Press, 1984

2037 **Gotman J:** Measurement of small time differences between EEG channels: method and application to epileptic seizure propagation. Electroencephalogr Clin Neurophysiol 56:501-514, 1983

2039 **Gotman J, Ives JR, Gloor P:** A computer system for prolonged EEG recordings of ictal and interictal activity in epilepsy. pp. 167-172
In: Akimoto H, Kazamatsuri H, Seino M, Ward A, eds. Advances in epileptology: XIIIth Epilepsy International Symposium. New York, Raven Press, 1982

2004 **Hamel E, Beaudet A:** Localization of opioid binding sites in rat brain by electron microscopic radioautography. J Electron Microsc Tech 1:317-329, 1984

2040 **Holland PC, Pena SDJ, Guerin CW:** Developmental regulation of neuraminidase-sensitive lectin-binding glycoproteins during myogenesis of rat L_6 myoblasts. Biochem J 218:465-473, 1984

2078 **Jasper HH:** The saga of KAC Elliott and GABA. Neurochem Res 9(3):449-460, 1984

2064 **Kaas JH, Nelson RJ, Sur M, Dykes RW, Merzenich MM:** The somatotopic organization of the ventroposterior thalamus of the squirrel monkey, Saimiri sciureus. J Comp Neurol 226:111-140, 1984

2010 **Karpati G:** Denervation and disuse atrophy of skeletal muscles—involvement of endogenous glucocorticoid hormones. TINS 7(3):61-62, 1984

1986 **Karpati G:** Muscle weakness. Medicine North America 31:2978- 2985, 1983

2012 **Karpati G:** Partially denervated and reinnervated muscles in Duchenne muscular dystrophy. Muscle Nerv 7(3):261, 1984

2011 **Karpati G:** Prospective therapeutic trials in neuromuscular diseases. pp. 529-531
In: Serratrice G et al, eds. Neuromuscular diseases. New York, Raven Press, 1984

1985 **Karpati G, Armani M, Carpenter S, Prescott S:** Reinnervation is followed by necrosis in previously denervated skeletal muscles of dystrophic hamsters. Exp Neurol 82:358-365, 1983

2015 **Karpati G, Carpenter S:** Repair of microscopic abnormalities in skeletal muscle fibers. pp. 157-160 In: Serratrice G et al, eds. Neuromuscular diseases. New York, Raven Press, 1984

1989 **Kato A, Menon D, Diksic M, Yamamoto YL:** Influence of the input function on the calculation of the local cerebral metabolic rate for glucose in the deoxyglucose method. J Cereb Blood Flow Metab 4:41-46, 1984

1999 **Keene DL, Melmed C, Andermann F:** Anoxic convulsions in asthmatic adults: a potentially dangerous complication. Practical Cardiology 10(11):90- 97, 1984

2042 **Kirkham TH, Coupland SG:** The pattern electroretinogram in optic nerve demyelination. Can J Neurol Sci 10(4):256-260, 1983

2044 **Kirkham TH, Guitton D:** A quantitative study of abnormal eye movements in Huntington's chorea using the scleral search coil technique. Neuro-ophthalmology 4(1):27-38, 1984

2019 **Knobler RL, Panitch HS, Braheny SL, Sipe JC, Rice GPA, Huddlestone JR, Francis GS, Hooper CJ, Kamin-Lewis RM, Johnson KP, Oldstone MBA, Merigan TC:** Systemic alpha-interferon therapy of multiple sclerosis. Neurology 34(10):1273-1279, 1984

2035 **Kostopoulos G, Gotman J:** Computer assisted analysis of relations between single-unit activity and spontaneous EEG. Electroencephalogr Clin Neurophysiol 57:69-82, 1984

1998 **Leblanc R, Feindel W, Yamamoto L, Milton JG, Frojmovic MM:** Reversal of acute experimental cerebral vasospasm by calcium antagonism with verapamil. Can J Neurol Sci 11:42-47, 1984

2059 **Leblanc R, Winfield JA:** The warning leak in subarachnoid hemorrhage and the importance of its early diagnosis. Can Med Assoc J 131:1235-1236, 1984

2031 **McLachlan RS, Avoli M, Gloor P:** Transition from spindles to generalized spike and wave discharges in the cat: simultaneous single-cell recordings in cortex and thalamus. Exp Neurol 85:413-425, 1984

2024 **McLachlan RS, Gloor P, Avoli M:** Differential participation of some 'specific' and 'non-specific' thalamic nuclei in generalized spike and wave discharges of feline generalized penicillin epilepsy. Brain Res 307:277-287, 1984

