

Contents

Purpose and General Aims

G. Schaltenbrand, A. E. Walker	1
The Changing Perspective	2

History of Human Stereotaxy (Stereencephalotomy)

E. A. Spiegel	3
-------------------------	---

Introduction	3
Stereotaxic Diagnostic Procedures	4
Therapeutic Lesions	5
Therapeutic Stimulations	8

A. Anatomical and Physiological Basis for Stereotaxy 11

1 Anatomy of the Spinal Cord

T. L. Peele	13
Macroscopic Features	13
Spinal Gray	13
Ascending Sensory Paths	16
Descending Spinal Cord Pathways	18
Fasciculi Proprii	20
Descending Spinal Autonomic Paths	20
Blood Supply of the Spinal Cord	20

2 Physiology of the Spinal Cord

D. M. Feeney	23
Introduction	23
Stretch Reflex	23
Descending Influences on Spinal Cord	26
Locomotion	27
Ascending Spinal Pathways	28
Ascending Pathways	30
Pain	31

3 Anatomy of the Brainstem

J. M. Henry	37
General	37
Mesencephalon (Midbrain)	41
Parkinson's Disease	46
Pons (Metencephalon)	47
Cranial Nerves of the Pons	48
Medulla Oblongata (Myelencephalon)	53
Cranial Nerves of the Medulla	53
Reticular Formation and Raphe Nuclei	55
Ascending and Descending Tracts of the Brainstem	56
Pain	57

4 Anatomy of the Cerebellum

L. T. Robertson, R. S. Dow	60
Introduction	60
Comparative Anatomy	60
Neurocytology of the Cerebellum	62
Afferent Axonal Systems	64

Corticonuclear Projections to the Deep

Cerebellar Nuclei	66
Efferent Connections of the Deep Cerebellar Nuclei	67
Conclusion	69

5 Physiology of the Cerebellum

M. Ito	71
Historical Views	71
Neuronal Circuitry of the Cerebellar Cortex	72
Corticonuclear Organization	75
Afferent Inputs to the Cerebellum	77
Involvement of the Cerebellum in Autonomic and Motor Functions	79
Interpretation of Cerebellar Symptoms	82

6 Anatomy of the Hypothalamus

H. G. Hartwig, W. Wahren	87
Introduction	87
Topographic Delineation	87
Morphological Subunits of the Hypothalamus	88
Types of Neurons	90
Cytoarchitectonic Classification	92
Tuber Cinereum	93
Mammillary Body	96
Fiber Connections	96
Input to the Hypothalamus	97
Projections of the Hypothalamus	99
Neurohumoral Projection Sites of Hypothalamic Neurons	100
Conclusion	101

7 Physiology of the Hypothalamus

S. Larsson, S. Benlamlih	107
Introduction	107
Hypothalamus and the Circulation	107
Hypothalamus and Regulation of Temperature	109

