Atlas of Topographical Anatomy of the Brain and Surrounding Structures

for Neurosurgeons, Neuroradiologists, and Neuropathologists

By W. Seeger

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With 258 Figures

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Foreword

The traditional education of the neurosurgeon and the clinician working in related specialties is based on their presumed knowledge of the macroscopic anatomy of the brain as traditionally taught. Most neurosurgical textbooks, therefore, provide macroscopic views of sections of the operative site. The literature that has accumulated in recent years on the subject of microneurosurgical operations also follows this principle.

For some years, however, the customary macroscopic representation of the anatomy of the brain has been inadequate for the needs of the neurosurgeon using refined modern operative techniques. Furthermore, despite their detailed presentation, stereotactic atlases are also insufficient for neurosurgical purposes, since the magnified views of sections reproduced in them are of little assistance to the operator in achieving spatial orientation in the brain.

In this work, therefore, an attempt is made to give a spatial representation of the brain, its vessels, and the surrounding structures, whose morphological details can be reproduced within the magnification range of the surgical microscope. The considerable variability of the vessels, which has become generally known only in recent years, has also been taken into account. At the same time, recognizable large topographical associations have been stressed for didactic reasons in the case of all structures shown with considerable enlargement.

The twofold aim – microanatomical presentation on the one hand, and a simultaneous illustration of the positional relationships in connection with the overall topic of the brain on the other – is impossible to realize by means of operation photographs or photographs of organ preparations, and it was, therefore, necessary to have recourse to anatomical drawings and operation sketches by the author. Another reason for the preference for drawings is the opportunity this affords of elucidating illustrations of complex structures by preceding them with drawings of the respective brain structure, then of the arteries, veins, meninges, etc., in stages, and then in a third step combining these in a comprehensive view representing the operative site. Moreover, it is technically almost impossible to produce simultaneous contrast preparations of the arteries and veins and thus obtain a complex photographic representation of the structures of the preparation.

The manuscript and drawings were completed in the years 1974–1976 after almost two decades of neurosurgical work. The data worked out in the early stages (Chapter 1 in particular) were used by the author as the basis for teaching programmes at the University of Giessen. Chapters 2–7, dealing with the operative technical aspects, were produced after mid–1975 and used by the author as the basis for microneurosurgical teaching of his colleagues at the University of Freiburg.

My thanks are due to Doz. Dr. E. Grote, a former colleague from Giessen, who first encouraged me to publish this work. I am grateful to Prof. A. Oksche, Director of the Anatomical Institute, University of Giessen, and Prof. J. Staubesand, Director of the Anatomical Institute I, University of Freiburg, as well as to my colleagues, in particular Dr. J. Gilsbach and Dr. H. Friedrich, for valuable suggestions and advice. Prof. U. Hachmeister, Centre for Pathology, University of Giessen, and Prof. W. Sandritter, Director of the Department of General Pathology and Pathological Anatomy, Pathological Institute, University of Freiburg, provided support by making available the necessary organic material.

Mr. K. Schmidt, Senior Dissector, Anatomical Institute I, University of Freiburg, gave suggestions and help with the production of injection preparations, which were prepared by Mr. D. Knapp, cand. med., in the course of work for his doctoral thesis. The painstaking work of translating the manuscript was undertaken by Ms. S. Brinkmann, Neurological Clinic, University of Freiburg. I wish to thank my colleagues Dr. E. Gröbner, Neurosurgical Clinic, and Prof. J. Dichgans, Neurological Clinic and Department of Neurophysiology, University of Freiburg, for looking over the translation. I am grateful to the secretaries of the Neurosurgical Clinic, University of Freiburg, Ms. E. Hilsenbek, Ms. V. Kullmann, and Ms. C. Cramer, for the helpful way in which they carried out the work of typing the German and English versions of the text.

Freiburg, January 1978 Wolfgang Seeger

Introduction

The aim of this work, as already briefly explained in the foreword, is to give a spatial representation of intracranial structures which will enable the microneurosurgeon to recognize the topographic-anatomical associations and thus facilitate his orientation during the operation. The book is intended to present the problems of the neurosurgeon to the clinician in related specialities, in particular to the neuroradiologist, thus putting him in a position to carry out preoperative examinations more purposefully than has hitherto been the case.