2038 **Meek D, Wolfe LS, Andermann E, Andermann F:** Juvenile progressive dystonia: a new phenotype of G_{M2}-gangliosidosis. Ann Neurol 15(4):348-352, 1984

2027 **Menon D, Diksic M, Meyer E, Sako K, Yamamoto YL:** A method for measurement of arterial concentration of cerebral blood flow tracer for autoradiographic experiments. Can J Neurol Sci 11:380-382, 1984

2002 **Nudleman K, Andermann E, Andermann F, Bertrand G, Rogala E:** The hemi-3 syndrome: hemihypertrophy, hemihypaesthesia, hemiareflexia and scoliosis. Brain 107:533-546, 1984

2029 **Ochs R, Gloor P, Quesney F, Ives J, Olivier A:** Does head-turning during a seizure have lateralizing or localizing significance? Neurology 34(7):884-890, 1984

2005 **Olivier A, Bertrand G:** A new head clamp for stereotactic and intracranial procedures: technical note. Appl Neurophysiol 46:272-275, 1983

1991 **Olivier A, Bertrand G, Peters T:** Stereotactic systems and procedures for depth electrode placement: technical aspects. Appl Neurophysiol 46:37-40, 1983

1990 **Olivier A, Bertrand G, Picard C:** Discovery of the first human stereotactic instrument. Appl Neurophysiol 46:84-91, 1983

2028 **Ouellet R, Rousseau J, Brasseur N, van Lier JE, Diksic M, Westera G:** Synthesis, receptor binding, and target-tissue uptake of carbon-11 labeled carbamate derivatives of estradiol and hexestrol. J Med Chem 27(4):509-513, 1984

2009 **Palo J, Haltia M, Carpenter S, Karpati G, Mushynski W:** Neurofilament subunit-related proteins in neuronal intranuclear inclusions. Ann Neurol 15(4):322-328, 1984

1993 **Pappius HM, Wolfe LS:** Effect of drugs on local cerebral glucose utilization in traumatized brain: mechanisms of action of steroids revisited. pp. 11-26 In: Go KG, Baethmann A, eds. Recent progress in the study and therapy of brain edema. New York, Plenum, 1984

2074 **Patel YC:** A high molecular weight form of somatostatin-$28_{(1-12)}$-like immunoreactive substance without somatostatin-14 immunoreactivity in the rat pancreas: evidence that somatostatin-14 synthesis can occur independently of somatostatin-28. J Clin Invest 72:2137-2143, 1983

2072 **Patel YC:** Radioimmunoassay of somatostatin-related peptides. pp. 307-327
In: Larner J, Pohl S, eds. Methods in diabetes research, Vol. I. New York, John Wiley, 1984

2014 **Pena SDJ, Karpati G:** Molecular sparks and chemical mediators in muscle regeneration. pp. 149-155
In: Serratrice G et al, eds. Neuromuscular diseases. New York, Raven Press, 1984

2006 **Peters TM, Olivier A, Bertrand G:** The role of computed tomographic and digital radiographic techniques in stereotactic procedures for electrode implantation and mapping, and lesion localization. Appl Neurophysiol 46:200-205, 1983

2007 **Peters TM, Sanctuary BC:** Overview of NMR reconstruction principles. pp. 15-26
In: Esser PD, Johnstone RE, eds. Technology of nuclear magnetic resonance. New York, Society of Nuclear Medicine, 1984

2060 **Petrides M, Pandya DN:** Projections to the frontal cortex from the posterior parietal region in the rhesus monkey. J Comp Neurol 228:105-116, 1984

2021 **Pickel VM, Joh TH, Chan J, Beaudet A:** Serotoninergic terminals: ultrastructure and synaptic interaction with catecholamine-containing neurons in the medial nuclei of the solitary tracts. J Comp Neurol 225:291-301, 1984

2001 **Quesney LF:** Pathophysiology of generalized photosensitive epilepsy in the cat. Epilepsia 25(1):61-69, 1984

2061 **Quesney LF, Fariello RG, Engel J, Morselli PL, Lloyd KG,** eds: Neurotransmitters, seizures, and epilepsy II. 390 pages. New York, Raven Press, 1984

2041 **Rasmussen T:** Characteristics of a pure culture of frontal lobe epilepsy. Epilepsia 24:482-493, 1983

2048 **Rasmussen T:** Results of cortical resection in focal epilepsy. pp. 449-455
In: Porter JP et al, eds. Advances in epileptology: XVth Epilepsy International Symposium. New York, Raven Press, 1984

2076 **Ruggere MD, Patel YC:** Impaired hepatic metabolism of somatostatin-14 and somatostatin-28 in spontaneously diabetic BB rats. Endocrinology 115(1):244-248, 1984

