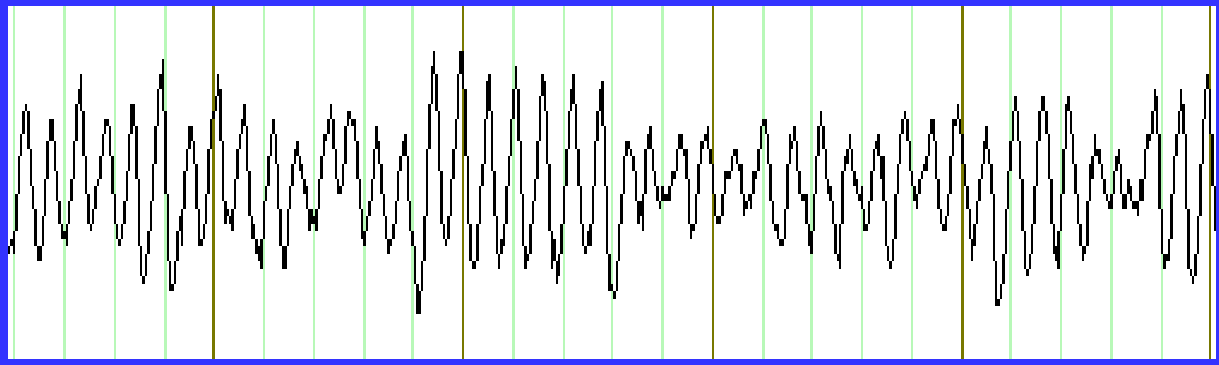


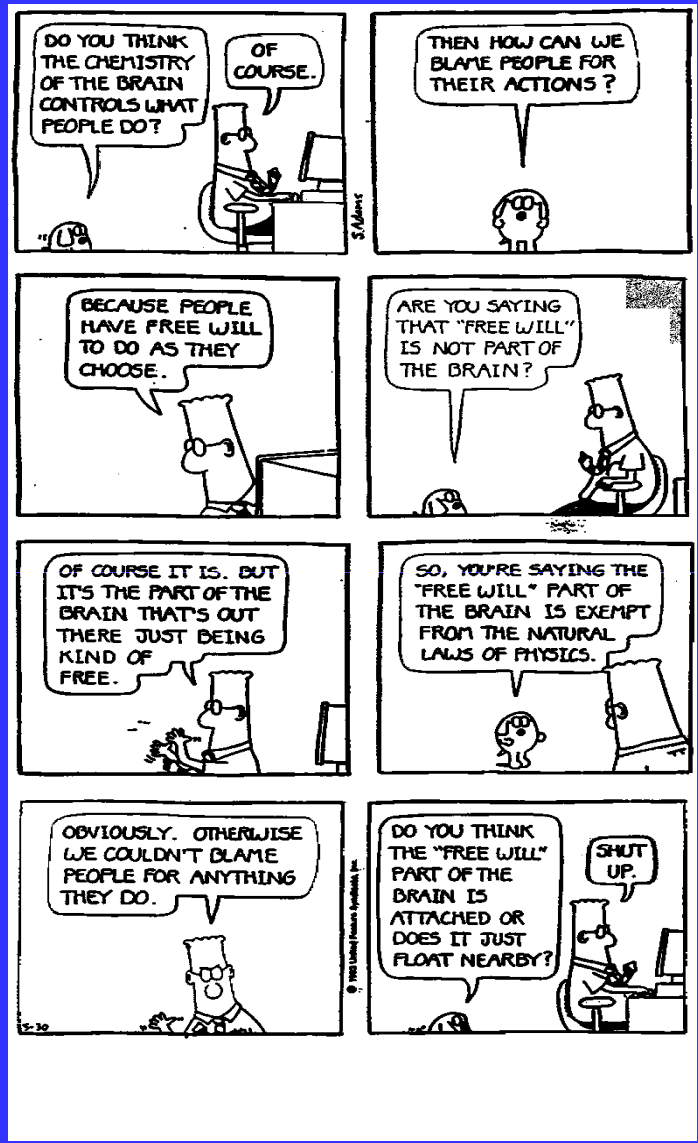
EEG & QEEG: Foundations to Methods Leading to Training Planning

Grant Bright, Ph.D.

