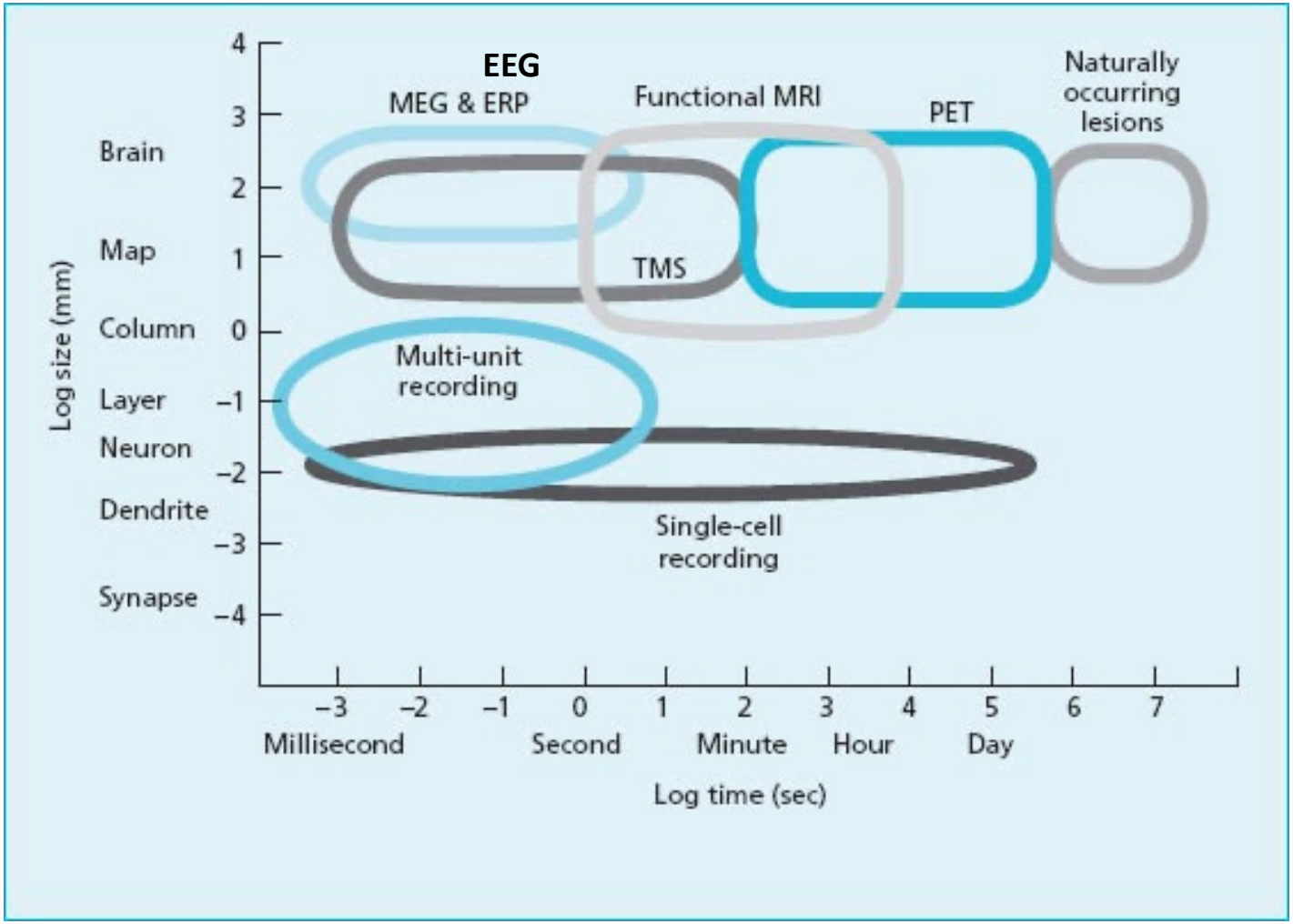
EEG och funktionell avbildning av hjärnan