X Contents

Hypothalamus and the Anterior Pituitary	112	11 Arterial Supply of the Thalamus	
Hypothalamic Control of the Posterior Pituitary	115	G. Percheron	218
Hypothalamus and Water Intake	116	Introduction	218
Hypothalamus and Regulation of Food Intake	118	Deep Arteries and Territory of the Middle Cerebral Artery	218
Food Intake and Possible Receptor Mechanisms	119	Anterior Choroidal Artery and Territory	219
Food Intake and Possible Role of Hormones	120	Posterior Communicating Artery and Territory	220
Ventromedial Hypothalamic Nucleus (VMH)	121	Communicating Basilar Artery and Territory	224
Some Biochemical Aspects on the Hypothalamus	123	Posteromedial Choroidal and Thalamic System	225
		Short Branches of the Posterior Cerebral Artery and Their Territory	227
8 Relations and Functions of the Pyramidal Tract		Posterolateral Choroidal and Thalamic System	228
D. Denny-Brown	131	Conclusion	230
Introduction	131	12 Anatomy and Physiology of the Basal Ganglia	
Anatomical Features	131	M. B. Carpenter	233
Recovery from Complete Bilateral Section of the Medullary Pyramids	132	Introduction	233
Extrapyramidal Motor Function	132	Striatum	233
Section of Cerebral Peduncle	133	Globus Pallidus	245
Cortical Stimulation	134	Substantia Nigra	254
Pyramidal Function in the Intact Animal	134	Nigral Afferent Fibers	255
The Part Played by Contact Reactions	136	Subthalamic Nucleus	260
Visually Directed Reaching and Grasping	138	Summary	261
		Addendum	262
9 Architectonic Organization of the Thalamic Nuclei		13 Anatomy of the Limbic System	
R. Hassler	140	H. Stephan, O. J. Andy	269
Introduction	140	Introduction	269
Anterior Nuclear Group (Territorium Anterius A)	142	Developmental Changes	270
Medial Nuclear Region (Territorium Mediale: M; Nucleus Medialis Dorsalis or Dorsomedialis)	145	Olfactory Cortex	270
Truncothalamic Nuclei (Nonspecific Thalamic Projection Nuclei)	147	Amygdala	274
Lateral Nuclear Region	153	Septum Telencephali	275
Metathalamus	170	Hippocampus	277
Reticulate Zone of the Thalamus (Zona Reticulata Thalami = Rt)	174	Gyrus Parahippocampalis	280
		Gyrus Cinguli	283
10 Normal and Pathological Physiology of the Thalamus		Limbic System Fiber Connections	286
A. E. Walker	181	Discussion	288
Introduction	181	14 Cortical Localization of Function	
Diffuse Nonspecific Thalamic System	184	H. Hécaen	293
Nucleus Centralis (CE)	185	Historical Introduction	293
Physiological Aspects	186	Localistic Concepts of Function	293
Specific Thalamic Systems	187	Contemporary Concepts	294
Medial Group	199	Integrated Functional Localization	296
Lateral Group	200	Cerebral Dominance	299
Pulvinar Group	201	Functional Hemispherical Asymmetry	300
Other Thalamic Systems	204	Conclusions	301
Clinical Contributions to Thalamic Physiology	205	15 Functional Organization of the Cerebral Isocortex	
Basic Patterns of Thalamic Physiology	208	K. H. Pribram	306
Summary	210	Introduction	306
		Problem of Cortical Organization	306
		Input-Output Relationships	307

Perifissural Cortex: Perceptual Constancy and Motor Skill	309	Distribution of Information and the Functions of Extrinsic Systems	322
Method of Classifying the Functions of the Intrinsic Cortex	311	Processing Mechanism	323
Modal Specificity within the Posterior Intrinsic Systems	311	Summary	324
Information Processing: The Search, Sampling and Selection of Sensory Invariants	312	16 Speech	
Modal Specificity within the Frontal Intrinsic System	316	Macdonald Critchley	329
Attaining Assurance: Organizing Responses to Variations in Experiences	317	17 Cortical Evoked Potentials	
Dimensions of Isocortical Processing	318	J. A. Ganglberger	334
An Alternative to the Transcortical Reflex	320	Definition of Terminology	334
The Brain Controls its Input	320	Introductory Remarks	334
		Characteristics of Recruiting and Augmenting Response	335
		Evoked Potentials	340
		Thalamic Interaction as Studied on Thalamic and Cortical SSEP	342
		Event-Related Slow Potentials of the Brain	343
B. Stereotaxic Techniques	349		
18 Instrumentation of Stereotaxy		Comparison of the Effects of Stimulation in the Dominant and the Nondominant Thalamus	406
T. Riechert, H. Spuler	350	Conclusion	406
Introduction	350	22 Implantation of Radioisotopes (Curie-Therapy)	
Instrumentation for Stereotaxic Operations	350	F. Munding	410
Instrument of Riechert and Wolff (First Model) and Riechert and Munding (Second Model)	350	Introduction	410
Stereotaxic Apparatus of Würzburg	356	Stereotaxic Interstitial and Intracavitary Curie-Therapy	411
Types of Lesion	361	Summary	432
19 Computers in Stereotaxic Surgery		23 Contributions of Electromyography to Stereotaxy	
G. Bertrand	364	A. Struppler	436
20 Depth Microelectrode Studies		Routine EMG in Diagnosis and Differential Diagnosis of Central Motor Disorders	436
C. Ohye	372	EMG as Monitor in the Operating Room	441
Introduction	372	Analysis of Motor Control in Man	443
Techniques of Extracellular Recording of Thalamic Neuronal Activity	372	24 Combined Open-Stereotaxic Procedures	
Quantitative Estimation of Neural Noise in the Subcortical Structures	373	T. Riechert	449
Unitary Activity of Thalamic Neurons	377	Principle of Combined Open-Stereotaxic Procedures	449
Summary and Conclusion	386	General Technique	449
21 Electroanatomical Observations		Indications for Operation	449
G. Schaltenbrand, W. Wahren	390		
Electroanatomy of the Deep Structures of the Brain	390		
Effects of Stimulation with Diffuse Localizations	404		