From APA

- *"Materials that are included in this course may include interventions and modalities that are beyond the authorized practice of mental health professionals. As a licensed professional, you are responsible for reviewing the scope of practice, including activities that are defined in law as beyond the boundaries of practice in accordance with and in compliance with your professions standards."*

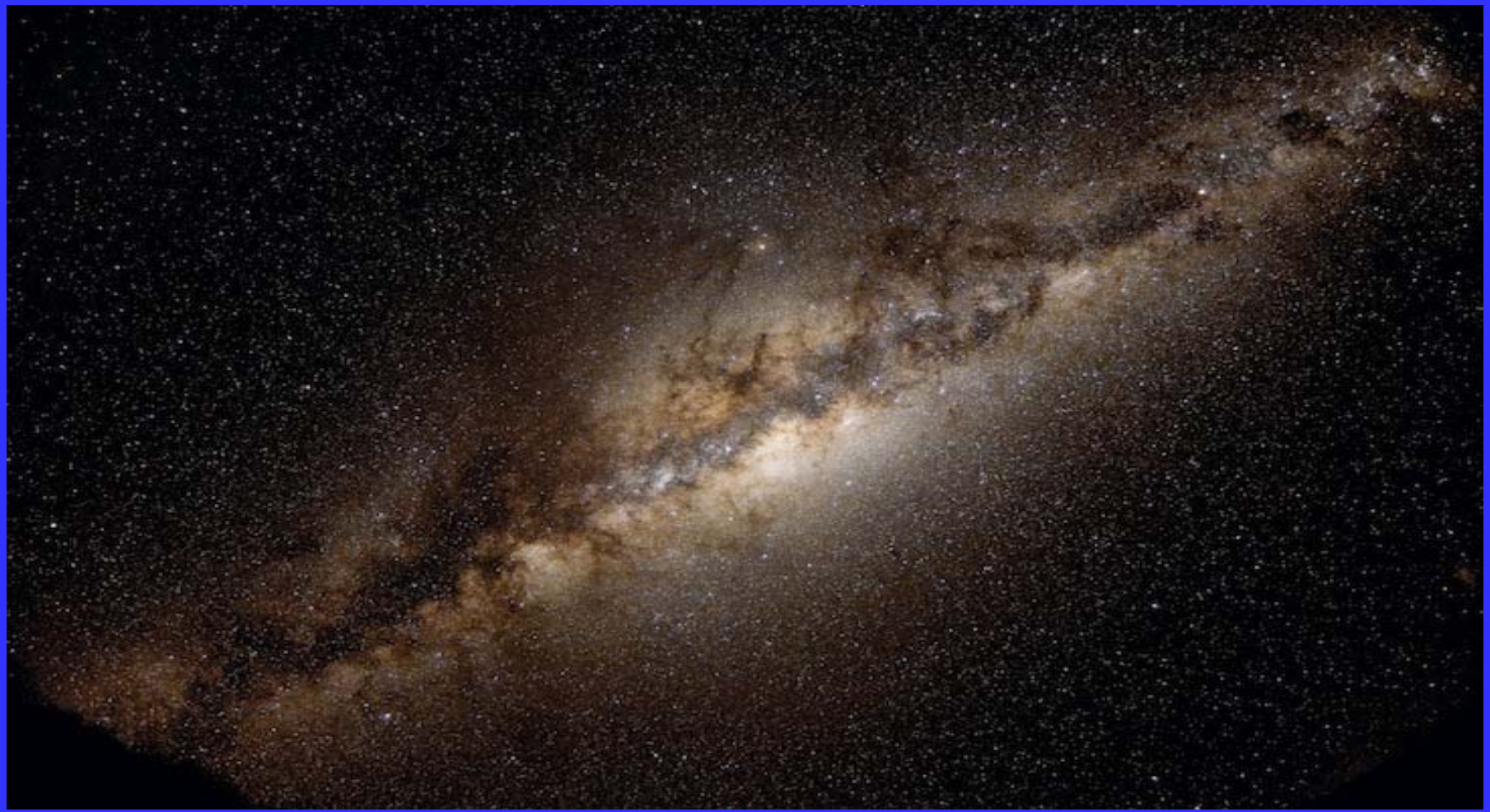
Confused about more important things….