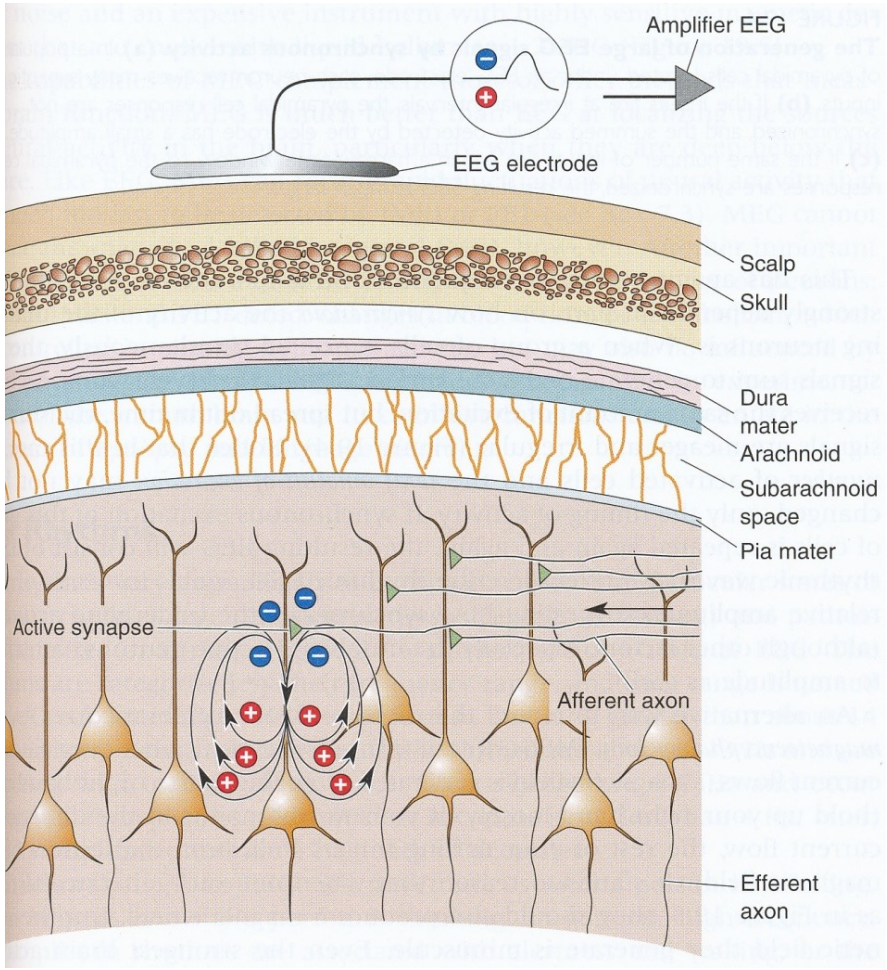


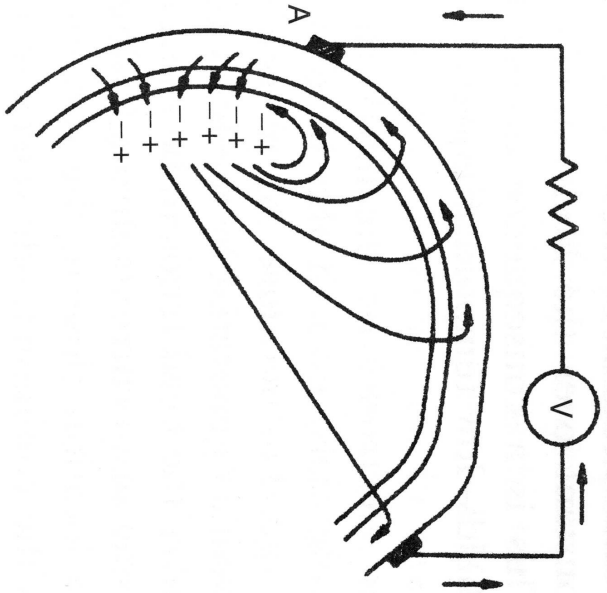
Johan Wessberg HT-2025

Bear & Connors kapitel 19

Purves kapitel 28

EEG - Elektroencephalografi: Strömkällor i kortex





- elektrisk ström, ffa från depolarisation från EPSPer i apikala dendriter i pyramidceller i kortex
- *summerade* strömmar från ett stort antal nervceller
- strömmarna leds i *hela huvudet* (volymskonduktion)

INTERNATIONAL (10-20) ELECTRODE PLACEMENT

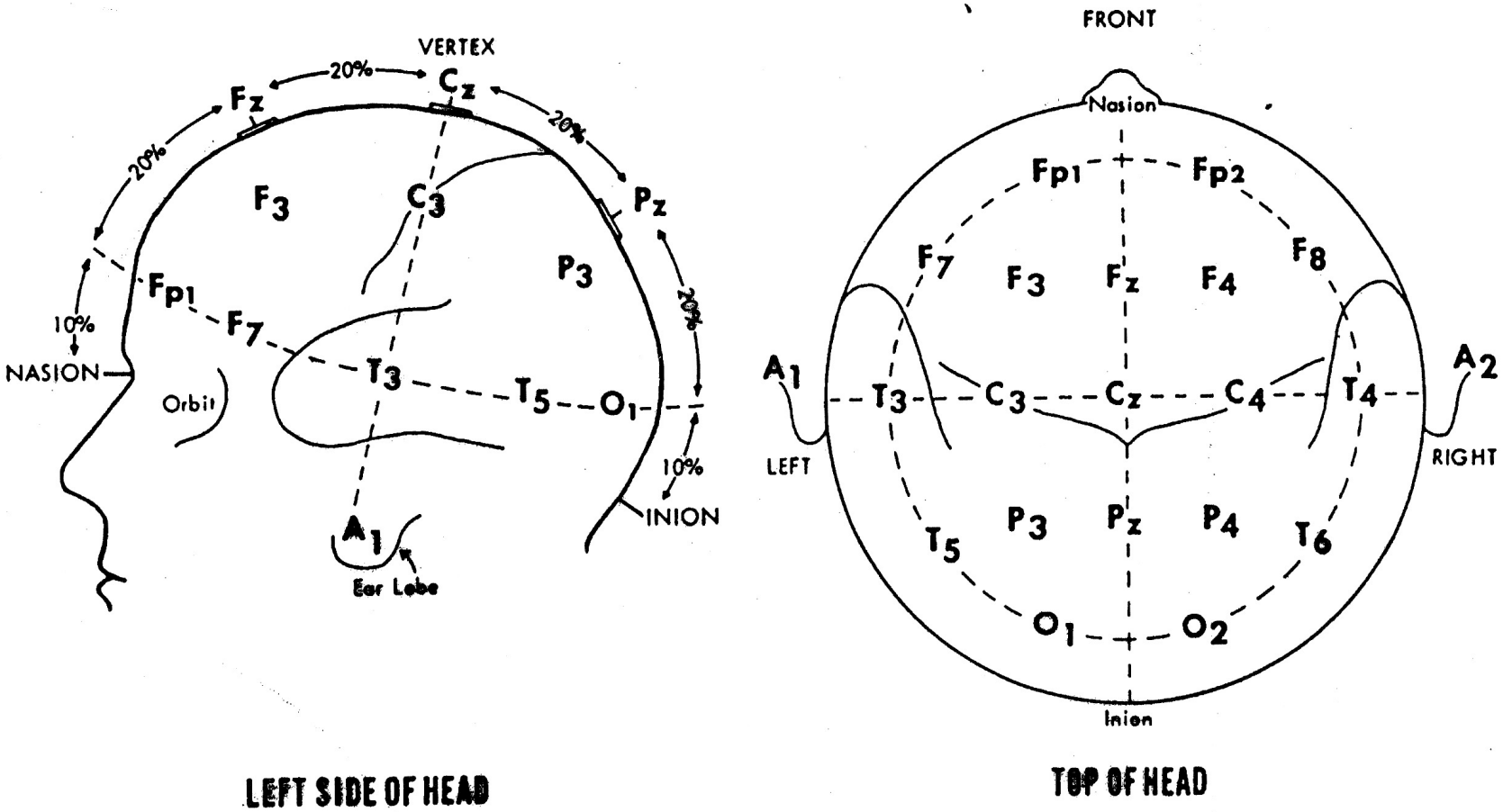


FIG. 1–1. International 10–20 electrode placement system. Electrode placements indicated in this atlas conform to this system.