2075 **Ruggere MD, Patel YC:** Somatostatin, glucagon, and insulin secretion from perfused pancreas of BB rats. Am J Physiol 247:E221-E227,1984

2023 **Sako K, Diksic M, Kato A, Yamamoto YL, Feindel W:** Evaluation of ^{18}F-4-fluoro-antipyrine as a new blood flow tracer for multiradionuclide autoradiography. J Cereb Blood Flow Metab 4:259-263, 1984

2050 **Sako K, Kato A, Diksic M, Yamamoto LY:** Use of short-lived ^{18}F and long-lived ^{14}C in double tracer autoradiography for simultaneous measurement of LCBF and LCGU. Stroke 15(5):896-900, 1984

2062 **Shapir J, Bach D, Melanson D, Ethier R, Frank P:** Plain film manifestations of retrocrural disease. J Assoc Can Radiol 35:318-321, 1984

2051 **Sherwin A, Quesney F, Gauthier S, Olivier A, Robitaille Y, McQuaid P, Harvey C, van Gelder N:** Enzyme changes in actively spiking areas of human epileptic cerebral cortex. Neurology 34:927-933, 1984

2073 **Skamene A, Patel YC:** Infusion of graded concentrations of somatostatin in man: pharmaco-kinetics and differential inhibitory effects on pituitary and islet hormones. Clin Endocrinol 20:555-564, 1984

2071 **Srikant CB, Patel YC:** Cysteamine-induced depletion of brain somatostatin is associated with up-regulation of cerebrocortical somatostatin receptors. Endocrinology 115(3):990-995, 1984

2034 **Taylor-Courval D, Gloor P:** Behavioral alterations associated with generalized spike and wave discharges in the EEG of the cat. Exp Neurol 83:167-186, 1984

2052 **Vincken WG, Gauthier SG, Dollfuss RE, Hanson RE, Darauay CM, Cosio MG:** Involvement of upper-airway muscles in extrapyramidal disorders. A cause of airflow limitation. New Eng J Med 311:438-442, 1984

2036 **Wolfe LS, Pappius HM:** Arachidonic acid metabolites in cerebral ischemia and brain injury. pp. 223-231 In: Bes A, Braquet P, Paoletti R, Siesjo BK, eds. Cerebral ischemia. Amsterdam, Elsevier, 1984

2054 **Wood PL, Etienne P, Lal S, Nair NPV, Finlayson MH, Gauthier S, Palo J, Haltia M, Paetau A, Bird ED:** A post-mortem comparison of the cortical cholinergic system in Alzheimer's disease and Pick's disease. J Neurol Sci 62:211-217, 1983

2056 **Wood PL, Nair NPV, Etienne P, Lal S, Gauthier S, Robitaille Y, Bird ED, Palo J, Haltia M, Paetau A:** Lack of cholinergic deficit in the neocortex in Pick's disease. Prog Neuro-Psychopharmacol Biol Psychiatry 7:725-727, 1983

2045 **Yamamoto YL, Ochs R, Ammann W, Meyer E, Evans AC, Cooke B, Izawa M, Kato A, Gloor P, Feindel WH, Diksic M, Thompson CJ:** Changes of energy metabolism and regional cerebral blood flow studied by positron emission tomography in the interictal phase of partial epilepsy. Acta Neurochir (Suppl 33):35-46, 1984

2069 **Yamamoto YL, Ochs R, Gloor P, Ammann W, Meyer E, Evans AC, Cooke B, Sako K, Gotman J, Feindel WH, Diksic M, Thompson CJ, Robitaille Y:** Patterns of rCBF and focal energy metabolic changes in relation to electroencephalographic abnormality in the inter-ictal phase of partial epilepsy. pp. 51-62
In: Baldy-Moulinier M, Ingvar DH, Meldrum BS, eds. Cerebral blood flow metabolism and epilepsy. Paris, John Libbey, 1983

2053 **Young SN, Gauthier S, Kiely ME, Lal S, Brown GM:** Effect of oral melatonin administration on melatonin, 5-hydroxyindoleacetic acid, indoleacetic acid, and cyclic nucleotides in human cerebrospinal fluid. Neuroendocrinology 39:87-92, 1984

