Swanson, L.W. (2004) Brain maps: structure of the rat brain, 3rd edition

This file has the second Annotated Nomenclature Table. In the book, the list of terms was in the left column, and footnote annotations were nearby in the righ column (instead of at the end, as here).

TABLE B. BASIC CELL GROUPS OR REGIONS OF THE RAT CNS

1. CEREBRUM (CH) **[1]**
- 1.1. CEREBRAL CORTEX (CTX)
  - 1.1.1. Cortical Plate (CTXpl)
    - Sensory-motor cortex (CTXsm)
      - Somatomotor areas (MO) **[2]**
        - primary somatomotor area (MOp)
        - secondary somatomotor areas (MOs)
      - Somatosensory areas (SS)
        - primary somatosensory area (SSp) **[3]**
          - barrel field (SSp-bfd)
          - lower limb (SSp-ll)
          - mouth (SSp-m)
          - nose (SSp-n)
          - trunk (SSp-tr)
          - upper limb (SSp-ul)
        - supplemental somatosensory area (SSs) **[4]**
      - Visceral sensory-motor areas (VSM)
        - visceral area (VISC) **[5]**
        - infralimbic area (ILA) **[6]**
      - Gustatory area (GU) **[7]**
      - Olfactory areas (OLF) **[8]**
        - main olfactory bulb (MOB) **[9]**
          - glomerular layer (MOBgl)
          - outer plexiform layer (MOBopl)
          - mitral layer (MOBmi)
          - inner plexiform layer (MOBipl)
          - granule cell layer (MOBgr)
        - accessory olfactory bulb (AOB) **[9]**
          - glomerular layer (AOBgl)
          - mitral layer (AOBmi)
          - granular layer (AOBgr)
        - anterior olfactory nucleus (AON) **[10]**
          - dorsal part (AONd)
            - molecular layer (AONd1)
            - pyramidal layer (AONd2)
          - external part (AONe)
            - molecular layer (AONe1)

- pyramidal layer (AONe2)
- lateral part (AONl)
  - molecular layer (AONl1)
  - pyramidal layer (AONl2)
- medial part (AONm)
  - molecular layer (AONm1)
  - pyramidal layer (AONm2)
- posteroventral part (AONpv)
  - molecular layer (AONpv1)
  - pyramidal layer (AONpv2)
- tenia tecta (TT) **[11]**
  - dorsal part (TTd)
    - layers 1-4 (TTd1-4)
  - ventral part (TTv)
    - layers 1-3 (TTv1-3)
- piriform area (PIR) **[12]**
  - molecular layer (PIR1)
  - pyramidal layer (PIR2)
  - polymorph layer (PIR3)
- postpiriform transition area (TR) **[13]**
- piriform-amygdalar area (PAA) **[14]**
- nucleus of the lateral olfactory tract (NLOT) **[15]**
  - molecular layer (NLOT1)
  - pyramidal layer (NLOT2)
- cortical amygdalar area (COA)
  - anterior part (COAa) **[16]**
  - posterior part (COAp) **[17]**
    - lateral zone (COApl)
    - medial zone (COApm)
- Auditory areas (AUD) **[18]**
  - primary auditory area (AUDp) **[18]**
  - dorsal auditory areas (AUDd) **[19]**
  - ventral auditory areas (AUDv) **[20]**
  - posterior auditory area (AUDpo) **[21]**
- Visual areas (VIS) **[22]**
  - anterior laterolateral visual area (VISlla)
  - anterolateral visual area (VISal)
  - anteromedial visual area (VISam)
  - intermediolateral visual area (VISli)
  - laterolateral visual area (VISll)
  - mediolateral visual area (VISlm)
  - posterolateral visual area (VISpl)
  - primary visual area (VISp)
  - rostrolateral visual area (VISrl)

Polymodal association cortex (CTSpm)

- Anterior cingulate area (ACA) **[23]**

- dorsal part (ACAd)
- ventral part (ACAv)

Prelimbic area (PL) **[23]**

Orbital area (ORB) **[24]**
- lateral part (ORBl)
- medial part (ORBm)
- ventral part (ORBv)
- ventrolateral part (ORBvl)

Agranular insular area (AI) **[25]**
- dorsal part (AId) **[26]**
- ventral part (AIv) **[26]**
- posterior part (AIp) **[26]**

Retrosplenial area (RSP) **[27]**
- dorsal part (RSPd) **[28]**
- lateral agranular part (RSPagl) **[29]**
- ventral part (RSPv) **[30]**
  - zone a (RSPv.a)
  - zone b/c (RSPv.b/c)

Posterior parietal association areas (PTLp) **[31]**

Temporal association areas (TEa) **[32]**

Ectorhinal area (ECT) **[33]**

Perirhinal area (PERI) **[34]**

Hippocampal formation (HPF) **[35]**
- retrohippocampal region (RHP)
  - entorhinal area (ENT)
    - lateral part (ENTl)
      - layers 1-6 (ENTl1-6)
    - medial part, dorsal zone (ENTm)
      - layers 1-6 (ENTm1-6)
    - medial part, ventral zone (ENTmv) **[36]**
  - presubiculum (PRE)
    - layers 1-6 (PRE1-6)
  - postsubiculum (POST)
    - layers 1-6 (POST1-6)
  - parasubiculum (PAR)
    - layers 1-6 (PAR1-6)
  - subiculum (SUB)
    - dorsal part (SUBd)
      - molecular layer (SUBd-m)
      - stratum radiatum (SUBd-sr)
      - pyramidal layer (SUBd-sp)
    - ventral part (SUBv)
      - molecular layer (SUBv-m)
      - stratum radiatum (SUBv-sr)
      - pyramidal layer (SUBv-sp)
- hippocampal region (HIP)

Ammon's horn (CA)
- field CA1 (CA1)
  - stratum lacunosum-moleculare (CA1slm)
  - stratum radiatum (CA1sr)
  - pyramidal layer (CA1sp)
    - deep (CA1spd)
    - superficial (CA1sps)
  - stratum oriens (CA1so)
- field CA2 (CA2)
  - stratum lacunosum-moleculare (CA2slm)
  - stratum radiatum (CA2sr)
  - pyramidal layer (CA2sp)
  - stratum oriens (CA2so)
- field CA3 (CA3)
  - stratum lacunosum-moleculare (CA3slm)
  - stratum radiatum (CA3sr)
  - stratum lucidum (CA3slu)
  - pyramidal layer (CA3sp)
  - stratum oriens (CA3so)

dentate gyrus (DG)
- crest (DGcr)
  - molecular layer (DGcr-mo)
  - granule cell layer (DGcr-sg)
  - polymorph layer (DGcr-po)
- lateral blade (DGlb)
  - molecular layer (DGlb-mo)
  - granule cell layer (DGlb-sg)
  - polymorph layer (DGlb-po)
- medial blade (DGmb)
  - molecular layer (DGmb-mo)
  - granule cell layer (DGmb-sg)
  - polymorph layer (DGmb-po)

indusium griseum (IG) **[37]**

fasciola cinerea (FC) **[38]**

1.1.2. Cortical Subplate (CTXsp)
- Layer 6b, isocortex (6b) **[39]**
- Claustrum (CLA) **[40]**
- Endopiriform nucleus (EP) **[41]**
  - Dorsal part (EPd)
  - Ventral part (EPv)
- Lateral amygdalar nucleus (LA) **[42]**
- Basolateral amygdalar nucleus (BLA) **[42]**
  - Anterior part (BLAa)
  - Posterior part (BLAp)
- Basomedial amygdalar nucleus (BMA) **[43]**
  - Anterior part (BMAa)

Posterior part (BMAp)
Posterior amygdalar nucleus (PA) **[44]**
Nucleus of the lateral olfactory tract, dorsal cap **[45]**
1.2. CEREBRAL NUCLEI (CNU)
1.2.1. Striatum (STR)
Caudoputamen (CP) **[46]**
Nucleus accumbens (ACB) **[47]**
Striatal fundus (FS) **[48]**
Olfactory tubercle (OT) **[49]**
Molecular layer (OT1)
Pyramidal layer (OT2)
Polymorph layer (OT3)
Islands of Calleja (isl) **[50]**
Major island of Calleja (islm) **[51]**
Lateral septal complex (LSX) **[52]**
Lateral septal nucleus (LS)
caudal (caudodorsal) part (LSc)
dorsal zone (LSc.d)
rostral region (LSc.d.r)
dorsal region (LSc.d.d)
lateral region (LSc.d.l)
ventral region (LSc.d.v)
ventral zone (LSc.v)
medial region (LSc.v.m)
dorsal domain (LSc.v.m.d)
ventral domain (LSc.v.m.v)
intermediate region (LSc.v.i)
lateral region (LSv.v.l)
dorsal domain (LSc.v.l.d)
ventral domain (LSc.v.l.v)
rostral (rostroventral) part (LSr)
medial zone (LSr.m)
dorsal region (LSr.m.d)
ventral region (LSr.m.v)
rostral domain (LSr.m.v.r)
caudal domain (LSr.m.v.c)
ventrolateral zone (LSr.vl)
dorsal region (LSr.vl.d)
medial domain (LSr.vl.d.m)
lateral domain (LSr.vl.d.l)
ventral region (LSr.vl.v)
dorsolateral zone (LSr.dl)
medial region (LSr.dl.m)
dorsal domain (LSr.dl.m.d)
ventral domain (LSr.dl.m.v)
lateral region (LSr.dl.l)