Mekanism för EEG: synkronisering av aktivitet i ett stort antal nervceller

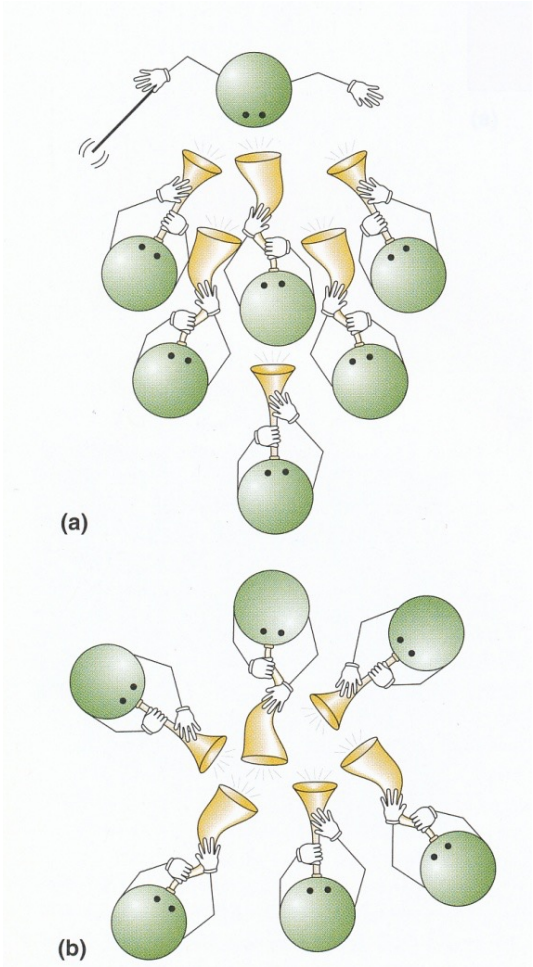


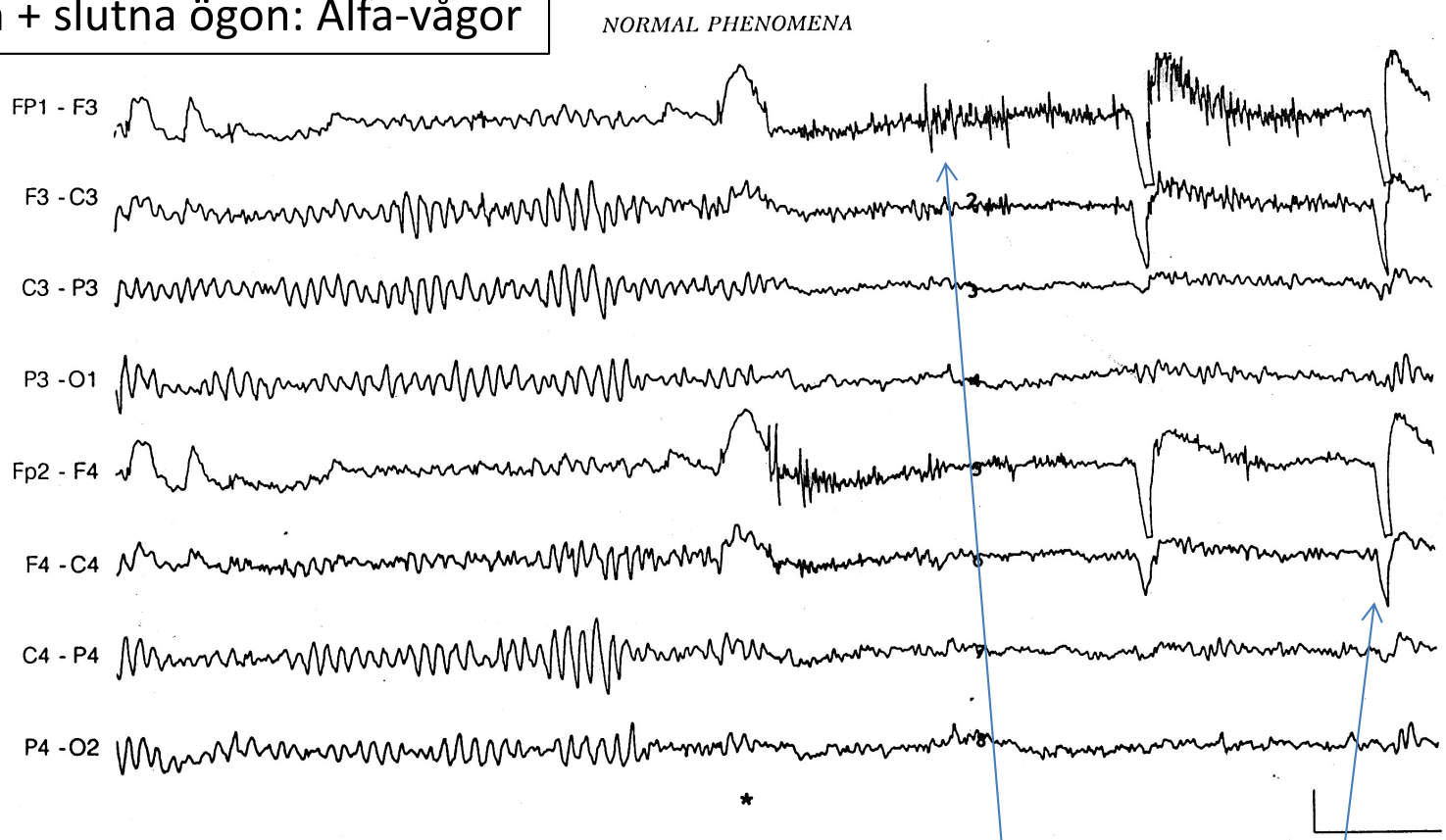
FIGURE 19.7
Two mechanisms of synchronous rhythms. Synchronous rhythms can **(a)** be led by a pacemaker or **(b)** arise from the collective behavior of all participants.

Normala EEG-rytmer:

beta	15 – 30 Hz	vaken
alfa	8 – 14 Hz	stängda ögon, lätt dåsig
theta	4 – 7 Hz	dåsig, lätt sömn
delta	< 4 Hz	djup sömn

(gamma >30 – *(ca)* 100 Hz
går inte att se i standard-EEG, avspeglar aktivitet i kretsar i kortex)

Vaken + slutna ögon: Alfa-vågor



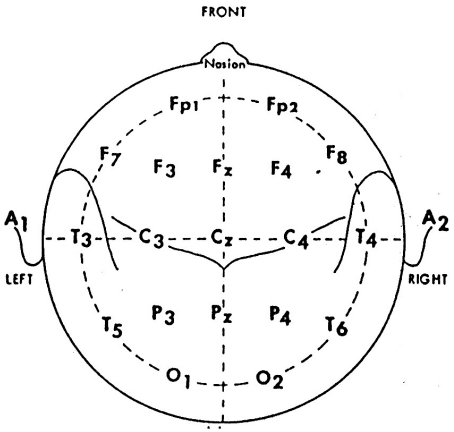


FIG. 3–19. Alpha attenuation with eye opening. 83 years. Eye opening *(asterisk)* completely abolishes the alpha activity in this example leaving a central (C3, C4) beta rhythm and low voltage lambda waves in the occipital derivations. Calibration signal 1 sec, 50μV.