In carrying out the conventional preoperative radiological analysis, orientation was taken, as in the anatomical atlas, from two or three standard projections. This convention inevitably led, after continual repetition of the sagittal and lateral projections in particular, to a two-dimensional conception of structures which were in fact three-dimensional. It was consequently necessary to promote spatial conception by using different oblique projections. These oblique projections were used as follows in this book: for the representation of anatomical preparations, for the simplified representation of radiological findings, and for the illustration of the operation site.

The choice of this method suggested itself for three reasons. First, modern anatomical reproductions have unfortunately deviated from the spatial representation by oblique projection known in earlier centuries (cf. for example those by Jan Kalkar, in 1543 AD, the draughtsman of Vesalius's works). Secondly, oblique projections are seldom used in neuroradiology. They have hitherto been made only to show certain structures without superimposition by other structures. Oblique projections should be used additionally, however, in order to facilitate spatial orientation by the operator and to improve the possibility of measuring the distances between certain structures before the operation. Thirdly, it should be remembered that in microsurgical operations, more than in conventional interventions, there is a danger of losing orientation in the intracranial space. The considerable enlargement shows only a small section of the operative field at one time. Furthermore, the varying oblique positions of the head of the patient used in the different operations make orientation more difficult. Today, operations in the strict lateral or sagittal position count as exceptions.

The use of oblique projections alone is nevertheless not sufficient to prevent disorientation of the operator. In the narrow, limited, microneurosurgical operative field the danger is that important neighbouring structures, which are not visible during operative preparation, may be endangered by pulling, pressure or inadvertent thermocoagulation. It was, therefore, necessary, instead of the customary method of showing the operation site, to include surrounding structures in the illustration and to give characteristic distance measurements between different structures.

The present work consists of two main parts. The first part is intended as a brief introduction to the macroscopic anatomy. The most important brain arteries have been included in a somewhat schematized form. The venous system of the brain could not be schematized meaningfully due to its extreme variability. It is, therefore, first shown in the second part, which makes use of more realistic illustrative methods. The second part of this work is concerned with the topographic-anatomical problems of the microneurosurgeon. Here a classification according to brain regions was chosen.

The various chapters of this book are to a large extent similarly arranged. Each begins with a written presentation of the topic, usually comprising several sections. This is followed by the illustrations relating to the respective chapter. At the end of the text of each chapter the relevant literature is listed.

Note:
(for Nomenclature)

If not otherwise indicated the numbers show distance measurements in millimetres.

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Contents

Part I

Anatomical Principles

Chapter 1
Brain and Cerebral Arteries

(for Veins see Part II)

A. Introduction and Notes on Nomenclature

The following survey applies only to the brain. The complicated structure of this organ and the difficulties of diagnostic visualization with conventional contrast media, which only picture the cavity systems (vessel lumina and C. S. F. spaces), necessitate a representation of the surface relief designed to meet the needs of the neurosurgeon. The surrounding bony structures and large blood vessels are well known from neuroradiological practice. Preoperative neuroradiological diagnostic techniques allow only an inadequate presentation of the relationships between the surface relief of the brain and the vascular arborizations covering it.

First, in the survey only the relationships between cerebral structures and arteries will be elaborated in order to give a general schematic view. Despite their great variability, the cerebral arteries reveal an arborization pattern which is easily understandable in principle. At operation, however, knowledge of this sort is not sufficient. This extreme variability, which has attracted a great deal of interest on the part of neurosurgeons in recent years, is therefore discussed in Part II, where the variable conditions are demonstrated under microsurgical aspects. The greater variability of the veins made it seem advisable to describe them first in Part II and to dispense with a survey here, in order to prevent too stereotyped thinking, which could lead to unpleasant surprise at the operating table.

Schematic cataloguing of the arteries seemed essential in order to facilitate orientation in the subsequent illustrations. The catalogue of arteries that follows was initially drawn up with acknowledgements to Ring (1969), as well as Stephens and Stilwell (1969). The large vessel trunks have been marked with their initials. The main trunk of these vessels has been given the number 1 – e.g., A. carotis interna = c1, A. cerebri ant. = a1 (not to be confused with the numbering of the proximal and distal segments of A. cerebri ant. and media, which has found increasing use in recent years). Higher numbers – e.g., c2, c3, c4-state the respective branch in question. This principle of abbreviation must be schematic because the branch offshoots do not always occur in this order. It is, however, a help to orientation. If a branch has subbranches these are designated by numbers after the point. Thus it is possible to designate an extended region of arborization with secondary and tertiary offshoots by simple numbering. As is well known, the nomenclature of the arteries in the international literature is not uniform. The author has limited himself to the simplest possible presentation. With regard to special questions the reader is referred in particular to the work of Newton and Potts (1974).