- dorsal domain (LSr.dl.l.d)
- ventral domain (LSr.dl.l.v)
- ventral part (LSv)
- Septofimbrial nucleus (SF)
- Septohippocampal nucleus (SH)
- Anterior amygdalar area (AAA) **[53]**
- Central amygdalar nucleus (CEA) **[54]**
  - Medial part (CEAm)
  - Lateral part (CEAl)
  - Capsular part (CEAc) **[55]**
- Medial amygdalar nucleus (MEA) **[56]**
  - Anterodorsal part (MEAad)
  - Anteroventral part (MEAav)
  - Posterodorsal part (MEApd)
    - sublayer a (MEApd-a) **[57]**
    - sublayer b (MEApd-b) **[57]**
    - sublayer c (MEApd-c) **[57]**
  - Posteroventral part (MEApv)
  - Bed nucleus of the accessory olfactory tract (BA) **[58]**
- Intercalated amygdalar nuclei (IA) **[59]**

1.2.2. Pallidum (PAL)

- Globus pallidus (GP) **[60]**
  - External segment (GPe)
  - Internal segment (GPi)
- Substantia innominata (SI) **[61]**
- Magnocellular nucleus (MA) **[62]**
- Medial septal complex (MSC) **[63]**
  - Medial septal nucleus (MS)
  - Diagonal band nucleus (NDB)
- Triangular nucleus of the septum (TRS) **[64]**
- Bed nuclei of the stria terminalis (BST) **[65]**
  - Anterior division (BSTa)
    - anterolateral area (BSTal)
    - anteromedial area (BSTam)
    - oval nucleus (BSTov)
    - juxtacapsular nucleus (BSTju)
    - rhomboid nucleus (BSTrh)
    - dorsomedial nucleus (BSTdm)
    - fusiform nucleus (BSTfu)
    - ventral nucleus (BSTv)
    - magnocellular nucleus (BSTmg)
  - Posterior division (BSTp)
    - principal nucleus (BSTpr)
    - interfascicular nucleus (BSTif)
    - transverse nucleus (BSTtr)
    - premedullary nucleus (BSTpm)

dorsal nucleus (BSTd)
strial extension (BSTse)
cell-sparse zone (BSTsz)
Bed nucleus of the anterior commissure (BAC) **[66]**
Bed nucleus of the stria medullaris (BSM) **[67]**

2. CEREBELLUM (CB) **[68]**

2.1. CEREBELLAR CORTEX (CBX) **[69]**
Vermal Regions (VERM)
Lingula (I) (LING)
Central lobule (CENT)
lobule II (CENT2)
sublobules a,b (CENT2a,b)
lobule III (CENT3)
sublobules a,b (CENT3a,b)
Culmen (CUL)
lobules IV,V (CUL4,5)
Declive (VI) (DEC)
sublobules a-d (DECa-d)
Folium-tuber vermis (VII) (FOTU)
Pyramus (VIII) (PYR)
sublobules a,b (PYRa,b)
Uvula (IX) (UVU)
sublobules ab,c (UVUab,c)
Nodulus (X) (NOD)
sublobules a,b (NODa,b)
Hemispheric Regions (HEM)
Simple lobule (SIM)
sublobules a,b (SIMa,b)
Ansiform lobule (AN)
crus 1 (ANcr1)
sublobules a-d (ANcr1a-d)
crus 2 (ANcr2)
sublobules a,b (ANcr2a,b)
Paramedian lobule (PRM)
Copula pyramidis (COPY)
sublobules a,b (COPYa,b)
Paraflocculus (PFL)
Flocculus (FL)

2.2. CEREBELLAR NUCLEI (CBN) **[70]**
Fastigial Nucleus (FN)
Interposed Nucleus (IP)
Main part (IPm)
Parvicellular part (IPp)
Dentate Nucleus (DN)
Magnocellular part (DNm)
Parvicellular part (DNp)

3. CEREBROSPINAL TRUNK (TK) **[71]**

- 3.1. SENSORY SYSTEM (SEN)
  - 3.1.1. Thalamus (TH) **[72]**
    - Sensory-motor cortex related (DORsm)
      - Ventral group of the dorsal thalamus (VENT) **[73]**
        - ventral anterior-lateral complex of the thalamus (VAL) **[74]**
        - ventral medial nucleus of the thalamus (VM) **[75]**
        - ventral posterior complex of the thalamus (VP)
          - ventral posterolateral nucleus of the thalamus, general (VPLg)
            - principal part (VPL) **[76]**
            - parvicellular part (VPLpc) **[77]**
          - ventral posteromedial nucleus of the thalamus, general (VPMg)
            - principal part (VPM) **[78]**
            - parvicellular part (VPMpc) **[79]**
        - subparafascicular nucleus (SPF) **[80]**
          - magnocellular part (SPFm)
          - parvicellular part (SPFp) **[81]**
            - medial division (SPFpm)
            - lateral division (SPFpl)
        - peripeduncular nucleus (PP) **[82]**
      - Geniculate group of the dorsal thalamus (GENd) **[83]**
        - medial geniculate complex (MG) **[84]**
          - dorsal part (MGd)
          - ventral part (MGv)
          - medial part (MGm)
        - lateral geniculate complex, dorsal part (LGd) **[85]**
    - Polymodal association cortex related (DORpm)
      - Lateral group of the dorsal thalamus (LAT) **[86]**
        - lateral posterior nucleus of the thalamus (LP) **[87]**
        - posterior complex of the thalamus (PO) **[88]**
        - suprageniculate nucleus (SGN) **[89]**
        - posterior limiting nucleus of the thalamus (POL) **[89]**
      - Anterior group of the dorsal thalamus (ATN) **[90]**
        - anteroventral nucleus of the thalamus (AV) **[91]**
        - anteromedial nucleus of the thalamus (AM) **[91]**
          - dorsal part (AMd) **[92]**
          - ventral part (AMv) **[92]**
        - anterodorsal nucleus of the thalamus (AD) **[93]**
        - interanteromedial nucleus of the thalamus (IAM) **[94]**
        - interanterodorsal nucleus of the thalamus (IAD) **[95]**
        - lateral dorsal nucleus of the thalamus (LD) **[96]**
      - Medial group of the dorsal thalamus (MED) **[97]**
        - mediodorsal nucleus of the thalamus (MD) **[98]**
          - medial part (MDm)
          - central part (MDc)
          - lateral part (MDl)

- - - - intermediodorsal nucleus of the thalamus (IMD)
      - submedial nucleus of the thalamus (SMT) **[99]**
      - perireuniens nucleus (PR) **[100]**
    - Midline group of the dorsal thalamus (MTN) **[101]**
      - paraventricular thalamic nucleus (PVT) **[102]**
      - paratenial nucleus (PT) **[103]**
      - nucleus reuniens (RE) **[104]**
        - rostral division
          - anterior part (REa)
          - dorsal part (REd)
          - ventral part (REv)
          - lateral part (REl)
          - median part (REm) **[105]**
        - caudal division
          - caudal part (REc)
          - dorsal part (REcd)
          - median part (REcm)
    - Intralaminar group of the dorsal thalamus (ILM) **[106]**
      - rhomboid nucleus (RH) **[107]**
      - central medial nucleus of the thalamus (CM) **[108]**
      - paracentral nucleus of the thalamus (PCN) **[108]**
      - central lateral nucleus of the thalamus (CL) **[109]**
      - parafascicular nucleus (PF) **[110]**
  - Reticular nucleus of the thalamus (RT) **[111]**

3.1.2. Visual (SENvis)

- Retina (R) **[112]**
  - outer nuclear layer (Ronl)
  - outer plexiform layer (Ropl)
  - inner nuclear layer (Rinl)
  - inner plexiform layer (Ripl)
  - ganglion cell layer (Rgcl)
- Superior colliculus, sensory related (SCs) **[113]**
  - zonal layer (SCzo)
  - superficial gray layer (SCsg)
  - optic layer (SCop)
- Parabigeminal nucleus (PBG) **[114]**

3.1.3. Somatosensory (SENss)

- Midbrain trigeminal nucleus (MEV) **[115]**
- Principal sensory nucleus of the trigeminal (PSV) **[116]**
- Spinal nucleus of the trigeminal (SPV) **[117]**
  - oral part (SPVO) **[118]**
    - ventrolateral part (SPVOvl)
    - rostral dorsomedial part (SPVOrdm)
    - middle dorsomedial part, dorsal zone (SPVOmdmd)
    - middle dorsomedial part, ventral zone (SPVOmdmv)
    - caudal dorsomedial part (SPVOcdm)

interpolar part (SPVI) **[119]**
caudal part (SPVC) **[120]**
Paratrigeminal nucleus (PAT) **[121]**
Dorsal column nuclei (DCN) **[122]**
gracile nucleus, general (GRg)
gracile nucleus, principal part (GR) **[123]**
median part (GRm) **[124]**
cuneate nucleus (CU) **[125]**
Nucleus z (z) **[126]**
External cuneate nucleus (ECU) **[127]**
Marginal zone of the spinal cord (MZ) **[128]**
Substantia gelatinosa of the spinal cord (SGE) **[129]**
Nucleus proprius of the spinal cord (NP) **[130]**
Reticular nucleus of the spinal cord (RS) **[131]**
Basal nucleus of the dorsal horn, general (BNg)
basal nucleus of the dorsal horn (BN) **[132]**
lateral cervical nucleus (LCN) **[133]**
lateral spinal nucleus (LSN) **[134]**
Intermediate gray of the spinal cord, general [IHg] **[135]**
intermediate gray of the spinal cord proper [IH]
central cervical nucleus (CEC) **[136]**
dorsal nucleus of the spinal cord, general (DSNg)
rostral part (DSN) **[137]**
caudal part (DSNc) **[138]**
3.1.4. Auditory (SENaud)
Cochlear nuclei (CN) **[139]**
dorsal nucleus (DCO) **[139]**
ventral nucleus (VCO) **[139]**
anterior part (VCOa)
posterior part (VCOp)
subpeduncular granular region (CNspg) **[140]**
granular lamina (CNlam) **[140]**
interstitial nucleus of the auditory nerve (IAN) **[141]**
Nucleus of the trapezoid body (NTB) **[142]**
Superior olivary complex (SOC) **[143]**
medial part (SOCm) **[144]**
lateral part (SOCl) **[145]**
periolivary region (POR) **[146]**
Nucleus of the lateral lemniscus (NLL)
dorsal part (NLLd) **[147]**
horizontal part (NLLh) **[148]**
ventral part (NLLv) **[149]**
Inferior colliculus (IC) **[150]**
external nucleus (ICe)
dorsal nucleus (ICd)
central nucleus (ICc) **[151]**