Artefakter:

Blinkningar, ögonrörelser

EMG (sväljer, biter, nackmuskler)

Sömnstadier och EEG

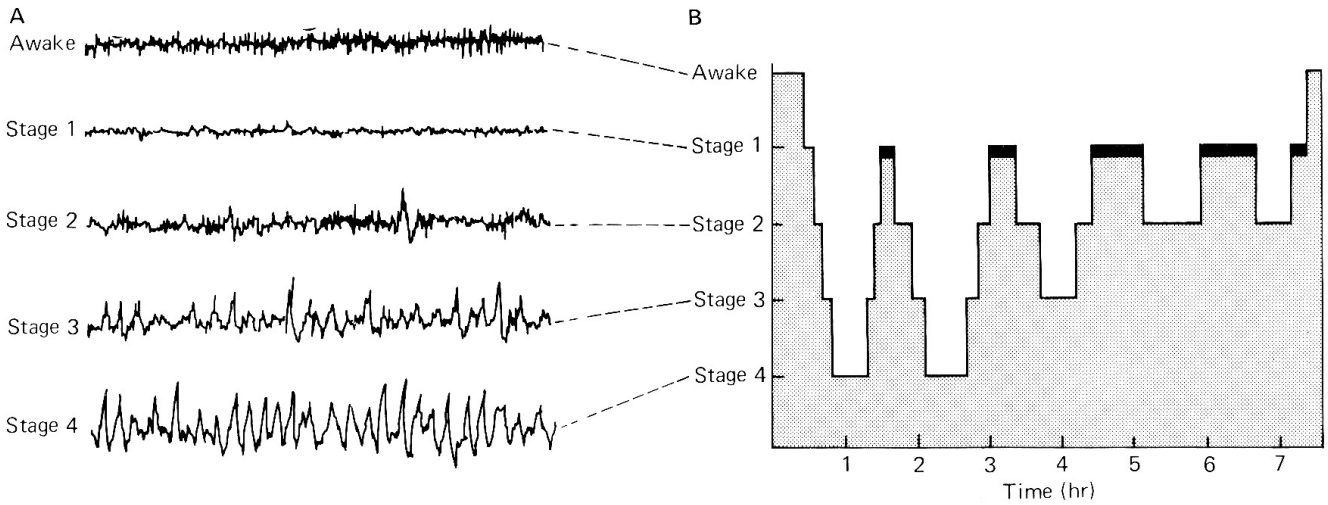
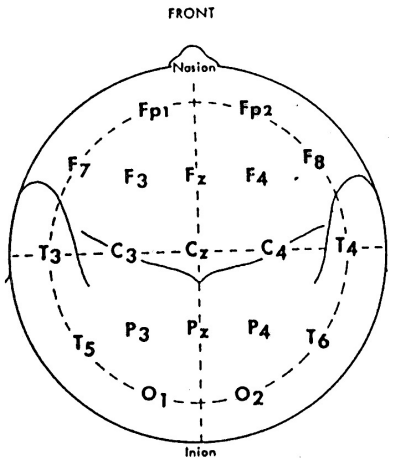


FIGURE 51–2
Stages of sleep form a cyclical pattern.

A. EEG recordings during different stages of wakefulness and sleep. Each record spans 30 s. The **top recording** of low-voltage, fast activity is that of an awake brain; the **next four** represent successively deeper stages of slow-wave sleep. Note that the stage 2 recording contains several characteristic bursts of waxing and waning waves (sleep spindles) lasting 1–2 s. Stage 1 rapid eye movement (REM) sleep can be distinguished from stage 1 non-REM sleep only by additional electrooculographic and electromyographic criteria.

B. A typical night's pattern of sleep in a young adult. The time spent in REM sleep is represented by a **black bar.** The first REM period is usually short (5–10 min), but tends to lengther successive cycles. Conversely, stages 3 and 4, which toget often referred to as "delta sleep," dominate the slow-wave periods in the first third of the night, but are often comple absent during the later, early morning cycles. The amount stage 2 slow-wave sleep increases progressively until it co pletely occupies the slow-wave periods toward the end of night. Note that in this example, because the morning aw interrupted the last REM period, the likelihood of a dream is good. If, instead, the REM period had been completed a sleeper had been awakened by an alarm clock from the ne 2 slow-wave sleep, the chance of a dream being recalled w greatly reduced.

Lätt sömn



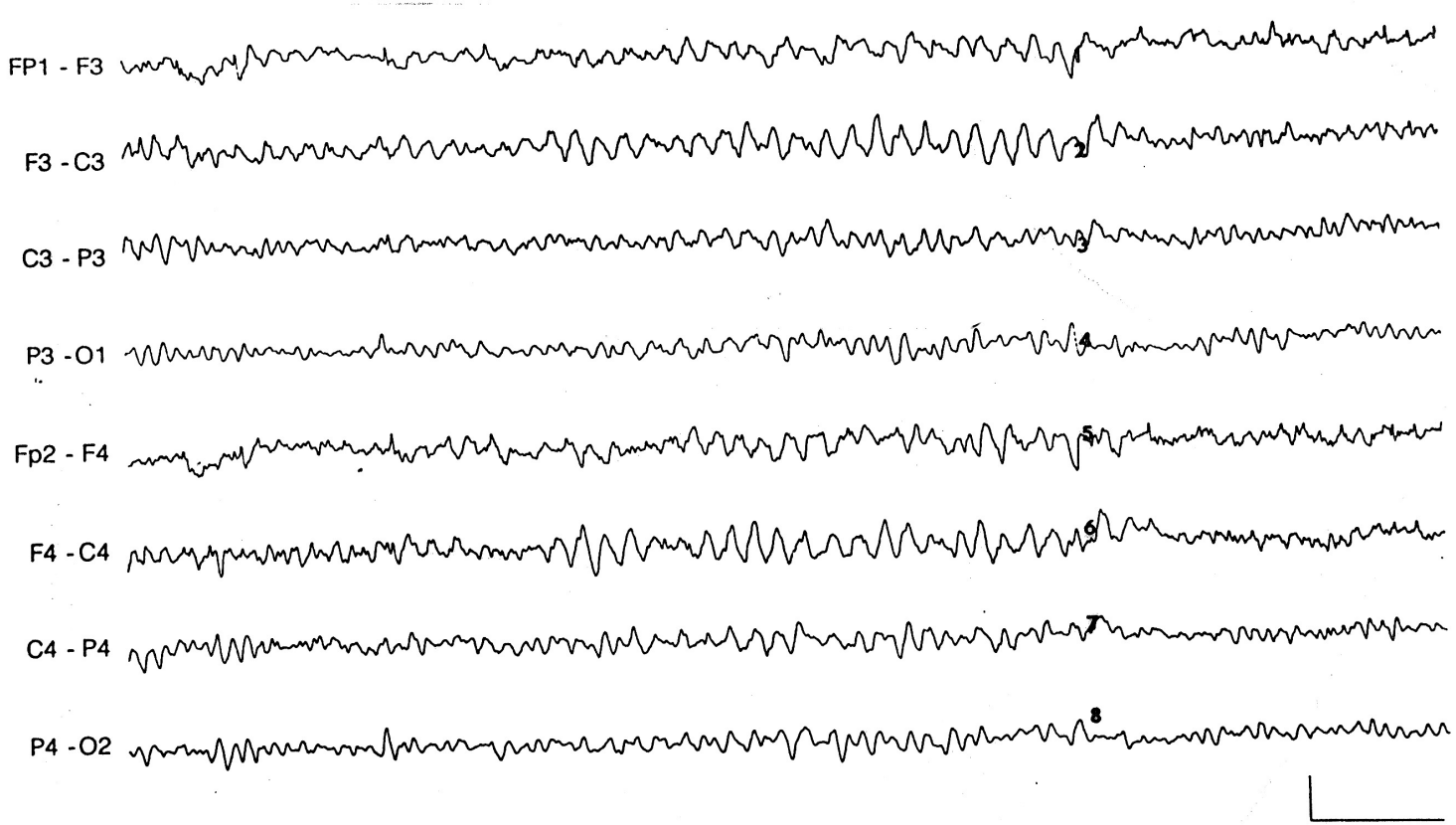
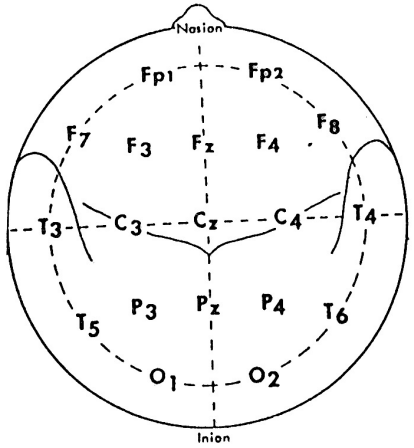