C. Clinical Applications of Stereotaxy	457
25 Age and Time as Factors in the Results of Stereotaxic Surgery	
Part 1. Effect of Age on the Complications and Results of Stereotaxic Surgery	
T. Riechert	458
Effect of Age on Complications	458
Effects of Age on Operative Results	459
Summary	460
1. Pain	462
26 General Considerations of Pain	
K. Sugita, S. Kobayashi	462
Introduction	462
Surgical Techniques for the Relief of Pain	463
New Concepts of Pain	464
27 Spinal Stereotaxic Procedures	
P. L. Gildenberg	469
Introduction	469
Treatment of Pain	469
Summary	473
28 Brainstem Stereotaxic Procedures	
B. S. Nashold, Jr.	475
Introduction	475
Anatomy and Physiology	476
Indications for Stereotaxic Mesencephalotomy	477
Stereotaxic Neurosurgical Technique	477
Effects of Electrical Stimulation of the Mesencephalon	478
29 Thalamic Stereotaxic Procedures	
R. R. Tasker	484
General Introduction	484
Evaluation of Results	484
Indications	484
Target for Thalamotomy	486
Results of Thalamotomy by Region	486
Chronic Stimulation for the Relief of Pain	493
Conclusions	494
30 Stereotaxic Induction Stimulation for Pain	
G. Dieckmann, J.-U. Krainick, U. Thoden	498
Introduction	498
Methods and Devices	498
Clinical Results at Different Targets	498
Discussion	501
2. Movement Disorders	503
31 Classification of Movement Disorders	
A. E. Walker	503
Introduction	503
Dyskinesia	503
Convulsive Movements	506
Miscellaneous Involuntary Movements	509
32 Tremor Mechanisms	
H. Narabayashi	510
Introduction	510
Vim Lesion for Tremor Alleviation	510
Analysis by Microelectrode Study of Vim	510
Hypothesis Regarding the Genesis of the Bursts	513
Tremor Rhythm (Clinical Analysis), Prototype of Tremor and Muscle Tone	513
Working Hypothesis for Tremor Genesis	514
33 Stereotaxic Surgery for Tremor	
A. E. Walker	515
Introduction	515
Indications for Operation	515
Site of the Lesion	515
Confirmation of Anatomical Locus	516
Types of Lesions	518
Results	519
Complications of Thalamotomy for Parkinsonian Tremor and Rigidity	519
Summary	520
34 Stereotactic Treatment for Spasmodic Torticollis	
R. Hassler, G. Dieckmann	522
Introduction	522
Material	523
Surgical Technique	525
Clinical Results of Different Authors	528