Nucleus of the brachium of the inferior colliculus (NB) **[152]**
Nucleus sagulum (SAG) **[153]**
3.1.5. Gustatory (SENgu)
Nucleus of the solitary tract, rostral zone of medial part (NTSm) **[154]**
3.1.6. Visceral (SENvsc)
Nucleus of the solitary tract (NTS) **[155]**
central part (NTSce) **[156]**
commissural part (NTSco) **[157]**
gelatinous part (NTSge) **[158]**
lateral part (NTSl) **[159]**
medial part, caudal zone (NTSm) **[160]**
Parabrachial nucleus (PB) **[161]**
lateral division (PBl)
central lateral part (PBlc)
dorsal lateral part (PBld)
external lateral part (PBle)
extreme lateral part (PBlex)
internal lateral part (PBli)
superior lateral part (PBls)
ventral lateral part (PBlv)
Kölliker-Fuse subnucleus (KF)
medial division (PBm)
medial medial part (PBmm)
external medial part (PBme)
ventral medial part (PBmv) **[162]**
3.1.7. Humerosensory (SENhum)
Vascular organ of the lamina terminalis (OV) **[163]**
Subfornical organ (SFO) **[164]**
Area postrema (AP) **[165]**
3.2. BEHAVIORAL STATE SYSTEM (STA)
Ventrolateral preoptic nucleus VLP **[166]**
Suprachiasmatic nucleus (SCH) **[167]**
dorsomedial region (SCHd)
ventrolateral region (SCHv)
Subparaventricular zone (SBPV) **[168]**
Hypothalamic lateral zone, state related (LZs)
lateral hypothalamic area, dorsal region (LHAd) **[169]**
Tuberomammillary nucleus (TM) **[170]**
dorsal part (TMd)
ventral part (TMv)
Supramammillary nucleus (SUM) **[171]**
medial part (SUMm)
lateral part (SUMl)
Substantia nigra, compact part (SNc) **[172]**
Pedunculopontine nucleus (PPN) **[173]**
Pontine reticular nucleus, rostral part (PRNr) **[174]**

- Raphé nuclei (RA) **[175]**
  - interfascicular nucleus raphé (IF) **[176]**
  - interpeduncular nucleus (IPN) **[177]**
    - rostral subnucleus (IPNr)
    - apical subnucleus (IPNa)
    - dorsomedial subnucleus (IPNd)
    - lateral subnucleus (IPNl)
      - dorsal part (IPNld)
      - intermediate part (IPNli) **[178]**
      - ventral part (IPNlv) **[178]**
      - rostral part (IPNlr)
    - intermediate subnucleus (IPNi)
    - central subnucleus (IPNc)
  - rostral linear nucleus raphé (RL) **[179]**
  - central linear nucleus raphé (CLI) **[180]**
  - superior central nucleus raphé (CS) **[181]**
    - medial part (CSm)
    - lateral part (CSl)
  - dorsal nucleus raphé (DR) **[182]**
  - nucleus incertus (NI) **[183]**
    - compact part (NIc)
    - diffuse part (NId)
  - nucleus raphé pontis (RPO) **[184]**
  - nucleus raphé magnus (RM) **[185]**
  - nucleus raphé pallidus (RPA) **[186]**
  - nucleus raphé obscurus (RO) **[187]**
- Laterodorsal tegmental nucleus (LDT) **[188]**
- Sublaterodorsal nucleus (SLD) **[189]**
- Locus ceruleus (LC) **[190]**
- Subceruleus nucleus (SLC) **[191]**

3.3. MOTOR SYSTEM (MOT)

- 3.3.1. Behavior Control Column (BCC) **[192]**
  - Medial preoptic nucleus (MPN) **[193]**
    - Lateral part (MPNl)
    - Medial part (MPNm)
    - Central part (MPNc)
  - Anterior hypothalamic nucleus (AHN) **[194]**
    - Anterior part (AHNa) **[195]**
    - Central part (AHNc) **[195]**
    - Posterior part (AHNp) **[195]**
    - Dorsal part (AHNd) **[196]**
  - Paraventricular hypothalamic nucleus, descending division (PVHd) **[197]**
    - Medial parvicellular part, ventral zone (PVHmpv)
    - Dorsal parvicellular part (PVHdp)
    - Lateral parvicellular part (PVHlp)
    - Forniceal part (PVHf)

- Ventromedial hypothalamic nucleus (VMH) **[198]**
    - Anterior part (VMHa)
    - Dorsomedial part (VMHdm)
    - Central part (VMHc)
    - Ventrolateral part (VMHvl)
- Ventral premammillary nucleus (PMv) **[199]**
- Dorsal premammillary nucleus (PMd) **[200]**
- Mammillary body (MBO) **[201]**
    - Medial mammillary nucleus (MMg) **[202]**
        - body (MM)
        - median part (MMme)
    - Lateral mammillary nucleus (LM) **[202]**
- Substantia nigra, reticular part (SNr) **[203]**
- Ventral tegmental area (VTA) **[204]**
- Midbrain reticular nucleus, retrorubral area (RR) **[205]**
- Midbrain reticular nucleus, parvicellular part (MRNp) **[206]**

3.3.2. Superior Colliculus, motor related (SCm) **[207]**

- Intermediate gray layer (SCig)
    - Sublayer a (SCig.a)
    - Sublayer b (SCig.b)
    - Sublayer c (SCig.c)
- Intermediate white layer (SCiw)
- Deep gray layer (SCdg)
- Deep white layer (SCdw)

3.3.3. Postcerebellar and Precerebellar Nuclei (CBPP)

- Red nucleus (RN) **[208]**
- Pontine gray, general (PGg)
    - Pontine gray (PG) **[209]**
    - Tegmental reticular nucleus (TRN) **[210]**
- Inferior olivary complex (IO) **[211]**
    - Dorsal accessory olive (IOda)
    - Medial accessory olive (IOma)
    - Principal olive (IOpr)
- Lateral reticular nucleus (LRN) **[212]**
    - Magnocellular part (LRNm)
    - Parvicellular part (LRNp)
- Linear nucleus of the medulla (LIN) **[213]**
- Paramedian reticular nucleus (PMR) **[214]**
- Parasolitary nucleus (PAS) **[215]**

3.3.4. Vestibulomotor regions (VMO)

- Vestibular nuclei (VNC) **[216]**
    - Medial vestibular nucleus (MV)
    - Lateral vestibular nucleus (LAV) [displaced cerebellar nucleus]
    - Superior vestibular nucleus (SUV)
    - Spinal vestibular nucleus (SPIV)
- Perihypoglossal nuclei (PHY) **[217]**

        - Anterior part (DMHa) **[257]**
        - Posterior part (DMHp) **[258]**
        - Ventral part (DMHv) **[259]**
    - Periventricular hypothalamic nucleus, posterior part (PVp) **[260]**
    - Internuclear area, hypothalamic periventricular region (I) **[261]**
- 3.3.7. Reticular Formation (RET) **[262]**
    - Hypothalamic lateral zone, motor related (LZm) **[263]**
        - Lateral preoptic area (LPO) **[264]**
        - Lateral hypothalamic area, motor related (LHAmo) **[265]**
            - juxtaparaventricular region (LHAjp) **[266]**
            - juxtadorsomedial region (LHAjd) **[267]**
            - juxtaventromedial region (LHAjv) **[268]**
                - dorsal zone (LHAjvd)
                - ventral zone (LHAjvv)
            - anterior region (LHAa)
                - dorsal zone (LHAad)
                - intermediate zone (LHAai)
                - ventral zone (LHAav)
            - retrochiasmatic area (RCH) **[269]**
            - tuberal nucleus (TU) **[270]**
                - subventromedial part (TUsv)
                - intermediate part (TUi)
                - terete part (TUte)
                - lateral part (TUl)
            - suprafornical region (LHAs) **[271]**
            - subfornical region (LHAsf)
                - anterior zone (LHAsfa) **[272]**
                - posterior zone (LHAsfp)
                - premammillary zone (LHAsfpm) **[273]**
            - magnocellular nucleus (LHAm)**[274]**
            - parvicellular region (LHApc)
            - ventral region (LHAv) **[275]**
                - medial zone (LHAvm)
                - lateral zone (LHAvl)
            - posterior region (LHAp)
        - Preparasubthalamic nucleus (PST) **[276]**
        - Parasubthalamic nucleus (PSTN) **[277]**
        - Subthalamic nucleus (STN) **[278]**
    - Zona incerta, general (ZIg)
        - Zona incerta (ZI) **[279]**
        - Dopaminergic group (ZIda) **[280]**
        - Fields of Forel (FF) **[281]**
    - Geniculate group, ventral thalamus (GENv)
        - Intergeniculate leaflet, lateral geniculate complex (IGL) **[282]**
        - Ventral part of the lateral geniculate complex (LGv) **[283]**
            - lateral zone (LGvl)

medial zone (LGvm)