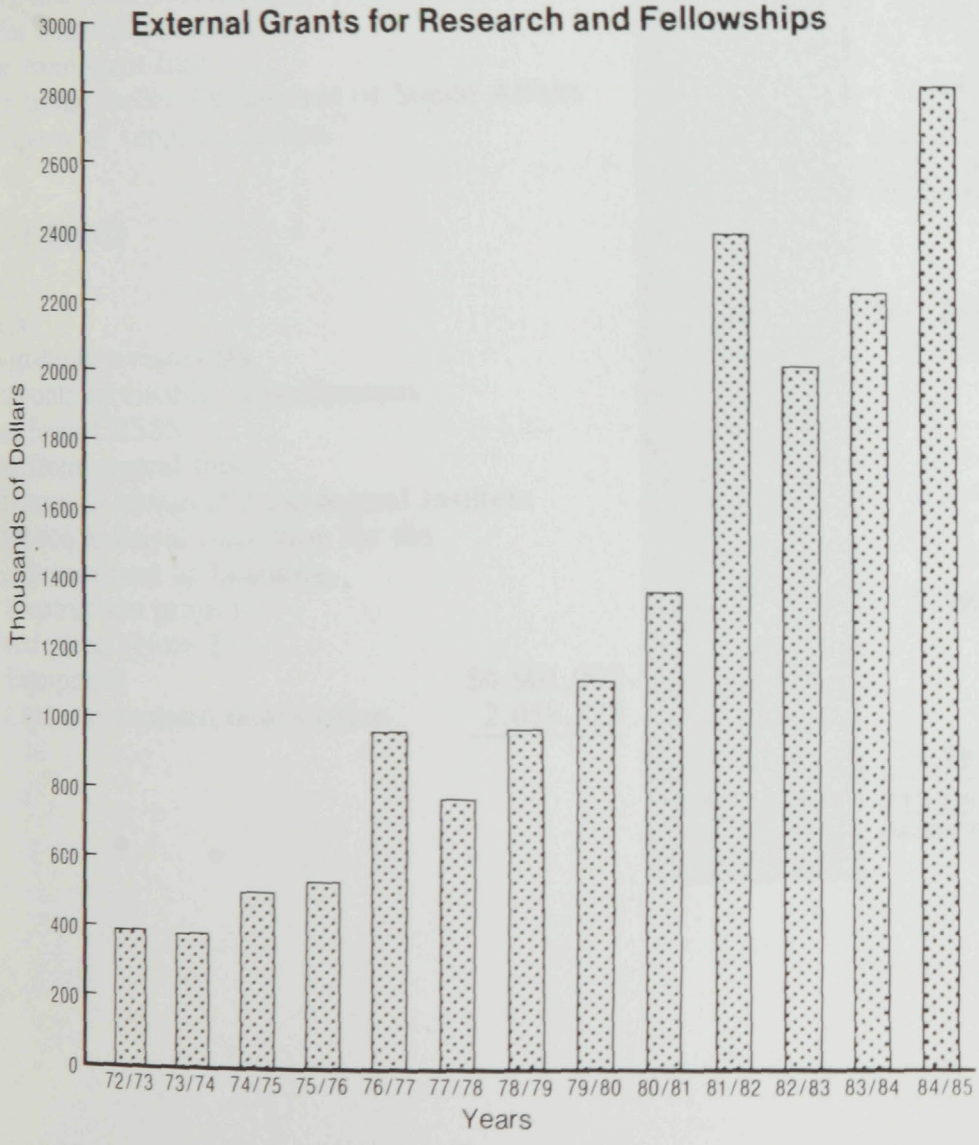
2055 **Young SN, Joseph MH, Gauthier S:** Studies on kynurenine in human cerebrospinal fluid: lowered levels in epilepsy. J Neural Transm 58:193-204, 1983

2013 **Zatorre RJ:** Category-boundary effects and speeded sorting with a harmonic musical-interval continuum: evidence for dual processing. J Exp Psychol 9(5):739-752, 1983

2030 **Zatorre RJ:** La représentation des langues multiples dans le cerveau: vieux problèmes et nouvelles orientations. Languages 18:15-31,1984

2008 **Zatorre RJ, McEntee WJ:** Semantic encoding deficits in a case of traumatic amnesia. Brain Cognition 2:331-345, 1983

Finances


Montreal Neurological Institute
External Grants for Research and Fellowships
Thousands of Dollars
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
72/73 73/74 74/75 75/76 76/77 77/78 78/79 79/80 80/81 81/82 82/83 83/84 84/85
Years

Montreal Neurological Hospital
Balance Sheet as at March 31, 1984

GENERAL FUND

	1984	1983
Assets		
Cash	**$ —**	$ 407,758
Accounts receivable, less provision for doubtful accounts	**1,614,042**	1,280,870
Due from plant fund	**—**	3,035
Due from Quebec Department of Social Affairs	**856,603**	443,763
Inventory of supplies, at cost	**250,301**	203,347
	$ 2,720,946	$ 2,338,773