FIG. 3–94. Drowsiness with theta. 27 years. Prominent rhythmic 5–6 Hz theta may characterize drowsiness in some adults as it commonly does in children. This is not an abnormality. Note the sudden return to wakefulness in the last 3 seconds. Calibration signal 1 sec, 50μV.

Djup sömn (stadium 3, NREM)



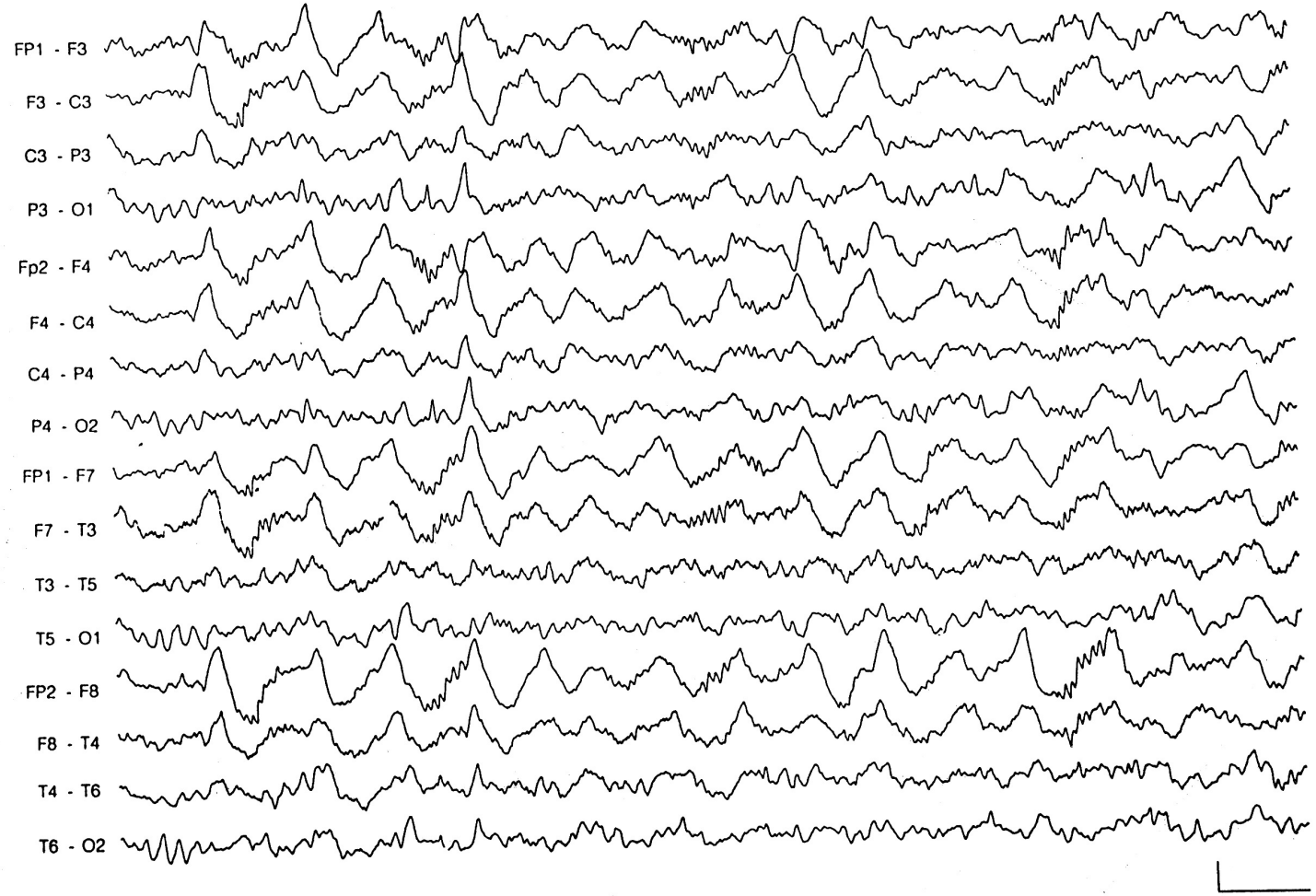


FIG. 3–138. Deep stage 3 sleep. 36 years. V-waves are less prominent in deep non-REM sleep (stage 3) which is dominated by diffuse delta and frontally predominant diffuse spindles. Calibration signal 1 sec, 70μV.