Pretectal region (PRT) **[284]**

Olivary pretectal nucleus (OP) **[285]**

Nucleus of the optic tract (NOT) **[286]**

Posterior pretectal nucleus (PPT) **[287]**

Nucleus of the posterior commissure (NPC) **[288]**

Anterior pretectal nucleus (APN) **[289]**

Medial pretectal area (MPT) **[290]**

Midbrain reticular nucleus, magnocellular part, general(MRNmg)

Midbrain reticular nucleus, magnocellular part (MRNm) **[291]**

Ventral tegmental nucleus (VTN) **[292]**

Anterior tegmental nucleus (AT) **[293]**

Medial terminal nucleus of the accessory optic tract (MT) **[294]**

Lateral terminal nucleus of the accessory optic tract (LT) **[295]**

Dorsal terminal nucleus of the accessory optic tract (DT) **[295]**

Cuneiform nucleus (CUN) **[296]**

Pontine reticular nucleus, caudal part (PRNc) **[297]**

Gigantocellular reticular nucleus (GRN) **[298]**

Paragigantocellular reticular nucleus (PGRN) **[299]**

Dorsal part (PGRNd) **[300]**

Lateral part (PGRNl) **[301]**

Parapyramidal nucleus (PPY) **[302]**

Deep part (PPYd) **[303]**

Superficial part (PPYs) **[304]**

Magnocellular reticular nucleus (MARN) **[305]**

Supratrigeminal nucleus (SUT) **[306]**

Parvicellular reticular nucleus (PARN) **[307]**

Medullary reticular nucleus (MDRN) **[308]**

Dorsal part (MDRNd) **[309]**

Ventral part (MDRNv)

3.3.8. Motoneuron Groups (MNG)

Neuroendocrine motor zone (NEM) **[310]**

Magnocellular (NEMm) **[311]**

supraoptic nucleus, general (SOg) **[312]**

supraoptic nucleus, proper (SO)

retrochiasmatic part (SOr)

accessory supraoptic group (ASO) **[312]**

nucleus circularis (NC)

paraventricular hypothalamic nucleus, magnocellular division (PVHm) **[313]**

anterior magnocellular part (PVHam)

medial magnocellular part (PVHmm)

posterior magnocellular part (PVHpm)

medial zone (PVHpmm)

lateral zone (PVHpml)

median eminence, internal lamina (MEin) **[314]**

infundibulum, internal lamina (INFin) **[314]**

- - - pituitary gland, neural lobe (NL) **[315]**
  - Parvicellular (NEMp) **[316]**
    - paraventricular hypothalamic nucleus, parvicellular division (PVHp) **[317]**
      - anterior parvicellular part (PVHap) **[318]**
      - medial parvicellular part, dorsal zone (PVHmpd)
      - periventricular part (PVHpv)
    - periventricular hypothalamic nucleus, anterior part (PVa) **[319]**
    - periventricular hypothalamic nucleus, intermediate part (PVi) **[320]**
    - arcuate hypothalamic nucleus (ARH) **[321]**
    - median eminence, external lamina (MEex) **[322]**
    - infundibulum, external lamina (INFex) **[322]**
- Somatic motoneuron pools (SMM)
  - Oculomotor nucleus (III) **[323]**
  - Trochlear nucleus (IV) **[323]**
  - Abducens nucleus (VI) **[323]**
  - Accessory abducens nucleus (ACVI) **[324]**
  - Motor nucleus of the trigeminal (V)
    - magnocellular part (Vma) **[325]**
    - parvicellular part (Vpc) **[326]**
  - Facial nucleus (VII) **[327]**
  - Accessory facial nucleus (ACVII) **[328]**
  - Efferent cochlear group (ECO) **[329]**
  - Efferent vestibular nucleus (EV) **[330]**
  - Nucleus ambiguus, dorsal division (AMBd) **[331]**
  - Nucleus of the spinal accessory nerve (XI) **[332]**
  - Hypoglossal nucleus (XII) **[333]**
  - Ventral horn of the spinal cord, general (VHg)
    - ventral horn of the spinal cord (VH) **[334]**
    - nucleus of the bulbocavernosus (NBC) **[335]**
    - Onuf's nucleus (ON) **[336]**
    - phrenic nucleus (PN) **[337]**
- Preganglionic autonomic pools (ANSpre)
  - Parasympathetic (ANSprep)
    - Edinger-Westphal nucleus (EW) **[338]**
    - superior salivatory nucleus (SSN) **[339]**
    - inferior salivatory nucleus (ISN) **[340]**
    - dorsal motor nucleus of the vagus nerve (DMX) **[341]**
    - nucleus ambiguus, ventral division (AMBv) **[342]**
    - intermediolateral spinal column, sacral division (IMLp) **[343]**
  - Sympathetic (ANSpres)
    - intermediolateral spinal column, thoracolumbar division (IMLs) **[343]**
    - intermediomedial spinal column (IMM) **[344]**
    - dorsal commissural nucleus (DOC) **[345]**
    - intercalated nucleus, spinal cord (ICS) **[346]**

Table B Annotations

1 Table B is an expanded version of Table A.c.g (Central nervous system gray matter).

2 Donoghue and Wise 1982; Neafsey et al. 1986.

3 Chapin and Lin 1984; Sanderson et al. 1984; Riddle and Purves 1995.

4 Welker and Sinha 1972; see also Chapin and Lin 1984.

5 Cechetto and Saper 1987.

6 Krettek and Price 1977; Vogt and Peters 1981.

7 Kosar et al. 1986; Cechetto and Saper 1987.

8 Defined here as regions of the cortical mantle that receive a direct input from the olfactory nerve (primary olfactory cortex; see Brodmann 1909), or from the main and accessory olfactory bulbs (see Price 1987). The latter also includes superficial regions of the amygdala (the NLOT, COA, PAA, and TR), and it is important to point out that the entorhinal area of the hippocampal formation also receives direct olfactory input (Kosel et al. 1981), although it receives many other types of sensory information and thus not usually included in the olfactory region.

9 Gurdjian 1925; Shipley et al. 1996.

10 This "nucleus" is an *area* of the olfactory cortex, with a molecular layer (1) and a pyramidal layer (2); except for the external part, the divisions are based on position, not architecture (see Haberly and Price 1978b).

11 There is little agreement in the literature about the parcelling and nomenclature associated with the tenia tecta and indusium griseum. From examining sections in the three standard planes, it seems clear to us that the indusium griseum continues uninterrupted around the genu of the

corpus callosum to the septohippocampal nucleus (Atlas Levels 11-13; also see Wyss and Sripanidkulchai 1983); the part of the indusium griseum rostral and ventral to the genu was called the dorsal part of the tenia tecta by Haberly and Price (1978b). The ventral tenia tecta of Haberly and Price (1978b) has a very different structure. They divided it into superior and inferior parts, which we refer to here as the dorsal and ventral parts of the tenia tecta proper, respectively. The tenia tecta reminds one of differentiated parts of the adjacent anterior olfactory nucleus (see Davis et al. 1978). We recognize three layers in the TTv (as Haberly and Price 1978b) and four layers in the TTd.

12 Craigie 1925; Haberly and Price 1978a.

13 Haug 1976; Canteras et al. 1992a.

14 Canteras et al. 1992a.

15 McDonald 1983; Millhouse and Uemura-Sumi 1985. Like the COA, PAA, and TR, this is an area of the olfactory cortex, usually grouped with the amygdala.

16 de Olmos et al. 1985.

17 Canteras et al. 1992a.

18 Sally and Kelly 1988; Kelly and Sally 1988; Arnault and Roger 1990; Doron et al. 2002.

19 Azizi et al. 1985; Sally and Kelly 1988; Kelly and Sally 1988.

20 Clear cytoarchitectonic differences between areas Te3 and Te2 (see Arnault and Roger 1990) were not observed.

21 Doron et al. (2002) have carefully remapped the traditional primary auditory area with electrophysiological methods in rat and suggest that a posterior auditory field be recognized in its posterior end, beginning about 5.8 mm posterior to bregma. They did not correlate their results with cytoarchitecture, so comparisons of borders between auditory areas across atlases,

rat strains, animal ages, and different histological procedures are crude at best when based strictly on a skull feature like bregma. Clearly, additional characterization of auditory and surrounding cortical areas with both anatomical and physiological methods is needed.

22 Sefton and Dreher 1985; Thomas and Espinosa 1987; Reid and Juraska 1991. Also see Coogan and Burkhalter 1993.

23 Krettek and Price 1977; Vogt and Peters 1981.

24 Krettek and Price 1977; our parcelling of these topologically difficult areas was greatly aided by examining sections cut in the three standard planes.