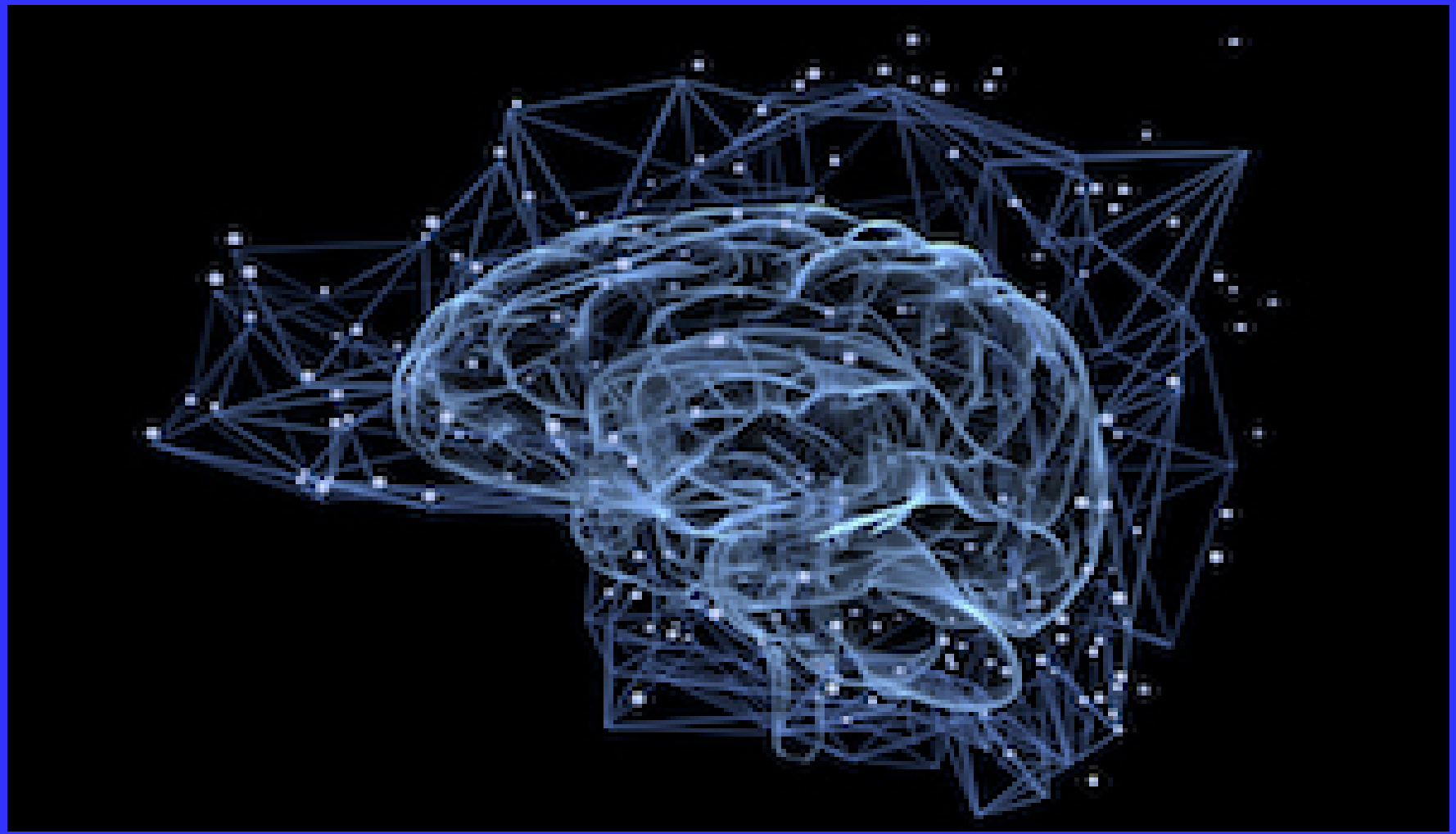
500th Anniversary of 95 Thesis

Our Little Planet

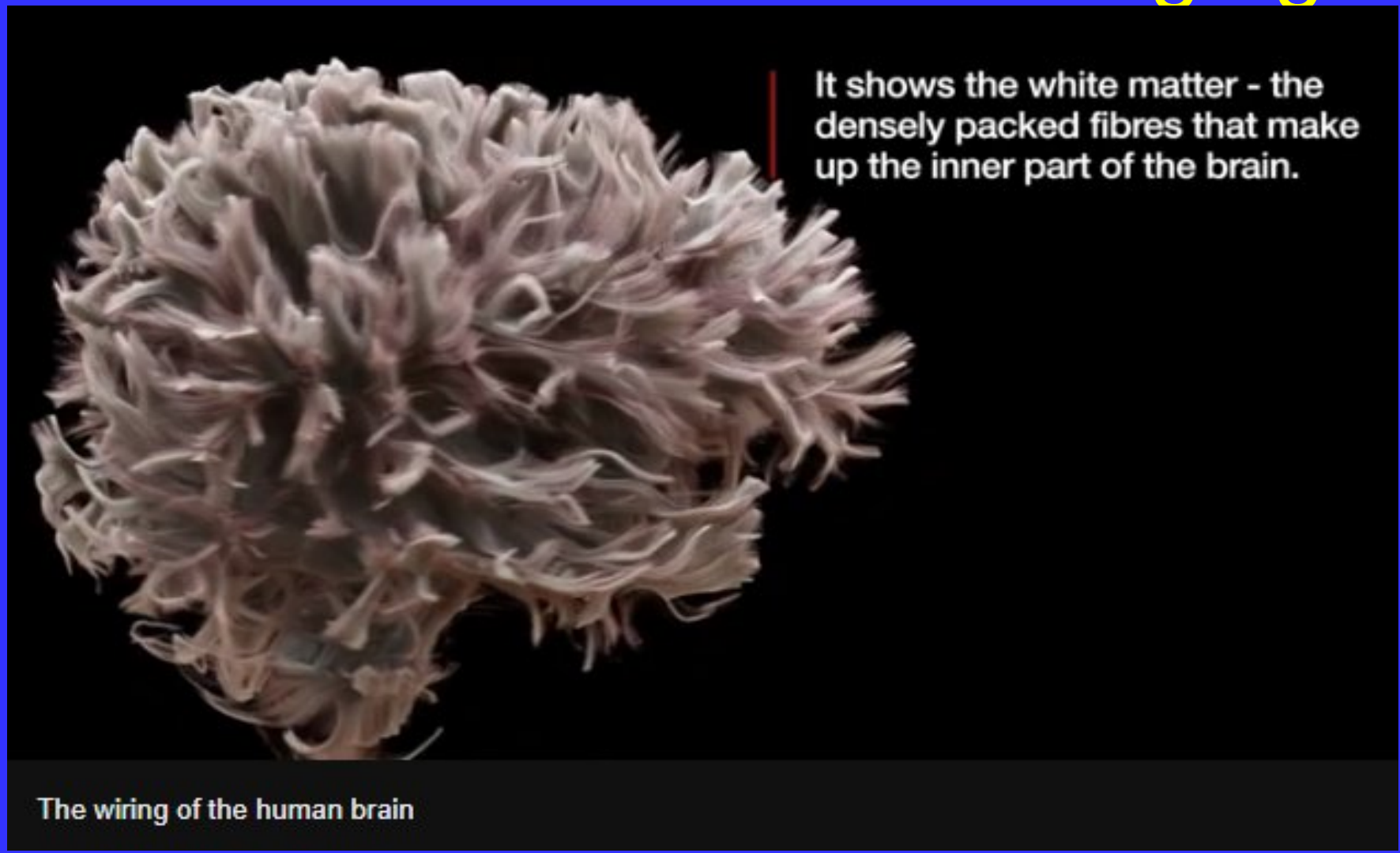
The Milky Way



Brain Network: Gross Level

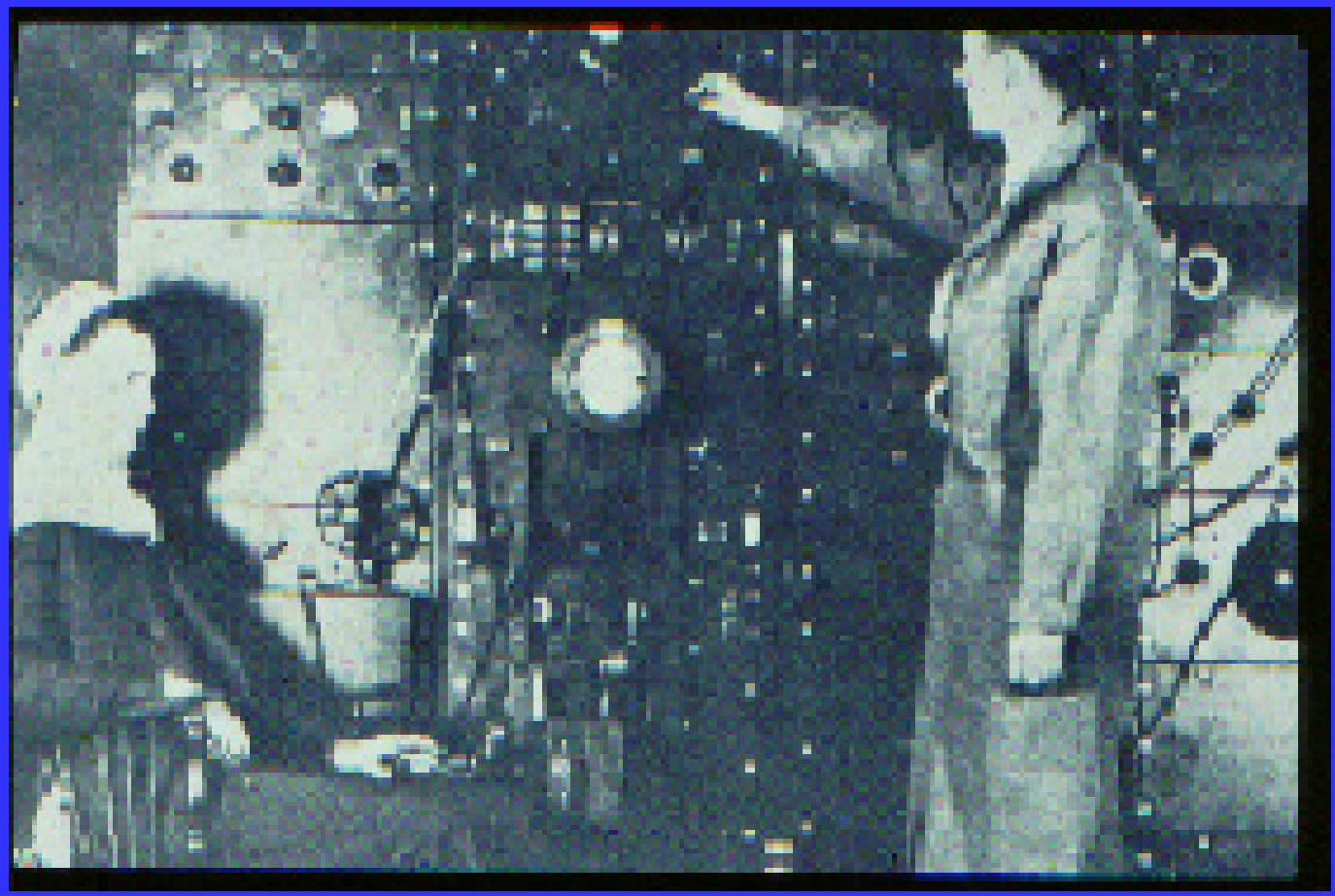


3 Siemens MRI for 3D Imaging



http://www.bbc.com/news/health-40488545

The Electroencephalographic Heritage



Donald Lindsley, subject; First EEG Lab, Harvard University

Patient Cooperation

TOPICS

- Frequency and amplitude characteristics
- Electrogenesis
- Electrode Placement
- Montages and montage reformatting (localization)
- Artifacts
- Patient State
- Recording Conditions
- Waveforms (background, transients)

Frequency and amplitude characteristics

Human EEG frequencies range from d.c. to over 100 Hz.

Most of the human EEG falls in the 1-42 Hz range.

The amplitude of the EEG usually ranges from 1-150 uV, averaging 25-50 uV in adults.

Amplitudes in children often exceed 100 uV, this is rarely seen in adults.

Genesis of the Electroencephalogram

- The electroencephalogram (EEG) is a recording of cerebral electrical potentials on the scalp. Cerebral electrical activity includes action potentials that are brief and produce circumscribed electrical fields, and slower, more widespread, postsynaptic potentials.

- The magnitude of the signal recorded from a neural generator depends on the solid angle subtended at the electrode. Consequently, the activity of a single neuron can be recorded by an adjacent microelectrode, but not at a distant scalp electrode.

- Synchronous activity in a horizontal laminar aggregate of neurons with parallel orientation may, however, constitute a generator of sufficient extent to be detectable on the scalp.

From:

"Electroencephalography"