Discussion	530	Acquired Dystonia	549
Summary	530	Cryothalamectomy	550
35 Choreoathetosis and Spasticity		Results	557
H. Narabayashi	532	Summary	558
Introduction	532	37 Stereotaxic Cerebellar Surgery for Spasticity	
Analysis of Various Types of Motor Disturbances in Cerebral Palsy	533	J. Siegfried	562
Surgery	534	History	562
Results	535	Technique	562
Summary	542	Results of Stereotaxic Lesion of Dentate Nucleus	563
36 Dystonia			
I. S. Cooper	544		
Introduction	544		
Natural History of Dystonia Musculorum Deformans	547		
3 Behavioral Disturbance	565		
38 General Considerations on Psychiatric Stereotaxic Surgery for Behavioral Disturbances			
H. J. Barahona Fernandes, J. L. Simões da Fonseca	565	Technique of Operation	603
Introduction	565	Results	607
Egas Moniz and Psychosurgery	565	Discussion	612
Epistemic Considerations	566	42 Aggressiveness	
The Ethical Problem Involved in the Alteration of Personality	567	K. Sano	617
Safeguarding the Patient	567	Introduction	617
Summary	569	Posteromedial Hypothalamotomy	617
39 Stereotaxic Surgery for Psychiatric Disturbances		Discussion	619
R. Hassler	570	43 Erethic Oligophrenia	
General Considerations for Psychosurgery	570	H. Spuler	622
Anatomical and Physiological Fundamentals of Psychosurgery	571	Introduction	622
Targets for Psychosurgical Interventions	579	Dorsomedial Thalamotomy	622
Mental Disturbances	581	Amygdalotomy	622
Tics and Gilles de la Tourette Syndrome	585	Hypothalamotomy	624
40 Depression and Schizophrenic Syndromes		Cingulectomy	624
R. Newcombe	591	Fornicotomy	625
Introduction	591	Subfrontal Gyrectomy	625
Stereotaxic Surgery for Depressive Illness	591	Personal Experiences	625
Schizophrenic Syndromes	596	44 Stereotaxic Surgery of the Limbic System	
Conclusion	598	O. J. Andy, H. Stephan	629
41 Sexual Disorders		Introduction	629
H. Orthner	600	Single Target Surgery	629
Introduction	600	Double Target Surgery	639
Classification	600	Triple Target Surgery	641
		Complications Resulting from Stereotaxic Surgery	641
		Summary and Conclusions	642

4. Epilepsy	645
45 General Principles of Stereotaxic Surgery for Epilepsy	
A. E. Walker	645
Introduction	645
Stereotaxic Surgery Designed to Destroy an Epileptogenic Focus	646
Stereotaxic Surgery to Interrupt Pathways of Epileptic Discharge	648
Stereotaxic Surgery to Decrease the Cortical Excitability	650
Discussion	651
46 Stereotaxic Targets for Epilepsy	
B. Ramamurthi, S. Kalyanaraman	653
Introduction	653
Possible Theories	653
Petit Mal	656
Myoclonus	656
Temporal Lobe Epilepsy	657
Localization of Target	657
Stereotaxic Amygdalotomy	658
Results	658
Complications	658
Other Sites for Surgery	658
Summary	659
47 Depth Recording	
A. E. Walker, S. Uematsu,	
E. Niedermeyer, L. MacDonald	661
Introduction	661
Rationale	661
Methods	662
The Authors' Technique	662
The Interpretation of Depth Electrograms	665
Risks of Depth Recording	665
The Future of Depth Recording	665
48 Behavioral Disturbances in Epilepsy	
H. Narabayashi	669
Introduction	669
Surgical Technique	670
Results	670
Lessons from Amygdalotomy	672
49 Stereotaxy for Vascular Anomalies	
R. W. Rand	674
Basis for Stereotaxic Intervention in Vascular Anomalies	674
Ferromagnetic Thrombosis	674
Balloon Catheters for Occlusion	679
Intravascular Coagulation	681
Stereotaxic Clipping of Aneurysms or Malformations	681
Cryosurgical Thrombosis	682
Gamma Ray Occlusion	682
Summary	685
50 The Future of Stereotaxy	
H. Narabayashi	686
Introduction	686
Progress in Stereotaxic Surgery – Introduction of Microelectrode Techniques	686
Indications for Stereotaxic Surgery	687
Collaborative Teamwork	688
Other Applications of Stereotaxy	688
Lessons from Stereotaxic Surgery	689
Epilogue	
A. E. Walker	690
Index	691