25 Cechetto and Saper 1987.

26 Krettek and Price 1977.

27 Vogt and Miller 1983.

28 This is the so-called agranular region of the retrosplenial area; see Krettek and Price 1977; Vogt and Miller 1983.

29 Risold et al. 1997.

30 This is the so-called granular region of the retrosplenial area; we could not distinguish clearly zones b and c of Miller and Vogt 1983; also see Sripanidkulchai and Wyss 1987 for information about lamination.

31 This region appears to lie between unimodal somatosensory and visual areas and receives inputs from the lateral posterior nucleus; to this extent it may correspond to posterior parietal association areas in primates and other mammals; see Hughes 1977; Miller and Vogt 1984.

32 We have recognized two distinct fields in the temporal region between the visual and auditory cortices dorsally and the perirhinal area ventrally. Krieg (1946a) appears to have regarded this entire area as ECT. More in keeping with Brodmann (1909), we suggest that the dorsal part of

this region (where layer 4 is still recognizable) may correspond to temporal association cortex (perhaps in the dorsal, middle, and inferior temporal gyri of humans), and have labeled it TEa. We have retained ECT for the distinct ventral area, just dorsal to the perirhinal area, where layers 2 and 4 are quite indistinct. The architecture and connections of this whole region require much more analysis.

33 Krieg 1946a,b; Miller and Vogt 1984; see note 32. Burwell (2001) has recognized 5 parts of what is considered here the ectorhinal area (Brodmann's area 36): the rostral two-thirds or so are divided into dorsal, ventral, and posterior parts of area 36; and the caudal third in divided into dorsal and ventral parts of what is called the postrhinal area.

34 Krieg 1946a,b; Deacon et al. 1983. This is Brodmann's (1909) area 35.

35 Blackstad 1956; Swanson et al. 1987.

36 Canteras et al. (1992a).

37 Wyss and Sripanidkulchai 1983 (see note 11).

38 Hjorth-Simonsen 1972.

39 Divak et al. 1987; Valverde et al. 1989, 1995; Vandevelde et al. 1996 (but see Price et al. 1997). Layer 6b in the rat may be a rather unique structure.

40 Krettek and Price 1977, 1978.

41 Krettek and Price 1978. This "nucleus" appears to form the olfactory component of the claustrum, deep to the piriform area (see also Gurdjian 1928). Ekstrand et al. (2001) have recognized a rostroventrolateral differentiation of the EPd as the pre-endopiriform nucleus (in Atlas Levels 6-9).

42 Krettek and Price 1978. The basolateral complex of the amygdala is included here because it develops just superficial to the external capsule, which has often been misidentified in the

region of the amygdala (see Atlas Levels 24-31). What we have called the amygdalar capsule is a fiber tract along the lateral border of this complex, and we suggest it is part of a fiber system within, and lateral to (for example, the extreme capsule) the subplate or deep cortex. Also see Swanson and Petrovich (1998) and Swanson (2003b).

43 de Olmos et al. 1985; Canteras et al. 1992a; Petrovich et al. 1996.

44 Canteras et al. 1992a.

45 Gurdjian 1928.

46 Graybiel and Ragsdale 1979. The term seems to have originated with Heimer and Wilson (1975).

47 There is no morphologically distinct boundary between this ventromedial region of the striatum and the caudoputamen; Gurdjian (1928) first defined the nucleus accumbens in the rat as that part of the ventromedial striatum lacking massive bundles of ascending and descending fibers, which is still a useful working criterion. It is common to divide the nucleus accumbens roughly into core (adjacent to the caudoputamen) and shell (external) regions, although there is controversy about where to draw a boundary between the two (see Groenewegen et al. 1999).

48 The cytoarchitecture of this ventrolateral region of the striatum just deep to the substantia innominata is more heterogeneous than that of the nucleus accumbens and especially the caudoputamen. While the term "striatal fundus" (fundus striati of Heimer 1972) has been used here and there in the recent literature, its borders have not been clearly defined; it is used here to refer to the region identified as the substriatal gray by Crosby and Humphrey (1941). The interstitial nucleus of the posterior limb of the anterior commissure lies within the striatal fundus and immediately adjacent regions of the caudoputamen (see Shammah-Lagnado et al. 2001).

49 Price 1973; Millhouse and Heimer 1984.

50 Meyer et al. 1989.

51 Gurdjian 1928.

52 Risold and Swanson 1997a, b.

53 This term was introduced by Gurdjian (1928) to describe an ill-defined region that essentially all later workers have defined somewhat differently, depending on how neighboring cell groups that are better differentiated have been defined; we have followed in this tradition here.

54 We have followed McDonald's (1982) parcelling into medial, lateral, and capsular parts, although it is clear that the nucleus is much more complex than this. McDonald's intermediate part was not recognized; it appears to fall within the lateral part as outlined here. The central and medial amygdalar nuclei receive cortical inputs and generate descending projections that are predominantly GABAergic, like the rest of the striatum. They also project to the BST, which we regard as pallidal.

55 Based on connectional and cytoarchitectonic grounds, we have removed former dorsal regions of the capsular part of the CEA, and placed them in the ventral caudoputamen (Petrovich et al. 2001), following Price et al. (1987).

56 de Olmos et al. 1985.

57 Swanson 1992.

58 Scalia and Winans 1975. This tiny cell group may simply be a part of the medial nucleus of the amygdala.

59 Millhouse 1986.

60 Gurdjian 1928; Graybiel and Ragsdale 1979; Van der Kooy and Carter 1981; Rajakumar et al. 1993. In the rat, the external or lateral segment is often referred to as "the globus pallidus",

whereas the internal or medial segment is often referred to as the entopeduncular nucleus. This anomalous nomenclature will probably gradually disappear.

61 Jones et al. 1976. This region was renamed the ventral pallidum (Heimer and Wilson 1975), and then later divided by Heimer and colleagues into a rostral part now referred to as the ventral pallidum and a caudal part referred to as part of the extended amygdala (see de Olmos and Heimer 1999, and a critique by Swanson 2003b). The substantia innominata contains characteristic subpopulations of scattered, cortically projecting cholinergic and noncholinergic neurons (Rye et al. 1984) that in some animals (especially primates), but not in rats, form distinct cell clusters known as the basal nuclei of Meynert (see Gorry 1963). These cholinergic cells extend into the medial septal complex, the magnocellular nucleus, and perhaps to a very limited extent the lateral preoptic area. The term magnocellular basal "nucleus" has been introduced to refer to the basal forebrain cholinergic neurons that project to the cerebral cortex (Saper 1984). A developmental model for how the substantia innominata comes to lie between two parts of the striatum (nucleus accumbens-striatal fundus and the olfactory tubercle) has been presented elsewhere (Alvarez-Bolado et al. 1995).

62 This nucleus comes as close to a basal nucleus of Meynert as anything in the rat; cholinergic neurons here innervate preferentially the olfactory bulb. It was originally named the magnocellular preoptic nucleus, but it seems doubtful if it is derived from third ventricular neuroepithelium during embryogenesis (thus "preoptic" has been dropped from the name). See Swanson 1976a; Rye et al. 1984; and notes 61 and 63.

63 Swanson and Cowan 1979. There is no morphologically distinct border between the medial septal nucleus and nucleus of the diagonal band, although an arbitrary border is often drawn at the widest point in this complex (see Atlas Level 16). This level also shows that it is often

convenient to describe horizontal and vertical limbs of the nucleus of the diagonal band (Raisman 1966). Unfortunately, Price and Powell (1970) applied the term "nucleus of the horizontal limb of the diagonal band" to a laterally adjacent cell group that had been widely referred to as the magnocellular preoptic nucleus since the time of Loo (1931), and that projects to the olfactory bulb rather than the hippocampal formation (see notes 61 and 62).

64 Swanson and Cowan 1979.

65 Based on extensive connectional data (see Dong et al. 2001; and Dong and Swanson, in preparation) we have simplified the nomenclature originally proposed by Ju and Swanson (1989). In essence, the anterodorsal, anteroventral, and dorsolateral areas of the anterior division have been combined into an anteromedial area, and the subcommissural zone has been merged with the anterolateral area of the anterior division. In addition, the rostral end of the dorsomedial nucleus has been added to the anteromedial area, and the caudal tip of the principal nucleus of the posterior division has been assigned to the interfascicular nucleus instead.

66 Gurdjian 1925; Swanson and Cowan 1979.

67 Risold and Swanson 1995b.

68 Larsell 1952; Voogd et al. 1996.

69 Larsell 1952, 1970; Palay and Chan-Palay 1974; Voogd et al. 1985. The cerebellar cortex has three layers: molecular (CBXm), Purkinje (CBXp), and granule cell (CBXg). The surface map provided by Campbell and Armstrong (1983) was particularly useful in constructing the flatmap. Note that the brain used for our atlas had one apparently unusual feature in the cerebellum (not illustrated in the above references): a very large fissure that we have called the pyramidal fissure (Atlas Levels 64-70).

70 Korneliussen 1968; Voogd et al. 1985.

71 Because the Atlas does not extend into the spinal cord [medulla spinalis], we have not provided an exhaustive account of cell groups within this division of the cerebrospinal trunk. For a general account of the rat spinal cord, see Waibl (1973) and Altman and Bayer (1984); for attempts to impose a laminar organization on the spinal cord, see Rexed (1952, 1954) and Brichta and Grant (1985).