C.D. Binnie, P.F. Prior

Journal of Neurology, Neurosurgery, and Psychiatry

1994, 37, 1308-1319

Electrogenesis: Cortical Generators

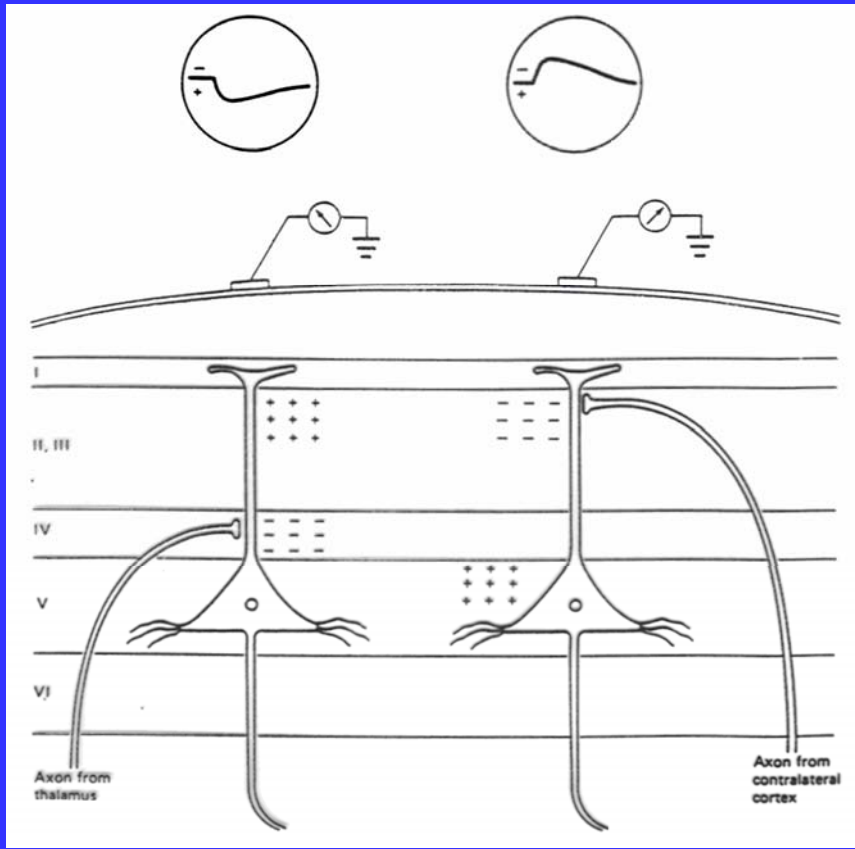


FIG. 3. Scalp recordings and underlying synaptic mechanisms showing that polarity of the scalp potential depends on the electrode's position in relation to current sources and sinks. **Left:** Potential recorded from a scalp electrode following activation of thalamic inputs. The terminals of thalamocortical neurons make excitatory connections on cortical neurons predominantly in layer IV. Thus, the site of inward current flow (sink) is in layer IV, and the site of outward current flow (source) is in the superficial cortical layers. Since the scalp recording electrode is closer to the site of outward current flow than to that of inward current flow, it detects a positive potential. In this example, a positive extracellularly recorded potential is shown as a downward deflection. **Right:** Potential recorded from an excitatory input from a callosal neuron in the contralateral cortex. The axons of callosal neurons terminate in the superficial cortical layers. A negative potential (upward deflection) is recorded because the electrode is closer to the site of inward current flow than to that of outward current flow. (From ref. 106.)

Electrogenesis: Eye Artifact

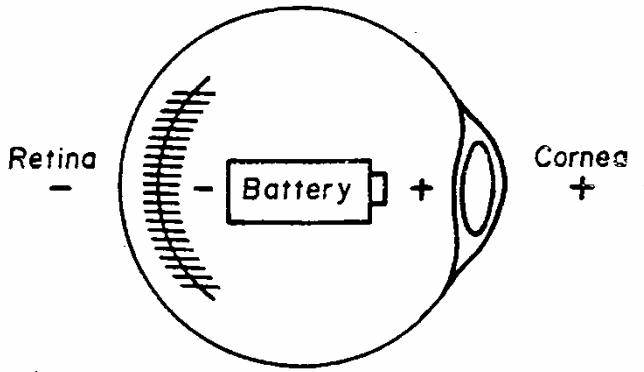


FIG. 16.10. Schematic representation of corneal–retinal potential.

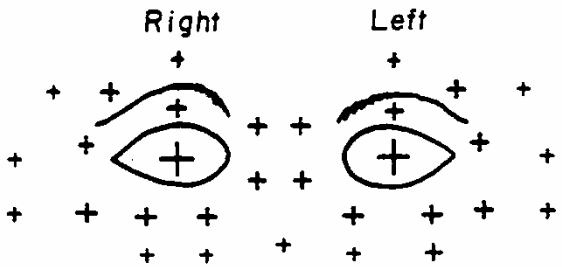


FIG. 16.11. Schematic representation of field of positivity around eye; polarity of eyes with position fixed forward.