Catalogue of Arteries

c1	*A. carotis int.*
c2	A. ophthalmica
c3	A. hypophyseos sup.
c4	Aa. temporo-polares
c5	A. chorioidea ant.
c5.1	Rr. temp. of A. chor. ant.
c5.2	Rr. perforantes
c6	Medial group of perforating arteries (ad Subst. perfor. ant.), see m2.2
a1	*A. cerebri ant.*
a2	Perforating arteries of Chiasma
a3	A. Heubneri (A. recurrens Heubneri)
a4	A. communicans ant.
a5	A. corporis callosi mediana
a6	A. frontopolaris
a6.1	A. orbitalis
a7	A. callosomarginalis

a8	Inconstant trunk of Aa. frontales intt.
a8.1	A. frontalis int. ant.
a8.2	A. frontalis int. media
a8.3	A. frontalis int. post.
a9	A. pericallosa
a10	A. paracentralis
a11	A. praecunealis
m1	*A. cerebri media, prox. trunk*
m2	Branches of prox. trunk of A. c. m.
m2.1	Aa. temporo-polares (A. temp. ant.)
m2.2	Medial group of perforating arteries (ad Subst. perfor. ant.), see c6
m2.3	Aa. lenticulostriatae
m3	A. cerebri media, distal trunk
m4	A. frontalis ascendens (A. frontoparietalis ascendens
m4.1	A. orbito-frontalis
m4.2	A. operculo-frontalis (A. candelabra)
m4.3	A. sulci centralis (Aa. sulci centralis)
m5	A. temp. media
m6	A. parietalis post. (Aa. parietales postt.)
m7	A. angularis
m8	A. temp. post. (Aa. thalamoperforantes)
p1	*A. cerebri post.*
p2 . .	Aa. thalamoperforatae
p3	Perforating arteries to the midbrain from the proximal segment of A. cerebri post.
p4	A. quadrigemina
p5/p5.1	A. communicans post./Rami perforantes
p6	*"A. chorioidea post."* (post. chor. group) *see Figs. 26 and 111*
p6.1	A. chor. post. med.
p6.1.1	Rr. antt.
p6.1.1.1	Rr. antt., medial branches
p6.1.1.2	Rr. antt., lateral branches
p6.1.2	Rr. postt.
p6.1.2.1	Rr. postt., medial branches
p6.1.2.2	Rr. postt., lateral branches
p6.2	A. *(Aa.)* chor. post. lat. (lateral post. chor. group)
p6.2.1	Rr. antt.
p6.2.1.1	Rr. antt., medial branches
p6.2.1.2	Rr. antt., lateral branches
p6.2.2	Rr. postt.
p6.2.2.1	Rr. postt., medial branches to Fornix and Thalamus
p6.2.2.2	Rr. postt., lateral branches to Lamina affixa and *Plexus chor.*
p7	Rr. perforantes to Crus cerebri and Tegmentum mesencephali
p8	Aa. thalamogeniculatae
p9	Aa. hippocampi
p10	Aa. splenii corp. call.
p11.1	Rr. temporales anteriores (R. temp. ant.)
p11.2	Rr. temporales postt. (R. temp. post.)
p12	A. parieto-occipitalis
p13	A. calcarina
v1	*A. vertebralis*
v2	Rr. ad medullam
v3	A. cerebelli inf. post.
v3.1	A. spinalis post. (origin from A. vertebralis possible, too)
v3.1.1	A. spinalis post., R. ascendens
v3.1.1.1	A. spinalis post., R. ascendens, Rr. ad medullam
v3.1.2	A. spinalis post., R. descendens
v3.1.2.1	A. spinalis post., R. descendens, Rr. ad medullam
v3.2	R. lateralis of A. cerebelli inf. post.
v3.3	R. medialis of A. cerebelli inf. post. (A. vermicularis)
v4	A. spinalis ant.
b1	*A. basilaris*
b2	Rr. ad pontem (pontine arteries)
b2.1	Rr. ad pontem, medial group ("Aa. medianae")
b2.2	Rr. ad pontem, lateral group
b2.2.1	Rr. ad pontem, lateral group, variation of one of the arteries: A. trigemina
b2.2.2	Rr. ad pontem, lateral group, variations of one or more of these: so-called Aa. cerebellares accessoriae
b3	A. auditiva int. (ca. 50% originate from A. cerebelli inf. ant., 50% directly from A. basilaris)
b3.1	Termination of A. auditiva int. (Meatus acusticus int.)
b3.1.1	Vestibular branch to N. VII
b3.1.2	Cochlear branches
b3.1.3	Vestibulocochlear branches
b4	A. cerebelli inf. ant.
b4.1	"RL" (rostral lateral artery after Naidich and Kriecheff), see Salamon
b4.1.1	Branch to Lobulus semilunaris superior (ascending artery)
b4.1.2	Branch to Lobulus biventer (descending artery)
b4.2	"CM" (caudomedial artery after Naidich and Kriecheff) + Rr. ad pontem (+ medullam)
b4.2.1	Branches to Plexus chorioideus
b4.2.2	Medial branch to Lobulus biventer
b4.2.3	Lateral branch to Lobulus biventer
b5	A. cerebelli sup.
b5.1	A. cerebelli sup., Rr. ad pontem and mesencephalic perforating arteries
b5.2	A. cerebelli sup., R. med.
b5.3	A. cerebelli sup., R. lat.