72 On embryological grounds the mammalian thalamus has most commonly been divided into epithalamus (note 224), dorsal thalamus (DOR), and ventral thalamus (Table A, note 30) (see Alvarez-Bolado and Swanson 1996). Dorsal thalamic nuclei project in a topographically organized way to virtually all parts of the cortical mantle, and are thought to develop more or less as a unit. We have chosen to represent the dorsal thalamus as a unit (divided into parts innervating predominantly sensory-motor related cortical areas, and parts innervating predominantly polymodal association related cortical areas) in this hierarchy because of the obvious topographic relationships displayed by its cortical projections—rather than attempting to distribute its various components to the various sensory and other modalities arranged below. The latter approach generates a more complex Table.

73 These nuclei innervate preferentially somatic sensory and motor cortical areas.

74 Sawyer et al. 1989.

75 Herkenham 1979.

76 Lund and Webster 1967b; Faull and Mehler 1985; Emmers 1988.

77 Cechetto and Saper 1987.

78 Lund and Webster 1967a; Faull and Mehler 1985; Emmers 1988.

79 Cechetto and Saper 1987.

80 Faull and Mehler 1985.

81 LeDoux and colleagues have clearly distinguished a caudolateral division of the SPFp, and the borders of the SPFp now conform to their results. The initial characterization of their posterior intralaminar nucleus (see LeDoux et al. 1987) has now been refined (Doron and LeDoux 1999) to eliminate their lateral subparafascicular nucleus. Our recognition of medial and lateral divisions of the SPFp is similar to Coolen et al. (2003).

82 Saper et al. 1976a. The original borders have been altered to reflect changes in SPFpl delineation (note 81).

83 These nuclei innervate preferentially auditory and visual cortical areas.

84 Winer and Laurue 1987; Clerici and Coleman 1990.

85 Reese 1988.

86 These nuclei preferentially innervate association areas in the parietal, temporal, and occipital regions.

87 Gurdjian 1927; Price 1995. This cell group, which includes the pulvinar complex of many other species, has been little studied in the rat.

88 Feldman and Kruger 1980; Price 1995; Fabri and Burton 1991; Diamond et al. 1992.

89 LeDoux et al. 1987; Clerici and Coleman 1990.

90 Gurdjian 1927. These nuclei preferentially innervate the cingulate region and hippocampal formation.

91 Krieg 1944.

92 Canteras and Swanson 1992a.

93 Krieg 1944; Rose 1942.

94 Gurdjian 1927.

95 Gurdjian 1927; Rose 1942.

96 Gurdjian 1927; Thompson and Robertson 1987.

97 These nuclei preferentially innervate the prefrontal region.

98 Gurdjian 1927; Krieg 1944; Krettek and Price 1977.

99 Krieg 1944; Price and Slotnick 1983.

100 Brittain 1988.

101 Macchi and Bentivoglio 1986; Berendse and Groenewegen 1991. These nuclei preferentially innervate the cingulate region, hippocampal formation, and amygdala.

102 Krieg 1944.

103 Gurdjian 1927.

104 Gurdjian 1927; Risold et al. 1997.

105 Gurdjian 1927.

106 Macchi and Bentivoglio 1986; Berendse and Groenewegen 1991. These "nonspecific" nuclei have somewhat wider projections to the cortex than many other thalamic nuclei.

107 Gurdjian 1927; Krieg 1944.

108 Gurdjian 1927; Jones and Leavitt 1974.

109 Jones and Leavitt 1974.

110 Gurdjian 1927. A closely related centre médian nucleus is now commonly identified in primates but not rodents. However, Krieg (1944) pointed out what he regarded as the equivalent of a centre médian nucleus in the rat, as did Kruger et al. 1995.

111 Gurdjian 1927; Spreafico et al. 1991. The reticular nucleus is traditionally assigned to the ventral thalamus, along with the very different zona incerta. We have placed it here in the hierarchy because it projects almost exclusively back to the dorsal thalamus.

112 Braekevelt and Hollenberg 1970; Morest 1970; Perry 1981; Ehinger and Dowling 1987. Developmentally the retina is an evagination of the hypothalamus, between the prospective preoptic and anterior hypothalamic levels (see Alvarez-Bolado and Swanson 1996).

113 Kanaseki and Sprague 1974; Bickford and Hall 1989.

114 Tokunaga and Otani 1978; Harting et al. 1991b.

115 Rokx et al. 1986a; Luo et al. 1991. This is a ‘displaced’ dorsal root ganglion.

116 Torvik 1957; Emmers 1988.

117 Olszewski 1950.

118 Falls et al. 1985; Jacquin and Rhoades 1990.

119 Phelan and Falls 1989a.

120 Nord 1967; Gobel et al. 1977; Kruger 1979.

121 Chan-Palay 1978; Phelan and Falls 1989b.

122 Torvik 1956; Nord 1967.

123 Gulley 1973; Cliffer and Giesler 1989; Maslany et al. 1991.

124 Kemplay and Webster 1989.

125 Cliffer and Giesler 1989; Maslany et al. 1991.

126 Low et al. 1986.

127 Campbell et al. 1974.

128 Lima and Coimbra 1986; Holstege 1988.

129 Willis and Coggeshall 1991; Light and Kavookjian 1988; Rustioni and Weinberg 1989; Cruz et al. 1991.

130 Todd 1989. The basic division of the dorsal horn used by Cajal (1995) has been adopted here. He divided the base of the dorsal horn into medial and lateral basal nuclei (together called here

the basal nucleus of the dorsal horn), whereas his head and neck (dorsoventral center) of the dorsal horn has come to be referred to as the nucleus proprius (see Carpenter and Sutin 1983); the reticular nucleus (process) is found lateral to the nucleus proprius (see Rexed 1952).

131 Rexed 1952. See note 130.

132 Cajal 1995.

133 Baker and Giesler 1984; Giesler et al. 1988; Broman and Blomqvist 1989.

134 Giesler and Elde 1985; Burstein et al. 1987; Broman and Blomqvist 1989.

135 Cajal (1995) essentially divided the intermediate gray into medial, intermediate, and lateral parts (the commissural nucleus, intermediate nucleus, and nucleus of the lateral funiculus, respectively).

136 Matsushita and Hosoya 1979; Matsushita et al. 1991.

137 Matsushita and Hosoya 1979.

138 Edgley and Grant 1991.

139 Harrison and Feldman 1970; Osen et al. 1984; Webster 1985.

140 Mugnaini et al. 1980.

141 Harrison and Feldman 1970; Merchan et al. 1988.

142 Harrison and Feldman 1970; Osen et al. 1984; Fay-Lund 1986; Bledsoe et al. 1990. This cell group is sometimes referred to as the medial nucleus of the trapezoid body (see note 146).

143 Harrison and Feldman 1970; Osen et al. 1984; Webster 1985; Fay-Lund 1986.

144 Osen et al. 1984; Webster 1985; Fay-Lund 1986.

145 Harrison and Feldman 1970; Osen et al. 1984; Webster 1985; Fay-Lund 1986.

146 There is general agreement that the medial and lateral parts of the superior olive are surrounded by a ring of periolivary gray matter, with a superior (e.g., Harrison and Feldman

1970) or dorsomedial (e.g., Morest 1973) periolivary "nucleus" that is particularly obvious. There is, however, little agreement about parcelling this ring of gray matter (some parts have been referred to as components of the nucleus of the trapezoid body). Because we could not distinguish clearly separate cell groups in this region, it has been referred to simply as the periolivary region (see Osen et al. 1984).

147 Tanaka et al. 1985.

148 Caicedo & Herbert 1993.

149 Merchán & Berbel 1996.

150 Fay-Lund and Osen 1985.

151 Malmierca et al. 1993.

152 Berman 1968.

153 Berman 1968; Andrezik and Beitz 1985; Henkel and Shneiderman 1988.

154 Travers and Norgren 1995.

155 Torvik 1956; Contreras et al. 1982.

156 Ross et al. 1985; Cunningham et al. 1991.

157 Torvik 1956.

158 Leslie et al. 1982; Shapiro and Miselis 1985b.

159 Berman 1968.

160 Berman 1968; Contreras et al. 1982.

161 Fulwiler and Saper 1984.

162 This region appears to us to be a ventral extension of the PBmm (of Fulwiler and Saper 1984).

163 Weindl 1973.

164 Shaver et al. 1990. It is difficult to classify the SFO. It develops in the roof plate, at the

junction between interbrain and endbrain, and is essentially a humoral sensory nucleus.

165 Shapiro and Miselis 1985a.

166 Sherin et al. 1998.

167 Krieg 1932; Watts et al. 1987.

168 Watts and Swanson 1987; Watts 1991.

169 This is a relatively distinct cell sparse region at the rostrocaudal level of the ventromedial hypothalamic nucleus (personal observations). The highest concentration of MCH and hypocretin/orexin neurons appear to be centered here (see Broberger et al. 1998; Brischoux et al. 2001).

170 Köhler et al. 1985.

171 Swanson 1982.

172 Danner and Pfister 1982; Björklund and Lindvall 1984. While a lateral part of the SN has been mentioned in the literature (see Gillilan 1943; Hanaway et al. 1970), more recent work has provided little reason to separate it from the compact part (see Björklund and Lindvall 1984). It should be noted that the ventral tegmental area has been included in the behavior control column of the motor system (below), although the dopaminergic cell population embedded within it is as much a part of the behavioral state system as the compact part of the substantia nigra (Swanson 2003a).