REM-sömn

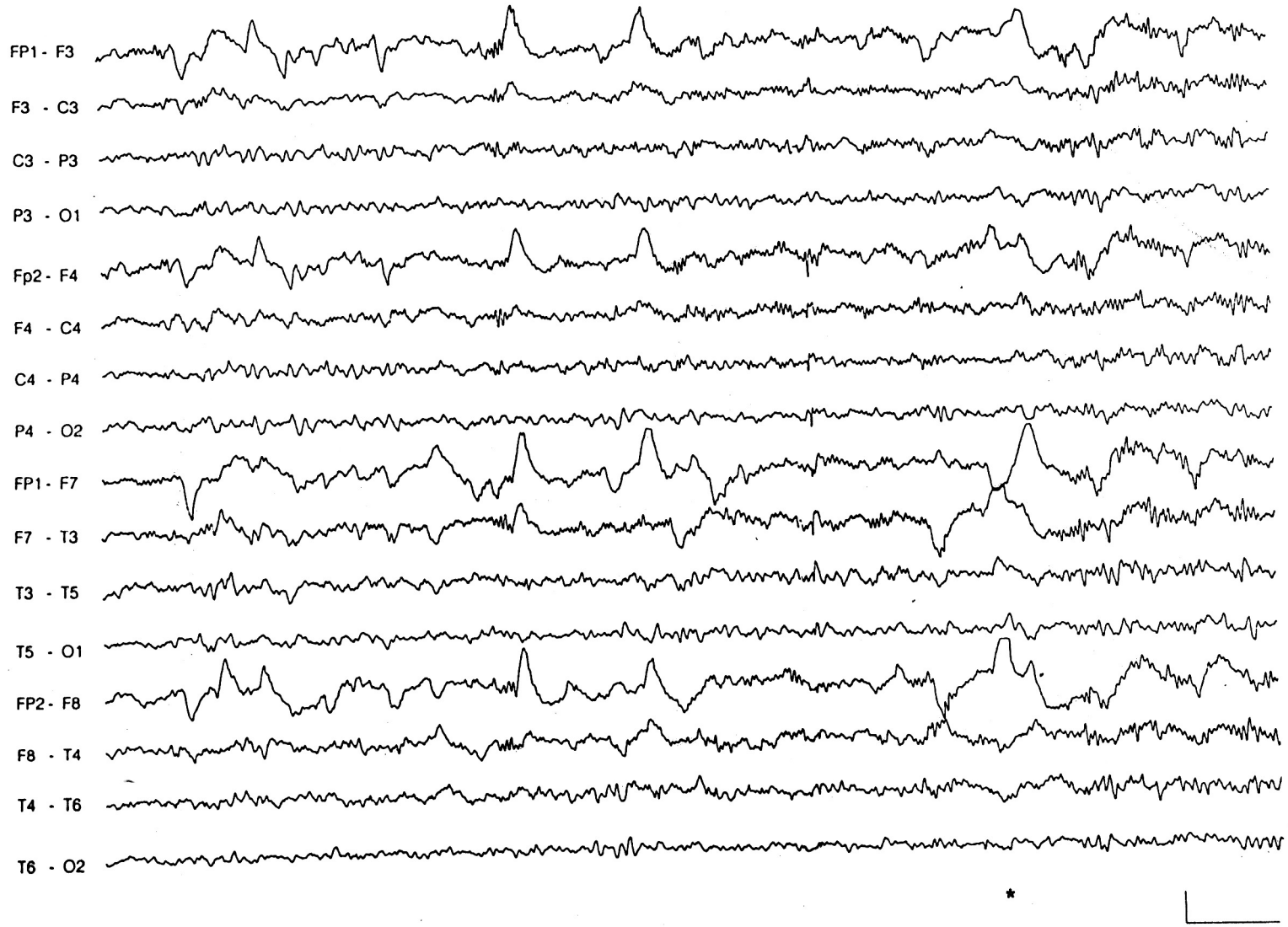


FIG. 3–141. Rapid eye movement (REM) sleep. 36 years. REM sleep may unexpectedly appear during routine recordings. As in this recording, a mixed frequency background occurs containing theta, beta, and delta activity. Note the vertical rapid eye movements. A prominent rightward eye movement is also present *(asterisk).* Calibration signal 1 sec, 70μV.

Auditory Evoked Potentials (Svarspotentialer; Event-Related Potentials, ERP)

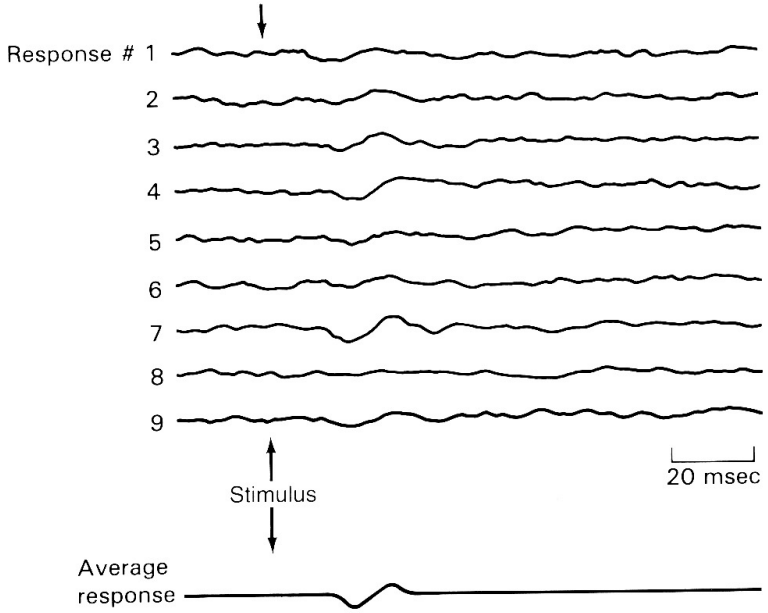
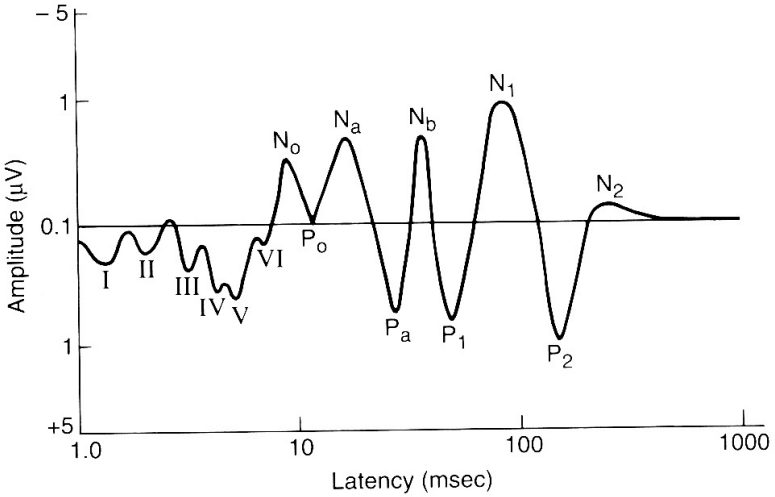


FIGURE 50–3
These tracings show nine separate records of the ensemble activity of cortical neurons during which a stimulus, for example a flash of light or a tap, was presented. The evoked potential occurs at a predictable interval following the stimulus. Since the size of the response in an individual record is small in relation to the amplitude of the fluctuations of the EEG, numerous records must be averaged using a computer to reveal the characteristic evoked potential. In this procedure the randomly occurring fluctuations in the EEG cancel each other out, leaving a record of an average sensory evoked potential that clearly illustrates the time course and waveform of the sensory activity.