Extradural carotid branches are not classified, but designated with their full names. Veins have not been classified since there is no uniform international nomenclature and types of course are extremely varied.

Since the work consists mainly of illustrations it will also be understood by non-English-speaking readers. It was decided to use the international Paris Nomenclature of 1955, which is also specifically

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recognized by the Anglo-Saxon countries*. This was not always possible, particularly for the designation of vessels, since in this regard the Paris Nomenclature is insufficient for the needs of neurosurgeons and neuroradiologists. Many structures have been named only in recent years, and the names differ with different authors. Some designations that were still included in the Basle Nomenclature of 1898 were excluded from the Paris nomenclature. The Jena Nomenclature of 1935 did not receive general recognition and has, therefore, been left out of consideration. Many anatomical terms have been in general use in clinical work for hundreds of years and, as can be seen from the special literature, even the Paris Nomenclature has not changed this. For this reason some well-known oder designations 'e.g., for the large fissures' have been kept.

In the following catalogue the Paris Nomenclature is given as an alternative to the customary designations used in the clinic, insofar as these are used in this book. In addition, for the sake of completeness, some structures that are not illustrated have been included in the catalogue.

* "Nomina anatomica" examined by the I.A.N.C. and permitted by the Fifth International Anatomical Congress Oxford 1950, printed in England by Spottiswoode, Ballantyne and Co. G. m.b.H., London and Colchester, private printing 1955, page VII.

Nomina anatomica (Paris 1955)	Nomina anatomica (Basle 1898 and earlier, selection used in this book)
Osteologia	
Ossa cranii	
Os occipitale	
Foramen magnum	For. occipitale magnum
Pars basilaris	
Sulcus sinus petrosi inferioris	
Squama occipitalis	
Clivus	
Tuberculum pharyngeum	
Condylus occipitalis	
Canalis hypoglossi	
Fossa condylaris	
Tuberculum jugulare	
Processus intrajugularis	
Protuberantia occipitalis externa (Inion)	
(Crista occipitalis externa)	
Linea nuchae suprema	
Linea nuchae superior	
Linea nuchae inferior	
Protuberantia occipitalis interna	
Sulcus sinus sagittalis superioris	Sulcus sagitt. sup.
Sulcus sinus transversi	Sulcus transversus
Sulcus sinus sigmoidei	Sulcus sigmoideus
Os sphenoidale	
Corpus	
Clivus	
Sella turcica	
Fossa hypophyseos	
Tuberculum sellae	
Dorsum sellae	
Processus clinoideus posterior	
Processus clinoideus medius	
Sulcus caroticus	
Lingula sphenoidalis	
Crista sphenoidalis	
Rostrum sphenoidale	