173 Jacobsohn 1909; Olszewski and Baxter 1954; Rye et al. 1987. Rye et al. (1987) regard the subpopulation of cholinergic neurons in this region as the pedunculopontine “nucleus” (see note 61); the region outlined here contains all of the cells identified earlier in the PPN (Jacobsohn 1909; Olszewski and Baxter 1954), although cholinergic neurons provide a very useful guide to its borders and seem to predominate numerically.

174 Often referred to as the oral part (Meessen and Olszewski 1949).

175 Olszewski and Baxter 1954; Taber et al. 1960; Steinbusch and Nieuwenhuys 1983.

176 Berman 1968; Phillipson 1979.

177 Groenewegen et al. 1986.

178 Wada et al. 1989.

179 Castaldi 1923; Brown 1943; Swanson 1982.

180 Castaldi 1923; Brown 1943 (intermediate linear nucleus); Swanson 1982.

181 Bechterew 1899; Taber et al. 1960; Valverde 1962. A superior central nucleus with medial and lateral zones has long been recognized. König and Klippel (1963) referred to the nucleus medianus raphés, which may correspond to the medial part, where serotonergic neurons are apparently concentrated (Dahlström and Fuxe 1964).

182 Brown 1943; Valverde 1962; Descarries et al. 1982; Park 1987.

183 Goto et al. 2001.

184 Brown 1943; Valverde 1962.

185 Meessen and Olszewski 1949; Valverde 1962; Mason et al. 1990.

186 Olszewski and Baxter 1954; Valverde 1962.

187 Olszewski and Baxter 1954; Valverde 1962; Bowker and Abbott 1990.

188 Gillilan 1943; Cornwall et al. 1990.

189 Swanson et al. 1984 (see also Gillilan 1943).

190 Swanson 1976b.

191 This term assumed a variety of connotations after the introduction of histochemical methods for localizing biogenic amines; it is used here as the equivalent of Meessen and Olszewski's (1949) nucleus subcoeruleus a.

192 Swanson 2000c, 2003a.

193 Simerly et al. 1984.

194 Gurdjian 1927; Krieg 1932; Risold et al 1994.

195 Saper et al. 1978.

196 This cell group, which Bleier et al. (1979) called the dorsal tuberal nucleus and Paxinos and Watson (1986) called the stigmoid hypothalamic nucleus, is clearly part of the AHN.

197 Swanson 1991, 1992b, 2000c; Swanson and Simmons 1989.

198 Gurdjian (1927) and Saper et al. (1976a) recognized dorsomedial and ventrolateral cell condensations separated by a relatively cell-sparse central region; Van Houten and Brawer (1978) also recognized a distinct anterior component. Also see Canteras et al. 1994.

199 Gurdjian 1927; Krieg 1932; Canteras et al. 1992b.

200 Canteras and Swanson 1992a.

201 There is no standard definition of the mammillary body. In the preceding edition it included the TM, SUM, and PMd.

202 Gurdjian 1927; Krieg 1932; Allen and Hopkins 1988.

203 Grofova et al. 1982.

204 Phillipson 1979; Swanson 1982; Björklund and Lindvall 1984. Also see note 172.

205 Berman 1968. This region is characterized by scattered dopamine cells, caudal and dorsal to the ventral tegmental area (see Swanson 1982; Björklund and Lindvall 1984).

206 Rye et al. (1987) have distinguished a caudal, small-celled part of the central tegmental field, which they refer to as the midbrain extrapyramidal area. We refer to this cell group as the parvicellular part of the midbrain reticular nucleus, and by extension refer to the rest of the nucleus as the magnocellular part. Typically, cells in the MEAp are also smaller than those in

the PRNr. Previous to the work of Rye et al. (1987) we included the MRNp within the pedunculopontine nucleus. Thus, projections we reported to the pedunculopontine nucleus from the substantia innominata or ventral pallidal region (Swanson et al. 1984) and medial preoptic area (Swanson et al. 1987) were actually to the MRNp, which Rye et al. (1988) suggest may correspond to the midbrain locomotor region.

207 Kanaseki and Sprague 1974; Bickford and Hall 1989.

208 Whereas small neurons predominate rostrally and large neurons caudally (Reid et al. 1975; Strominger et al. 1987), it is difficult to draw a boundary between parvicellular and magnocellular parts in the rat.

209 Mihailoff et al. 1981, 1989; Wiesendanger and Wiesendanger 1982.

210 Torigoe et al. 1986.

211 Azizi and Woodward 1987; Nelson and Mugnaini 1988; Bourrat and Sotelo 1991.

212 Kapogianis et al. 1982a,b.

213 Watson and Switzer, 1978. Based on connections (Watson and Switzer 1978), cytology, and topology, these cells are reminiscent of a bridge of LRN cells over the rostral end of the nucleus ambiguus.

214 Mehler 1969; Somana and Walberg 1978; Andrezik and Beitz 1985.

215 Allen 1923; Walberg et al. 1962; Low et al. 1986; Barmack et al. 1998.

216 Rubbertone et al. 1995. Although the vestibular nuclei are often included in the sensory system, the vast majority of their projections are to the motor system. In fact, because of its predominant input from cerebellar Purkinje cells, the lateral nucleus is probably best regarded as a “displaced” cerebellar nucleus. Nevertheless, there are projections from the superior, medial, and spinal vestibular nuclei to the thalamus (Shiroyama et al. 1999).

217 Brodal 1952, 1983; McCrea and Baker 1985.

218 Meessen and Olszewski 1949; Brodal 1952.

219 Torvik 1956.

220 Meessen and Olszewski 1949; Torvik 1956; Valverde 1962.

221 Mehler and Rubertone 1985.

222 Fredrickson and Trune 1986.

223 It is often thought that the periaqueductal gray extends into periventricular regions of the interbrain (see Krieg 1932; Sutin 1966), although exactly how is unclear. We suggest that dorsally this extension involves at least the habenula and ventrally at least the posterior hypothalamic nucleus.

224 These nuclei do not project to the cerebral cortex.

225 Gurdjian 1925; Herkenham and Nauta 1979.

226 Wada et al. 1989.

227 Gurdjian 1925; Herkenham and Nauta 1979.

228 Ariëns Kappers 1960.

229 Gurdjian 1927; Krieg 1932.

230 Recent work has clarified the structural organization of the rat PAG, which is that part of the brain central gray within the midbrain. The basic parcelling of the caudal three-quarters of the PAG follows Beitz (1985).

231 Paxinos and Watson 1986; Canteras and Goto 1999.

232 This relatively clear cell group lies caudal to the precommissural nucleus, as indicated by the name we have given it (Swanson 1998-1999).

233 This relatively homogeneous cell group lies between the caudal end of the interbrain and the

caudal three-quarters of the PAG subdivided by Beitz (1985), exclusive of the PRC, COM and PAGrl. It forms the rostroventromedial part of the PAG (Swanson 1998-1999).

234 This relatively small, distinct group of neurons lies lateral to the PAGrm. We have assigned the names PAGrm and PAGrl simply on the basis of their location in the PAG (Swanson 1998-1999).

235 Beitz 1985.

236 Beitz 1985; Herbert and Saper 1992. This is perhaps the clearest division of the caudal PAG cytoarchitectonically (small, densely packed neurons), and because of this the dorsal division is also very easy to distinguish.

237 Beitz (1985). This large division is undoubtedly heterogeneous (Keay et al. 1994), and requires further structural characterization. For example, there is a supraoculomotor region ventrally (Herbert and Saper 1992).

238 Leichnetz 1982; Gonzalo-Ruiz et al. 1990.

239 Rutherford and Gwyn 1982.

240 Gillilan 1943; Rutherford et al. 1989.

241 This is simply the caudal extension of the periaqueductal gray.

242 Cowan et al. 1964; Hayakawa and Zyo 1983.

243 We (Swanson 1998-1999) have applied this name to a distinguishable cell group between the locus ceruleus and Barrington's nucleus that receives circumscribed inputs from the lateral hypothalamic area (Kelly 1995) and central nucleus of the amygdala (Petrovich and Swanson 1997).

244 Imaki et al. 1991.

245 Meessen and Olszewski 1949; Andrezik and Beitz 1985.

246 Nahin et al. 1983.

247 Thompson and Swanson 2003. This is quite different than the traditional hypothalamic periventricular zone—basically it is the region between the neuroendocrine motor zone and the behavior control column, near the third ventricle.

248 Swanson 1976a.

249 Simerly et al. 1984.

250 Gurdjian 1927.

251 Simerly et al. 1984. The septohypothalamic nucleus of Bleier et al. (1979) includes the ADP and the LSv; however, these two cell groups do not merge, and are cytoarchitectonically distinct.

252 Simerly et al. 1984. The AVP appears to form a major component of the pyrogenic ventromedial preoptic region of Scammell et al. (1996).

253 Simerly et al. 1984.

254 As defined here, the MPO is the relatively cell sparse region between the lateral preoptic area and bed nuclei of the stria terminalis, and the medial preoptic nucleus. In addition to the latter, the MPO surrounds or borders several more distinct cell groups, including the MEPO, ADP, AVP, PS, and PD.

255 As defined here, the AHA is the relatively cell sparse region between the lateral hypothalamic area and bed nuclei of the stria terminalis, and the rostral pole of the anterior hypothalamic nucleus.

256 Gurdjian 1927; Krieg 1932; Thompson and Swanson 1998.

257 Gurdjian (1927) referred to this poorly defined cell group as the dorsal part of the DMH.

258 Gurdjian (1927) referred to this dense group of cells as the ventral part of the DMH.

259 A variety of features indicate that this region differs from the anterior and posterior parts (Thompson and Swanson 1998).