Electrode Placement

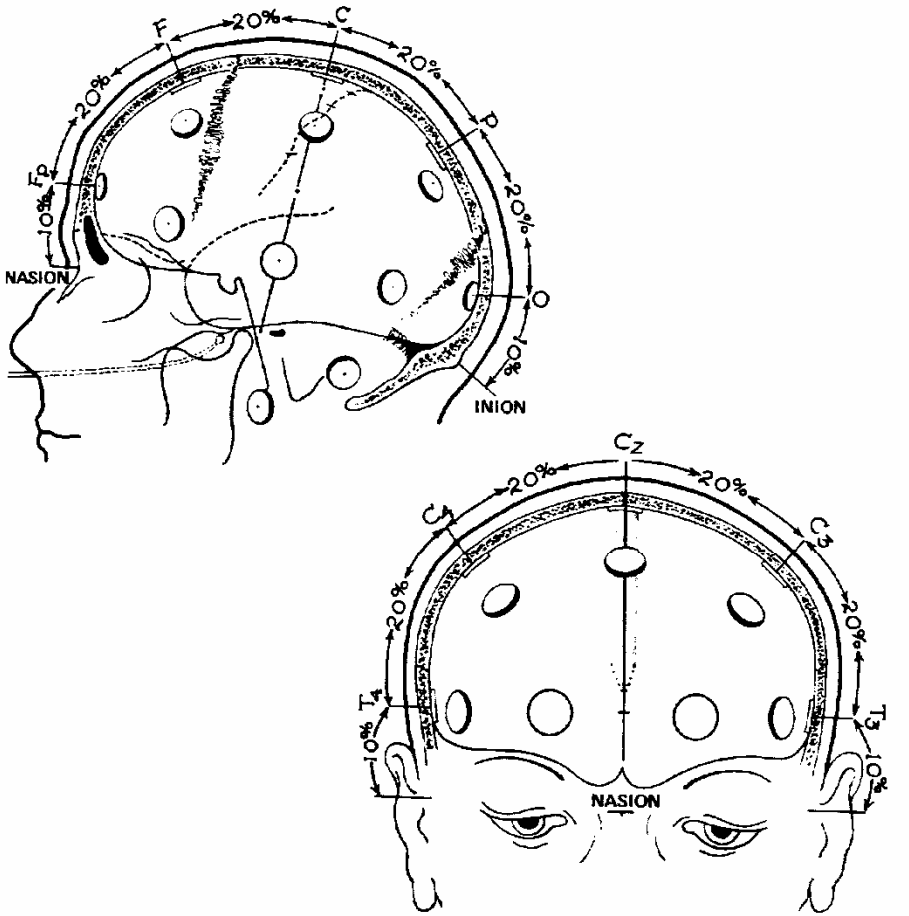


FIGURE 1.4 Electrode placements in the 10–20 electrode system. (Fp = frontal pole; C = central; P = parietal; O = occipital). *Top:* lateral view showing measurements in the midsagittal plane. C is placed at 50% of the nasion-inion distance; F, P, Fp, and O are placed at 20% intervals. *Bottom:* frontal view showing measurements in the central coronal plane, with electrodes at 20% intervals of distance between the left and right preauricular points. (Reproduced from EEG Clin Neurophysiol 10:372, 1958, with permission of Elsevier Science.)

Be Careful of Bestowed Grants

"You're the large grant that's been bestowed on us?"

Montages

- REFERENTIAL (monopolar) ... LINKED EARS

- BIPOLAR with Homologuous Pairs ... LINKED EARS

- BIPOLAR e.g. LONGITUDINAL
  ("DOUBLE BANANA")

- SOURCE DERIVATION (computed) e.g. LAPLACIAN
  (AVERAGE, Cz reference)

Montage Issues

1) Active Reference (linked ears) – projected activity, poor localiziation especially in the temporals
2) Bipolar Montages – sources appear flat, common signal
3) Laplacian – weighting, extent of surround, perimeter effects
4) Special electrodes - invasive, e.g. nasopharyngeal, sphenoidal, also true anterior temporal (T1, T2)