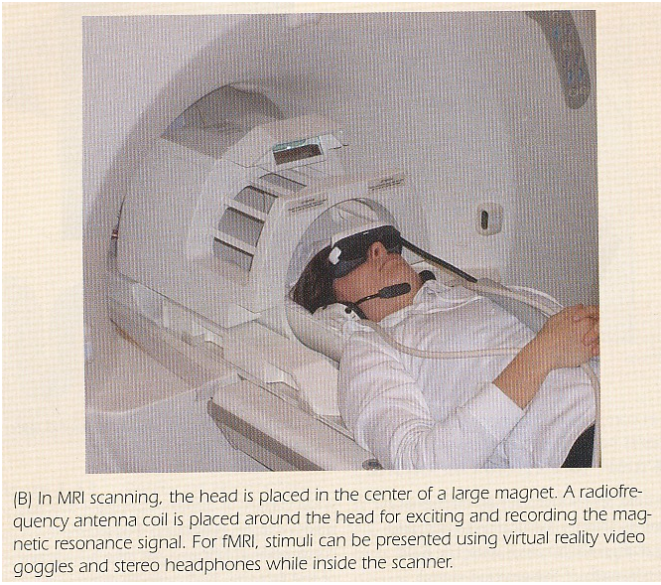
FIGURE 50–4
The auditory evoked potential has separate components corresponding to electrical activity at each relay and the cortex. Components I to VI are generated by successive structures in the auditory pathway, from the cochlea to the medial geniculate nucleus. Sources for later negative components (N_0, N_a, N_b, and N_2) and positive components (P_0, P_a, P_1, P_2) include thalamic nuclei other than the medial geniculate nucleus, the auditory cortex, and association cortices. The potentials are plotted on logarithmic scales. (Adapted from Picton et al., 1974.)



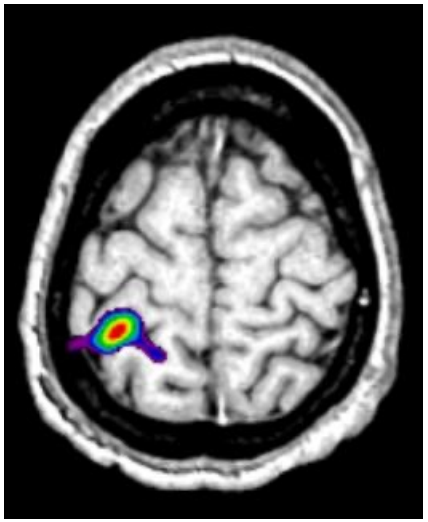
kallas även Auditory Brainstem Response, ABR

Fler möjligheter: Sensory Evoked Potentials, SEP – elektrisk stimulering av hudnerv
Visual Evoked Potentials, VEP – stimulering av synen

fMRI: Functional Magnetic Resonance Imaging, MR-kamera



(B) In MRI scanning, the head is placed in the center of a large magnet. A radiofrequency antenna coil is placed around the head for exciting and recording the magnetic resonance signal. For fMRI, stimuli can be presented using virtual reality video goggles and stereo headphones while inside the scanner.