260 Ingram et al. 1932; Christ 1969.

261 It is useful to have a term indicating the area between nuclei in the medial half of the hypothalamus. This region is often referred to as medial regions of the fibrous "capsule" that is said to surround the medial nuclei, but this "capsule" has considerable neurons, in addition to the dendrites of neurons in adjacent nuclei, and axons from many sources. Specific zones of the internuclear area can be named by the pair of flanking nuclei, although some zones have already received a specific name (in particular the subparaventricular zone). In the current hypothalamus parcelling, the lateral half or so of the "capsule" associated with most of the ANH, and all of the VMH, is included in the LHA.

262 While there is some confusion in the literature about the various parts of the reticular formation, virtually every modern account is based on the pioneering work of Olszewski and his colleagues (Meessen and Olszewski 1949; Olszewski and Baxter 1954), which was modified by Brodal (1957) for the cat and by Valverde (1962) for the rat.

263 This very heterogeneous, poorly understood region is often thought of as an interstitial nucleus of the medial forebrain bundle, and the rostral end of the reticular formation (see Nauta and Haymaker 1969).

264 Gurdjian 1927; Swanson 1976a.

265 Gurdjian 1927; Krieg 1932. We have finally attempted a systematic parcelling of this area, based on extensive connectional and cytoarchitectonic evidence (e.g., Risold and Swanson 1997b; Goto et al. 2001; Petrovich et al. 2001; personal observations).

266 This region of small, moderately-densely packed neurons lies rostral to, and is distinct from,

the PHHjd.

267 This region is quite distinct due to a high density of small to medium-sized neurons.

268 This region is distinguished by a lower density of neurons than is found in all surrounding areas. A dorsal zone receives a circumscribed input from the posterior basolateral nucleus of the amygdala (Petrovich et al. 2001) and is slightly less cell-dense than a ventral zone.

269 Swanson and Kuypers 1980. These scattered neurons lie among the fibers of the supraoptic commissures; they were called the nucleus supraopticus diffusus by Gurdjian (1927).

270 Canteras et al. 1994. TUte comes from Petrovich et al. 2001 and is derived from Paxinos and Watson (1986). The TUl is frankly parvicellular, and obviously corresponds to the traditional lateral tuberal nucleus, including a small protrusion on the base of the hypothalamus (Nauta and Haymaker 1969).

271 Its cytoarchitecture is similar to that of the LHAjd, but there tend to be more neurons that are larger, and the cell density is somewhat greater.

272 Goto et al. 2001. The vertical and horizontal limbs of this region have clear cytoarchitectural differences.

273 Goto et al. 2001. This tiny region consists almost entirely of small neurons, with large neurons scattered along its dorsal border.

274 Paxinos and Watson 1986.

275 This region has a considerably greater cell density than the LHAd (note 169); neurons are more densely packed in the LHAvl as compared to the LHAvm.

276 A tiny but obvious group of small to medium-sized fusiform neurons that tend to be oriented horizontally.

277 Wang and Zhang 1995.

278 Gurdjian 1927; Afsharpour 1985; Canteras et al. 1990.

279 Gurdjian 1927. It used to be said that derivatives of the embryonic ventral thalamus do not project to the endbrain. However, a population of neurons in the zona incerta projects to the cerebral cortex, along with adjacent neurons in the underlying LHA (see Lin et al. 1990 and note 169). At least based on topography and connections, the zona incerta might be viewed best as a component of the LHA. The zona incerta is different in almost every way from the other traditional components of the ventral thalamus, the reticular nucleus of the thalamus and ventral part of the lateral geniculate complex (notes 111, 282, and 283).

280 Björklund and Lindvall 1984.

281 Kuzemensky 1977; Berman and Jones 1982.

282 Hickey and Spear 1976; Moore and Card 1994.

283 Swanson et al. 1974.

284 Scalia 1972.

285 Campbell and Lieberman 1985; Gregory 1985.

286 Giolli et al. 1985; Gregory 1985.

287 Gregory 1985.

288 Kanaseki and Sprague 1974.

289 Scalia 1972.

290 Siminoff et al. 1968; Kanaseki and Sprague 1974.

291 Brodal 1957. See note 206 for the parvicellular part.

292 Cowan et al. 1964; Hayakawa and Zyo 1983.

293 Paxinos and Butcher 1985.

294 Hayhow et al. 1960; Giolli et al. 1989.

295 Hayhow et al. 1960; Terubayashi and Fujisawa 1984; Giolli et al. 1985.

296 Castaldi 1926; Olszewski and Baxter 1954; Swanson et al. 1984.

297 Meessen and Olszewski 1949. The A5 noradrenergic group (Dahlström and Fuxe 1964) and associated depressor region (see Loewy et al. 1986) appear to be centered in ventrolateral regions of the PRNc, including the region of the rubrospinal tract, although a few cells also appear to extend into the periolivary region (see Westlund et al. 1983; Byrum et al. 1984). Most of the cells appear to lie adjacent to the superior salivatory nucleus (see note 301).

298 Meessen and Olszewski 1949.

299 Olszewski and Baxter 1954.

300 Taber 1961; Newman 1985a.

301 Andrezik et al. 1981. Although this problem has not been addressed in detail, it seems likely from published maps (see Dahlström and Fuxe 1964; Hökfelt et al. 1984; Sawchenko et al. 1985; Giuliano et al. 1989; Ellenberger et al. 1990) that the C1 adrenergic group, the A1 noradrenergic group, the ventrolateral medulla, and the rostral ventrolateral medulla are centered in (though not necessarily confined strictly to) the PGRNl, with relatively minor possible involvement of the ventral division of the nucleus ambiguus (see note 297).

302 We use this term in referring to the dorsal and ventral cell groups identified recently.

303 Niura et al. 1996.

304 Fukuda et al. 1993.

305 Berman 1968; Newman 1985a,b. This appears to be a ventromedial extension of the gigantocellular reticular nucleus.

306 Lorente de Nó 1922; Torvik 1956; Rokx et al. 1986b.

307 Meessen and Olszewski 1949; Mehler 1983; ter Horst et al. 1991.

308 Meessen and Olszewski 1949; Valverde 1962.

309 Villanueva et al. 1988.

310 This zone is defined by pools of neuroendocrine motoneurons (Markakis and Swanson 1997, Thompson and Swanson 2003).

311 These neurons release neurotransmitter/hormones into the general circulation at the level of the pituitary neural lobe. Most axons pass through the MEin.

312 Peterson 1966; Palkovits et al. 1974.

313 Swanson and Kuypers 1980.

314 Daniel and Prichard 1975.

315 Schwind 1928; Daniel and Prichard 1975.

316 These neurons release neurotransmitter/hormones into the proximal end of the hypophysial portal system, in the MEex.

317 Swanson and Kuypers 1980; Swanson and Simmons 1989; Swanson 1991, 1992b, 2000c.

318 The rostral tip of the PVH (the PVHap) was extended onto Atlas Level 21 (L.W. Swanson and D.M. Simmons, personal cytoarchitectonic observations).

319 Gurdjian 1927.

320 For the sake of consistency (see notes 249, 250, 260, and 319) we have applied this name to what Gurdjian (1927) referred to as the dorsal part of the posterior periventricular nucleus.

321 Krieg 1932; Everitt et al. 1986.

322 Schwind 1928; Daniel and Prichard 1975. The MEex and INFex contain the proximal end of the hypophysial portal system (note 316), the vascular link between hypothalamus and pituitary (PIT) anterior lobe (AL). The AL and IL (intermediate lobe) of the pituitary are derived embryologically from the roof of the mouth whereas the neural lobe is an outgrowth of

the hypothalamus.

323 Glicksman 1980.

324 Székely and Matesz 1982.

325 Mizuno et al. 1975; Jacquin et al. 1983.

326 Spangler et al. 1982.

327 Martin et al. 1977; Watson et al. 1982; Friauf and Herbert 1985; Friauf 1986.

328 Székely and Matesz 1982.

329 White and Warr 1983; Vetter et al. 1991; Vetter and Mugnaini 1992.

330 Strutz 1982.

331 Bieger and Hopkins 1987; Patrickson et al. 1991. For stylopharyngeal motoneurons see Fukuda et al. 1995.

332 Brichta et al. 1987.

333 Krammer et al. 1979; Jacquin et al. 1983; Kitamura et al. 1983.

334 Brichta and Grant 1985.

335 Sasaki and Arnold 1991.

336 Kuzuhara et al. 1980.

337 Kuzuhara and Chou 1980.

338 Loewy et al. 1978; Martin and Dolivo 1983.

339 Contreras et al. 1980; Senba et al. 1987; Spencer et al. 1990.

340 Contreras et al. 1980.

341 Fox and Powley 1985; Norgren and Smith 1988; Altschuler et al. 1991.

342 Bieger and Hopkins 1987. This region is characterized by preganglionic neurons that contribute to thoracic branches of the vagus nerve, although other cell types may be present.

343 Rubin and Purves 1980; Mawe et al. 1986; Strack et al. 1988; Anderson et al. 1989; Barber et al. 1991; Hosoya et al. 1991.

344 Petras and Cummings 1972; Molander et al. 1984; Brichta and Grant 1985; Molander et al. 1989.

345 Hancock and Peveto 1979.

346 Petras and Cummings 1972; Barber et al. 1991.