PLANT FUND

		1984	1983
Assets			
Cash		**$ 409 831**	$ 331 012
Short-term investments		**—**	250,000
Accounts receivable, miscellaneous		**2,158**	—
Due from CRSSS		**49,508**	—
Due from general fund		**17,359**	—
Advance to Montreal Neurological Institute		**739,250**	—
Advance to Royal Institution for the Advancement of Learning, construction project		**10,413,078**	9,693,229
Fixed assets (Note 2)			
Equipment	$4,801,902		
Less accumulated depreciation	2,058,373		
		2,743,529	2,781,710
		$14,374,713	$13,055,951

GENERAL FUND

	1984	1983
Liabilities		
Bank indebtedness	**$ 367,278**	$ —
Accounts payable and accrued liabilities	**1,309,537**	937,452
Due to plant fund	**17,359**	—
Due to Royal Institution for the Advancement of Learning		
Current account	**100,398**	159,091
Advances to cover prior years' deficit	**10,683**	10,683
Surplus	**915,691**	1,231,547
	$ 2,720,946	$ 2,338,773

PLANT FUND

Liabilities		
Bank loan including interest	**$ 1,793,509**	$ 1,440,939
Accounts payable and accrued liabilities	**42,146**	43,655
Due to general fund	**—**	3,035
Construction project funds	**9,529,578**	8,507,774
Capital	**3,009,480**	3,060,548
	$14,374,713	$13,055,951

Montreal Neurological Hospital

Statement of Capital Accounts for the year ended March 31, 1984

GENERAL FUND

	1984	1983
Surplus at beginning of year	**$1,231,547**	$ 242,277
Add		
1983 adjustment related to professional development	**13,305**	—
Contributions from the Quebec Department of Social Affairs	**—**	—
Related to part-time employees	**18,197**	—
Related to prior year	**—**	36,007
Surplus for the year	**—**	529,634
Settlement of prior years' deficit	**—**	453,855
	1,263,049	1,261,773
Deduct		
Settlement of prior year's surplus	**190,027**	—
Distribution to part-time employees	**18,197**	—
Deficit for the year	**139,134**	—
Prior years' adjustments related to interns and residents	**—**	30,226
Surplus at end of year	**$ 915,691**	$1,231,547

PLANT FUND

Capital at beginning of year	**$3,060,548**	$3,119,132
Increase in plant capital	**249,051**	230,222
	3,309,599	3,349,354
Less depreciation on equipment	**300,119**	288,806
Capital at end of year	**$3,009,480**	$3,060,548

Montreal Neurological Hospital

Statement of Operations for the year ended March 31, 1984

GENERAL FUND

	1984	1983
Income		
Quebec Department of Social Affairs (Note 3)	**$11,722,074**	$11,159,540
Revenue from patients	**3,931,437**	4,091,844
Other income	**1,237,053**	1,218,720
	16,890,564	16,470,104
Expenses		
Salaries and wages	**11,250,769**	10,614,266
Fringe benefifs	**1,038,376**	889,522
Drugs, medical and surgical supplies	**1,004,223**	875,118
Services and supplies	**3,736,330**	3,561,564
	17,029,698	15,940,470
(Deficit) surplus for the year	**($ 139,134)**	$ 529,634

Montreal Neurological Hospital
Notes to Financial Statements March 31, 1984

1. *Preparation of financial statements*
These financial statements have been prepared in accordance with the standards and accounting practices required by the directives issued by the Department of Social Affairs pursuant to the Regulations to the Act respecting health and social services of the Province of Quebec.

2. *Fixed assets*
Equipment is recorded at cost and depreciated over its estimated useful lives using the straight-line method over a period of 16 years.

3. *Quebec Department of Social Affairs*
Income from the Quebec Department of Social Affairs includes the amounts approved to May 7, 1984. The Department may, subsequent to a review of the accounts of the Hospital, modify amounts previously approved which would either give rise to additional amounts becoming due to the Hospital or cause amounts to be subject to reimbursement to the Government.

4. *Construction project*
The final approval of the construction project was received through Decree No. 887-83 dated May 4, 1983 of the Province of Quebec for an amount of $13,071,982 of which $4,867,290 is the responsibility of the Montreal Neurological Hospital.
During the year, two contracts totalling $2,859,000 were signed by the Hospital in respect of Phase IV of the construction project.

5. *Contingent liabilities*
Employees' accumulated sickness benefits, which are not recorded in the accounts but charged to expenses when paid, amounted to approximately $713,000 at March 31, 1984.
Two separate actions totalling $3,250,000 have been instituted against the Hospital for professional negligence. In the opinion of management, the actions are unfounded.

6. *Subsequent event*
Subsequent to year-end, the Hospital has received an invoice in the amount of $142,817 from the Montreal Neurological Institute regarding medical specialist fees for prior years. This invoice has not been recorded in the books of the Hospital as authorization must be obtained from the Quebec Department of Social Affairs in order to modify prior years' surpluses (deficits).