Nomina anatomica (Paris 1955)	Nomina anatomica (Basle 1898 and earlier, selection used in this book)
Sinus sphenoidalis	
Septum sinuum sphenoidalium	
Apertura sinus sphenoidalis	
Ala Minor	*Ala parva*
Canalis opticus	
Processus clinoideus anterior	
Fissura orbitalis superior	
Ala major	*Ala magna*
Facies cerebralis	
Facies temporalis	
Facies sphenomaxillaris	
Facies orbitalis	
Foramen rotundum	
Foramen ovale	
Foramen spinosum	
Spina ossis sphenoidalis	
Processus pterygoideus	
Os temporale	
Pars petrosa	
Processus mastoideus	
Sulcus sinus sigmoidei	Sulcus sigmoideus
Sulcus a. occipitalis	
Foramen mastoideum	
Apex (partis petrosae)	
Canalis caroticus	
Tegmen tympani	
Eminentia arcuata	
Hiatus canalis facialis	
Sulcus n. petrosi majoris	
Sulcus n. petrosi minoris	
Impressio trigemini	
Sulcus sinus petrosi superioris	Sulcus petrosus sup.
Porus acusticus internus	
Meatus acusticus internus	
Sulcus sinus petrosi inferioris	Sulcus petrosus inf.
Processus intrajugularis	
Processus styloideus	
Foramen stylomastoideum	
Pars tympanica	
Meatus acusticus	
Porus acusticus externus	
Pars squamosa	
Processus zygomaticus	
Os parietale	
Foramen parietale	
Tuber parietale	
Linea temporalis superior	
Linea temporalis inferior	
Sulcus sagittalis	
Sulcus sinus sigmoidei	Sulcus sigmoideus
Os frontale	
Squama frontalis	
Tuber frontale	
Arcus superciliaris	
Glabella	
Margo supraorbitalis	
Foramen sive Incisura orbitalis	
Incisura sive Foramen frontale	

Nomina anatomica (Paris 1955)	Nomina anatomica (Basle 1898 and earlier, selection used in this book)
Pars orbitalis	
Fossa glandulae lacrimalis	Fossa lacrimalis
Sinus frontalis	
Os ethmoidale	
Lamina cribrosa	
Crista galli	
Lamina perpendicularis	
Cellulae ethmoidales	
Os lacrimale	
Fossa sacci lacrimalis	
Os nasale	
Vomer	
Maxilla	
Canalis infraorbitalis	
Os zygomaticum	
Processus temporalis	
Processus frontalis	
Cranium	
Lamina externa	
Diploë	
Lamina interna	
Basis cranii interna	
Basis cranii externa	
Fossa crani anterior	
Fossa cranii media	
Fossa cranii posterior	
Impressiones digitatae	
Foveolae granulares	Foveolae granulares (Pacchioni)
Fossa temporalis	
Arcus zygomaticus	
Fossa infratemporalis	
Fossa pterygopalatina	
Fissura pterygopalatina	
Foramen jugulare	
Fissura sphenopetrosa	
Fissura petro-occipitalis	
Foramen lacerum	
Cavum nasi	
Septum nasi osseum	
Apertura piriformis	
Choanae	
Orbita	
Margo supraorbitalis	
Margo infraorbitalis	
Fissura orbitalis superior	
Fissura orbitalis inferior	

Nomina anatomica (Paris 1955)	Nomina anatomica (Basle 1898 and earlier, selection used in this book)
Syndesmologia	
Suturae cranii	
Sutura coronalis	
Sutura sagittalis	
Sutura lambdoidea	
Sutura occipitomastoidea	
Sutura sphenofrontalis	
Sutura spheno-ethmoidalis	
Sutura squamosa	
(Sutura frontalis)	
Sutura frontozygomatica	
Synchondroses cranii	
Synchondrosis spheno-occipitalis	
Synchondrosis sphenopetrosa	
Encephalon	
Rhombencephalon	
Myelencephalon	
Medulla oblongata	
Sulcus medianus posterior	
Fissura mediana anterior	
Pyramis (medullae oblongatae)	
Sulcus lateralis anterior	
Sulcus lateralis posterior	
Oliva	
Pedunculus cerebellaris inferior	Corpus restiforme
Tuberculum nuclei cuneati	
Ventriculus quartus	
Fossa rhomboidea	
Sulcus medianus	
Striae medullares ventriculi quarti	
Colliculus facialis	
Velum medullare posterius	
Velum medullare anterius	
Frenulum veli medullaris anterioris	
Obex	
Apertura mediana ventriculi quarti	Foramen Magendi
Apertura lateralis ventriculi quarti (?)	Foramen Luschkae (?)*
Metencephalon	
Pons	
Sulcus basilaris	
Pedunculus cerebellaris medius	Brachium pontis
Cerebellum	
Fissura horizontalis cerebelli	
Fissura prima	
Vermis	
Lingula cerebelli	
Lobulus centralis	
Culmen	
Declive	
Folium vermis	
Tuber vermis	
Pyramis (vermis)	
Uvula (vermis)	
Nodulus	

* Usually recessus without aperture.