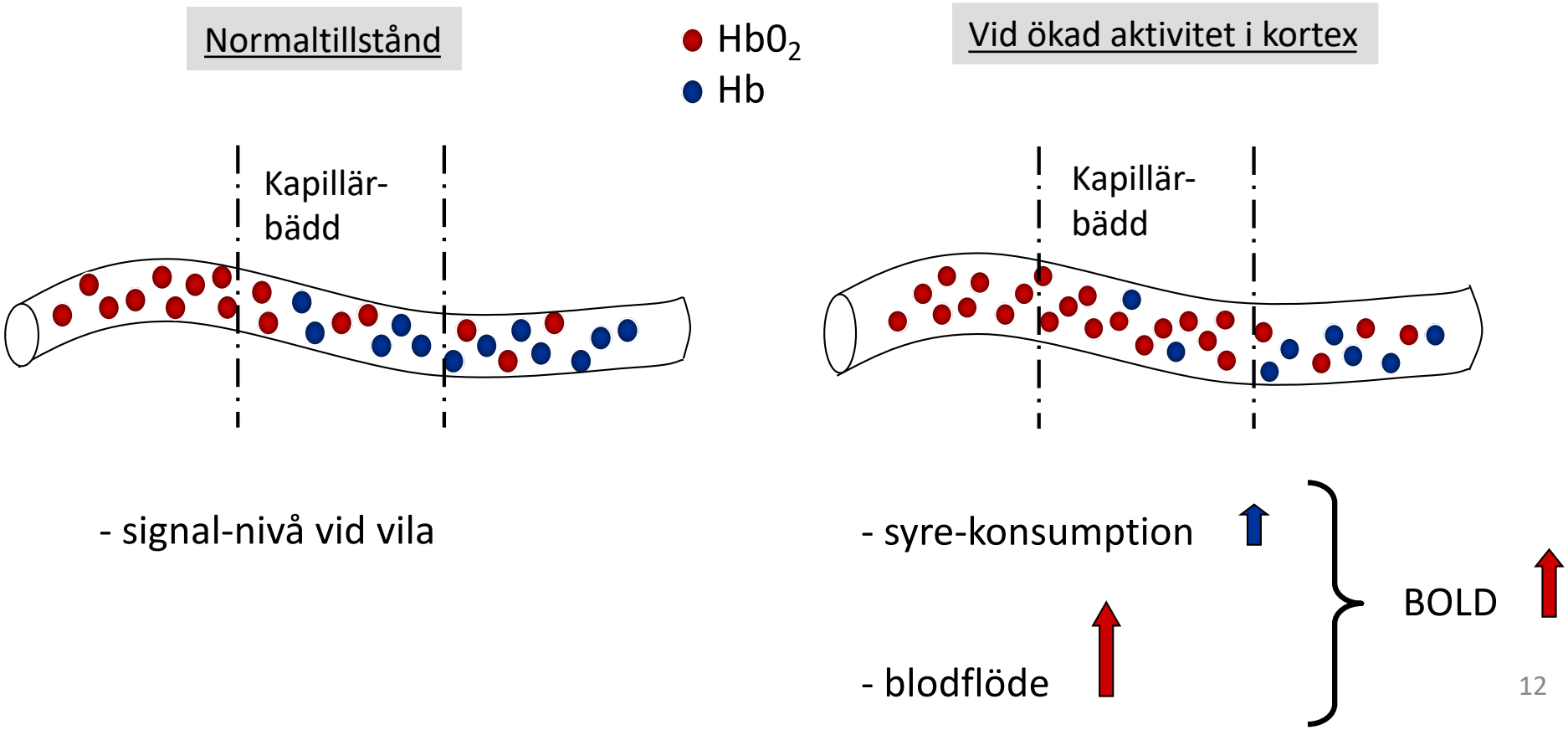


bildupplösning, ca 2-5 mm

anatomi <-> funktion

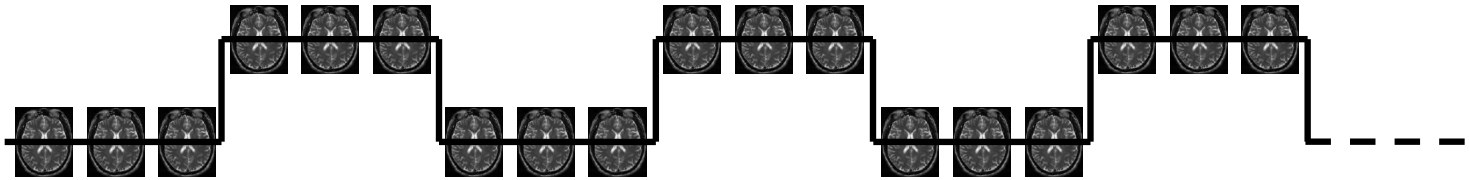
”BOLD-signal” (Blood Oxygen Level Dependence)

• Deoxy-hemoglobin (Hb) är magnetiskt, minskar MR-signalen

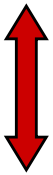


• Långsamt! Tidsupplösning några sekunder
• Svag signal! Ett par % ändring (som mest)

fMRI-försök: Omväxlande block av vila och stimulering

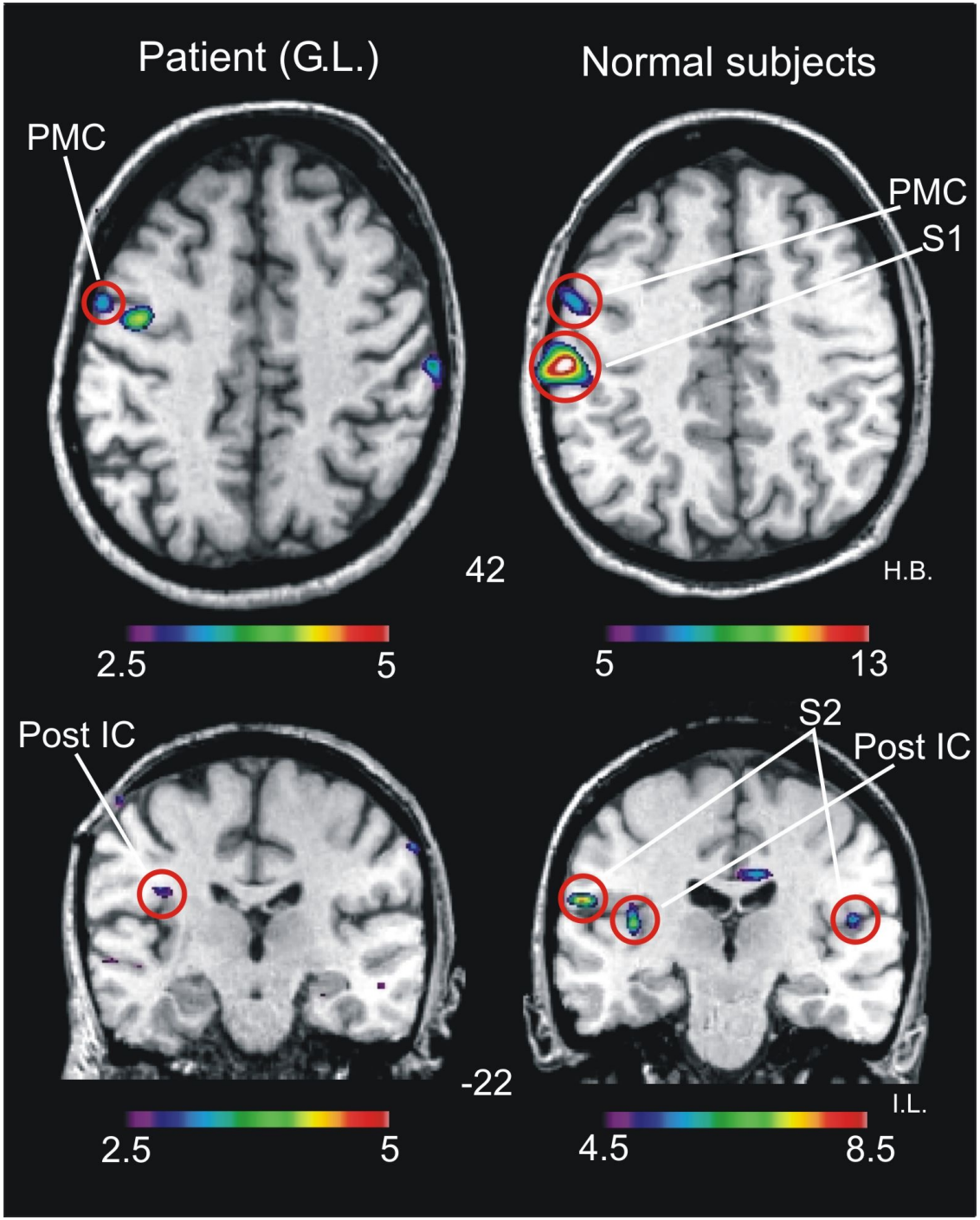


MR-signalen varierar med 1-5%



Korrelation?
Effekt av stimulering?

- kräver många upprepningar (ca 20-50 ggr; jfr. evoked potentials i EEG)
- kräver upprepningsbara stimuli som ger en tydlig effekt på hjärnans aktivitet
- kliniska tillämpningar t.ex. utredning inför neurokirurgi: språkområde? handområde?



fMRI-studie: Lätt beröring på armen med en mjuk borste.

Hos friska kontrollpersoner syns aktivitet i primär och sekundär känselkortex (S1, S2) (och dessutom i pre-motorcortex, här betecknad med PMC).

Hos en patient som saknar A-fibrer efter en autoimmun sjukdom syns inte S1+S2, men både hos patienten och friska syns en aktivering i bakre insula (=Post IC).

Detta beror troligen på aktivering av C-taktila afferenter, beröringsafferenter med omyeliniserade axon.