Auditors' Report

The Board of Directors,
Montreal Neurological Hospital.

We have examined the balance sheet of the Montreal Neurological Hospital as at March 31, 1984 and the statements of operations and capital accounts for the year then ended. Our examination was made in accordance with the mandate outlined in Schedule II of the Regulations to the Act respecting health and social services of the Province of Quebec and with generally accepted auditing standards, and accordingly included such tests and other procedures as we considered necessary in the circumstances.

In our opinion, these financial statements present fairly the financial position of the Hospital as at March 31, 1984 and the results of its operations for the year then ended in accordance with the standards and accounting practices required by the directives issued by the Quebec Department of Social Affairs pursuant to the Regulations to the Act respecting health and social services.

Montreal, Quebec,
June 20, 1984.

Charette, Fortier, Hawey & Cie
Touche Ross & Cie
Chartered Accountants

Montreal Neurological Institute
Statement of Income and Expenditures

	Year-ended March 31, 1984		Year-ended March 31, 1983	
Opening Balance		**$ 368,377**		$ 514,695
Income				
External grants for research and fellowships		**2,261,580**		2,075,968
Current donations		**1,014,137**		749,112
Previous donations decapitalized		**1,336,597**		718,364
Endowment income		**1,766,751**		1,814,411
University funds:				
GFT clinical staff: MNH/MNI	**255,321**		285,669	
Other salary support for teaching	**158,524**	**413,845**	162,246	447,915
		7,161,287		6,320,465
Expenditure				
Salaries				
University funds:				
GFT clinical staff MNH/MNI	**255,321**		285,669	
Other salary support for teaching	**158,524**	**413,845**	162,246	447,915
MNI Funds:				
Staff				
GFT clinical	**374,347**		401,504	
Other teaching	**258,817**		268,781	
Research	**1,227,339**		1,089,718	
Technical: External grants	**674,083**		691,995	
Technical: MNI funds	**237,690**		236,463	
Support service	**452,705**		393,007	
	3,224,981		3,081,468	
Fringe benefits	**429,247**	**3,654,228**	349,258	3,430,726
Material and supplies		**681,453**		741,671
Building services (McGill)		**238,606**		234,382
Cyclotron and installation		—		15,880
Scientific equipment		**314,696**		281,880
Donner renovations		**104,900**		299,634
NMR scanner		**442,303**		500,000
Webster Pavilion		**1,032,405**		—
Digital angiography system		**233,104**		—
Therascan		**275,000**		—
Renovations and furnishing 3661 University Street		**144,082**		—
		7,534,622		5,952,088
Closing Balance (Deficit)		**(373,335)**		368,377

Endowments

1934 Rockefeller Endowment
1951 Donner Canadian Foundation Grant
1954 Lily Griffith McConnell Endowment
1957 Hobart Anderdon Springle Memorial Endowment
1958 Rupert Bruce Memorial Endowment
1959 Percy R. Walters Memorial Endowment
1960 William Cone Memorial Endowment
1963 Walter Chamblet Adams Memorial Endowment
1964 MNI Research Endowment Fund
1966 Izaak Walton Killam Memorial Endowment
1969 Sophie M.C. Letang Memorial Endowment
1972 Senator and Mrs. Lorne Webster Memorial Endowment
1973 G. Maxwell Bell Memorial Endowment
1974 Flora Campbell Memorial Endowment
1975 Cosgrove Multiple Sclerosis Research Fund
1976 Wilder Penfield Memorial Endowment
1978 William D. Munro Memorial Endowment
1980 Clive Baxter Memorial Endowment Research Fund

Fellowship Endowments

1948 Duggan Fellowship
1950 Lewis L. Reford Fellowship
1956 Dr. and Mrs. Charles F Martin Fellowship
1966 Izaak Walton Killam Memorial Fund for Advanced Studies
1982 Reitman Scholarship Fund

Grants for Special Projects
September 1, 1983 to August 31, 1984

Canadian Association Friedreich's Ataxia
Dr. Eva Andermann

Canadian Heart Foundation
Dr. Antoine Hakim

Conseil québecois de la recherche sociale
Verna Bound

Continental Metal Inc.
Dr. Serge Gauthier
Dr. Richard Leblanc

E.A. Baker Foundation for the Prevention of Blindness, CNIB
Dr. Trevor Kirkham

Fonds de la recherche en santé du Québec
Chercheurs-boursiers
Dr. Massimo Avoli
Dr. David Caplan
Dr. Heather Durham
Dr. Robert Dykes
Dr. Jean Gotman
Dr. Paul Holland
Dr. Barbara Jones
Dr. Justine Sergent