Nomina anatomica (Paris 1955)	Nomina anatomica (Basle 1898 and earlier, selection used in this book)
Ala lobuli centralis	
Lobulus quadrangularis	Lobulus quadrangularis sup.
Lobulus simplex	Lobulus quadrangularis inf.
Lobulus semilunaris superior	
Lobulus semilunaris inferior	
Lobulus biventer	
Tonsilla cerebelli	
Flocculus	
Pedunculus flocculi	
(Isthmus rhombencephali)	
Pedunculus cerebellaris superior	Brachium conjunctivum
*Mesencephalon**	
Pedunculus cerebri	
Crus cerebri	
Fossa interpeduncularis	
Substantia perforata posterior	
Tectum mesencephali	*Lamina quadrigemina*
Colliculus superior	
Colliculus inferior	
Brachium colliculi superioris	
Brachium colliculi inferioris	
Aquaeductus cerebri	Aquaeductus (Sylvii)
Prosencephalon	
Diencephalon	
Ventriculus tertius	
Commissura posterior	
Foramen interventriculare	For. interventriculare (Monroi)
Sulcus hypothalamicus	
Adhaesio interthalamica	
Recessus opticus	
Recessus infundibuli	
Hypothalamus	
Corpus mamillare	
Tuber cinereum	
Infundibulum	
Hypophysis	
Tractus opticus	
Chiasma opticum	
Lamina terminalis	
Fasciculus mamillothalamicus	
Ansa lenticularis	
Thalamencephalon	
Thalamus	
Pulvinar	
Taenia thalami	
Stria medullaris thalami	
Metathalamus	
Corpus geniculatum mediale	
Corpus geniculatum laterale	
Epithalamus	
Corpus pineale	
Recessus pinealis	

* Trigonum lemnisci (missing in Nomina Anat. 1955).

Nomina anatomica (Paris 1955)	Nomina anatomica (Basle 1898 and earlier, selection used in this book)
Recessus suprapinealis	
Habenula	
Commissura habenularum	
Telencephalon	
Cerebrum	
Hemispherium	
Fissura longitudinalis cerebri	
Fissura transversa cerebri	
Fossa lateralis cerebri	Fissura lat. cerebri (Sylvii)
Sulcus lateralis	
Insula	
Gyri insulae	
Gyrus longus insulae	
Gyri breves insulae	
Sulcus circularis insulae	
Sulcus centralis	
Lobus frontalis	
Polus frontalis	
Sulcus praecentralis	
Gyrus praecentralis	
Gyrus frontalis superior	Gyrus front. I
Sulcus frontalis superior	
Gyrus frontalis medius	Gyrus front. II
Sulcus frontalis inferior	
Gyrus frontalis inferior	Gyrus front. III
Pars opercularis	
Pars triangularis	
Pars orbitalis	
Gyrus rectus	
Gyri orbitales	
Lobus temporalis	
Polus temporalis	
Sulci temporales transversi	
Gyri temporales transversi	
Gyrus temporalis superior	Gyrus temp. I
Sulcus temporalis superior	
Gyrus temporalis medius	Gyrus temp. II
Sulcus temporalis inferior	
Gyrus temporalis inferior	Gyrus temp. III
Lobus occipitalis	
Polus occipitalis	
Incisura praeoccipitalis	
Lobus parietalis	
Sulcus postcentralis	
Gyrus postcentralis	
Lobulus parietalis superior	
Sulcus intraparietalis	
Lobulus parietalis inferior	
Gyrus supramarginalis	
Gyrus angularis	
Sulcus corporis callosi	
Sulcus cinguli	
Sulcus collateralis	
Gyrus occipitotemporalis medialis	
Gyrus occipitotemporalis lateralis	
Gyrus cinguli	
Isthmus gyri cinguli	
Gyrus parahippocampalis, Uncus	

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