Fonds de la recherche en santé du Québec
Subventions a l'établissement
Dr. Massimo Avoli
Dr. David Caplan
Dr. Heather Durham
Dr. Kenneth Hastings
Dr. Elizabeth Matthew
Dr. Michael Petrides
Dr. Justine Sergent
Dr. Robert Zatorre

Johnston Foundation
Dr. Eva Andermann

Medical Research Council of Canada
Career Investigators
Dr. Brenda Milner
Dr. Leonhard Wolfe

Medical Research Council of Canada
Grants
Dr. Massimo Avoli
Dr. Alain Beaudet
Dr. David Caplan
Dr. Stirling Carpenter
Dr. Heather Durham
Dr. William Feindel
Dr. Serge Gauthier
Dr. Pierre Gloor
Dr. Jean Gotman
Dr. Daniel Guitton
Dr. Antoine Hakim
Dr. Kenneth Hastings
Dr. Paul Holland
Dr. Barbara Jones
Dr. George Karpati
Dr. Elizabeth Matthew
Dr. Brenda Milner
Dr. Hanna Pappius
Dr. Allan Sherwin
Dr. Leonhard Wolfe
Dr. Lucas Yamamoto

Medical Research Council of Canada
Scholarships
Dr. Alain Beaudet
Dr. Jean Gotman
Dr. Daniel Guitton
Dr. Kenneth Hastings
Dr. Elizabeth Matthew
Dr. Yogesh Patel

Multiple Sclerosis Society of Canada
Dr. Gordon Francis

Muscular Dystrophy Association of Canada
Dr. Stirling Carpenter
Dr. Heather Durham
Dr. Paul Holland
Dr. George Karpati

National Cancer Institute of Canada
Dr. Kenneth Hastings

Quebec Heart Foundation
Dr. Serge Gauthier
Dr. Antoine Hakim

Quebec Genetics Network
Dr. Eva Andermann

Savoy Foundation
Dr. Eva Andermann
Dr. Luis Felipe Quesney
Dr. Yvon Robitaille

The Hospital for Sick Children Foundation
Dr. Massimo Avoli

Montreal Neurological Institute Grants
September 1, 1983 to August 31, 1984

Killam Fellows
Antonio Incisa della Rocchetta
Hirofumi Nakai

Killam Scholars
Massimo Avoli
Alain Beaudet
David Caplan
Mirko Diksic
Heather Durham
Robert Dykes
Serge Gauthier
Jean Gotman
Antoine Hakim
Kenneth Hastings
Barbara Jones
George Karpati
Donald Lawrence
Maria Grazia Marciani
Ernst Meyer
Rachel Ochs
Ronald Pokrupa
Luis Felipe Quesney
Christopher Thompson
Lucas Yamamoto

Suggested Forms for Bequests to the Montreal Neurological Institute

Unrestricted

I give and bequeath the sum of _____ dollars (or designated property or portion of estate) to the Montreal Neurological Institute, McGill University, both the principal and income to be derived therefrom to be used in such manner as the Board of Governors of the said University shall from time to time determine.

Restricted only as to principal

I give and bequeath the sum of _____ dollars (or designated property or portion of estate) to the Montreal Neurological Institute, McGill University, to constitute part of its general endowment funds, the income to be derived therefrom to be used in such manner as the Board of Governors of the said University shall from time to time determine.

Restricted as to purpose

I give and bequeath the sum of _____ dollars to the Montreal Neurological Institute, McGill University, both the principal and the income to be derived therefrom to be used for the purpose of (stating purpose) in such manner as the Board of Governors of the said University shall from time to time determine.

For founding fellowships and student aid

I give and bequeath the sum of _____ dollars (or designated property or portion of estate) to the Montreal Neurological Institute, McGill University, for the purpose of founding in the said University one or more fellowships or bursaries to be known as "Fellowship or Bursary," the net annual income from this fund to be awarded annually in such amounts, under such conditions, and to such recipients as may be determined from time to time in accordance with the directions of the Board of Governors of the said University.

For information and suggestions, contact:

Director
Montreal Neurological Institute
3801 University Street
Montreal, Quebec H3A 2B4
Telephone: (514) 284-4655

Statistics

Montreal Neurological Institute and Hospital
1985

Classification of Operations
April 1, 1983 to March 31, 1984

Craniotomy and craniectomy		
and excision of epileptogenic focus (lobectomy)	93	
and removal of cerebral tumor	62	
and hypophysectomy transsphenoidal for pituitary or intrasellar tumor	30	
and removal of posterior fossa tumor	28	
and excision, clipping, or wrapping of aneurysm	19	
and drainage of intracerebral hematoma	8	
and correction Chiari malformation (plugging of central canal)	6	
and drainage of subdural hematoma	6	
and biopsy	4	
and excision of epileptogenic focus (hemispherectomy)	4	
and excision of abscess	4	
and decompression, debridement, and repair of dural laceration	3	
and removal of arteriovenous malformation	3	
and trigeminal rhizotomy, suboccipital	2	
and plastic repair of dura, CSF rhinorrhea, or fistula	2	
and removal of tumor of skull	2	
and incision, drainage, or removal of cyst	2	
and cerebral vascular bypass anastomosis	1	
and drainage of abscess	1	
and plastic repair of skull defect (plate, bone, acrylic)	1	
and elevation of depressed skull fracture	1	
and decompression (debridement)	1	
and hypophysectomy for pituitary or intrasellar tumor	1	284
Trepanation		
and drainage of epidural, intracerebral, or subdural space	18	
and implantation of thalamic stimulator electrodes stage 1 and 2	6	
and biopsy	1	
and removal of thalamic stimulator electrode	1	
Shunt Procedures		
replacement or revision of shunt	18	
ventricular peritoneal	18	
ventricular caval (atrial)	7	
removal of shunt	1	
Stereotaxic Procedures		
and ventriculography, PEG, angiography (localization)	17	
and placement of electrodes for seizures	14	
and biopsy or drainage of cyst	12	
and lesion (mechanical or neurolytic agent, including electrophysiological localization)	9	122

Laminectomy, Hemilaminectomy

and decompression or exploration of spinal cord or cauda equina for stenosis or dentate ligament section, or spondylosis	36	
and discoidectomy, lumbar, sacral	31	
and discoidectomy, anterior approach, cervical (Cloward)	18	
and removal of tumor, extradural, metastatic bone, etc.	16	
and implantation dorsal column stimulator unit	7	
and removal of tumor, extramedullary, intradural	4	
and spinal fusion with bone graft, autogenous or bone bank	4	
and incision and drainage of intramedullary cyst (syringomyelia)	3	
and rhizotomy, torticollis	3	
and anterolateral cordotomy, thoracic	2	
and spinal fusion with Harrington rods, and autogenous or other graft	2	
and spinal fusion with wire, plate, or surgical simplex	1	
and discoidectomy, anterior approach, cervical without arthrodesis	1	
and rhizotomy, dorsal	1	
and rhizotomy, ventral	1	
and spinal fusion, cranio-cervical and traction of vertebral body fracture or dislocation	1	131

Nerve Exploration

and neurolysis, transplantation, or decompression or exploration	37	
and avulsion or section	3	
and excision of neuroma	1	
and neurolysis, by radiofrequency	1	

Artery Exploration

and endarterectomy (patch graft)	10	
and exploration, carotid artery	1	

Wound Reopening

and drainage of infection	4	
and removal of bone flap, tantalum plate or wire mesh or acrylic	3	
and evacuation of hematoma	1	
and further removal of tumor	1	
and removal of foreign body	1	63

Miscellaneous

muscle biopsy	82	
tracheostomy	18	
miscellaneous	14	
radiofrequency trigeminal rhizotomy	10	124

Diagnoses
April 1, 1983 to March 31, 1984

Epilepsy	377
Cerebrovascular disease	208
Functional psychosis and behavior disorders	147
Intracranial tumors and cysts	124
Radiculopathy due to intervertebral discs	108
Subarachnoid hemorrhage	105
Craniocerebral trauma	77
Myelopathy (unspecified)	55
Migraine	51
Multiple sclerosis	50
Cranial neuropathies	42
Hydrocephalus	33
Parkinsonism	33
Meningitis	31
Spinal trauma	30
Subdural hematoma	27
Myasthenia gravis	21
Guillain-Barré syndrome	15
Peripheral neuropathy	15
Syringomyelia	14
Motor neuron disease	12
Cerebrospinal fluid rhinorrhea	12
Muscular dystrophy	11
Intracerebral abscess	10
Alzheimer's disease	8
Arnold-Chiari malformation	8
Myalgia	8
Intracranial aneurysm (not ruptured)	6
Myopathy	5
Ulnar neuropathy	4
Tuberous sclerosis	3
Median neuropathy	2

Causes of Death
April 1, 1983 to March 31, 1984

Cerebral hemorrhage	12	
Cerebral hemorrhage	12	
Intracranial hemorrhage	5	
Subarachnoid hemorrhage	11	
Traumatic subarachnoid, subdural, extradural hemorrhage	1	
Occlusion of cerebral arteries	7	
Malignant brain tumor	16	
Intracranial trauma unspecified	1	
Others	29	82