STRATEGY – Use montages Appropriate for training situation

Eye Movement Artifacts

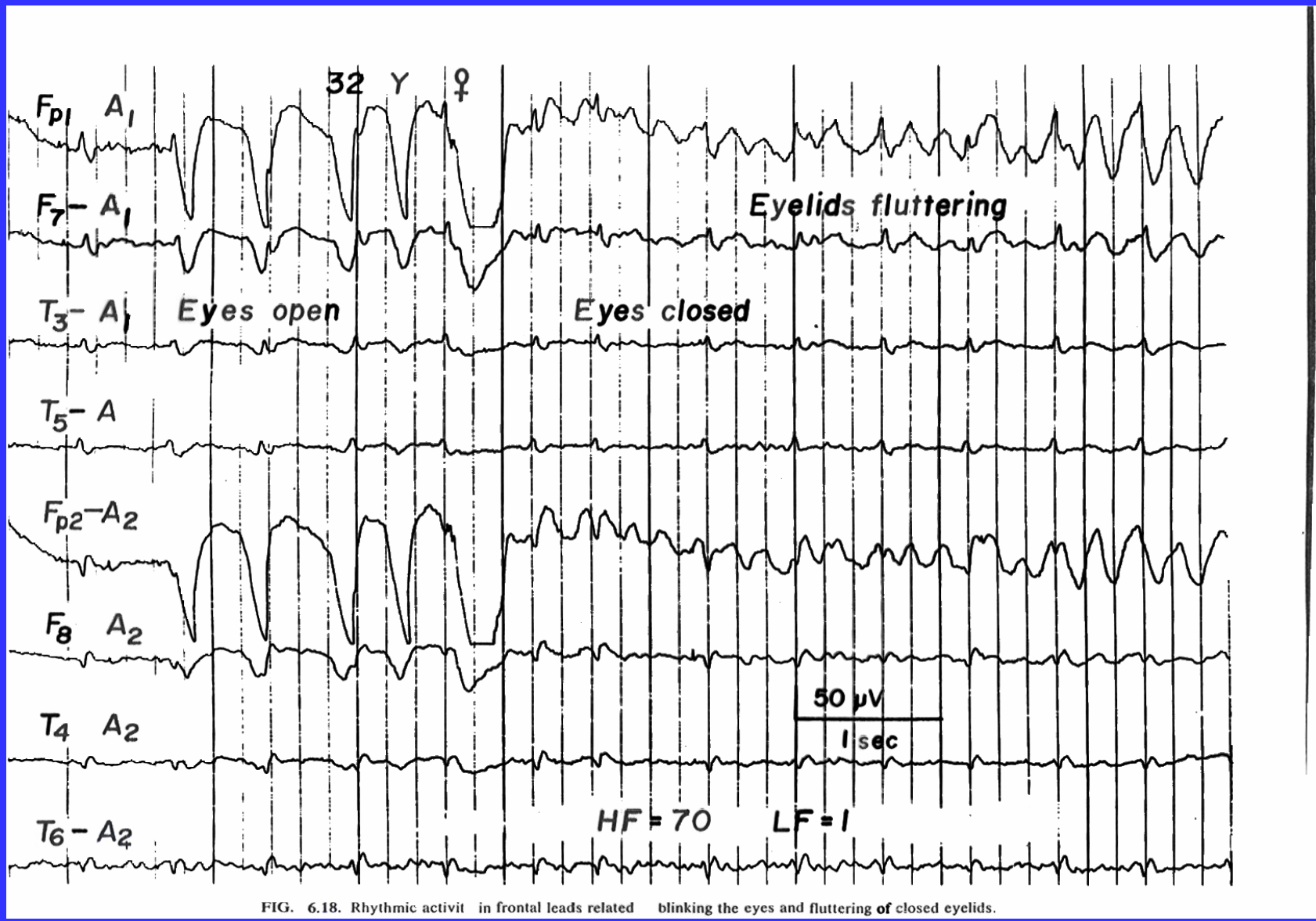


FIG. 6.18. Rhythmic activit in frontal leads related blinking the eyes and fluttering of closed eyelids.

EKG Artifact

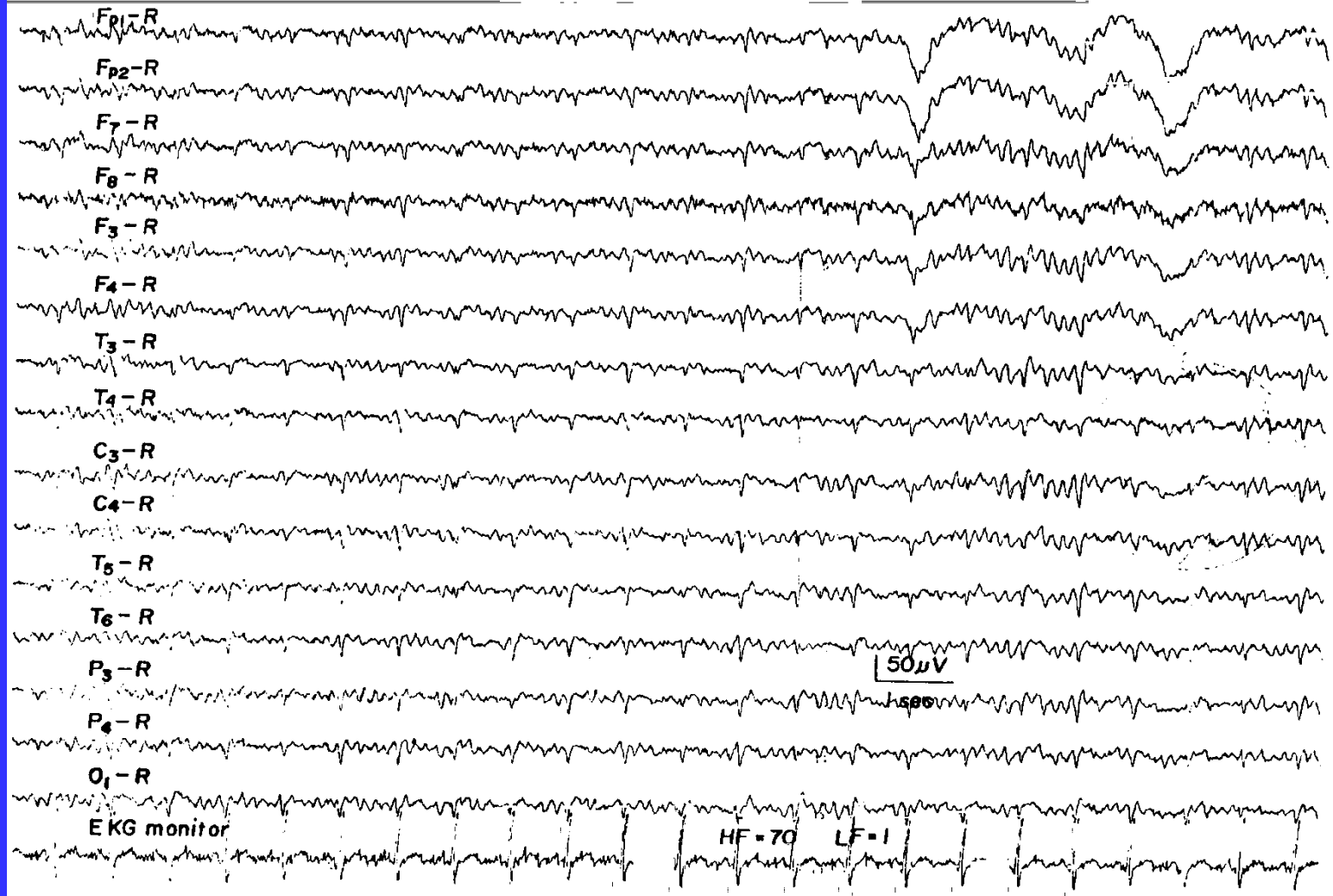


FIG. 16.6. EKG artifact. Referential recording using noncephalic (neck–chest) reference.

EMG Artifact

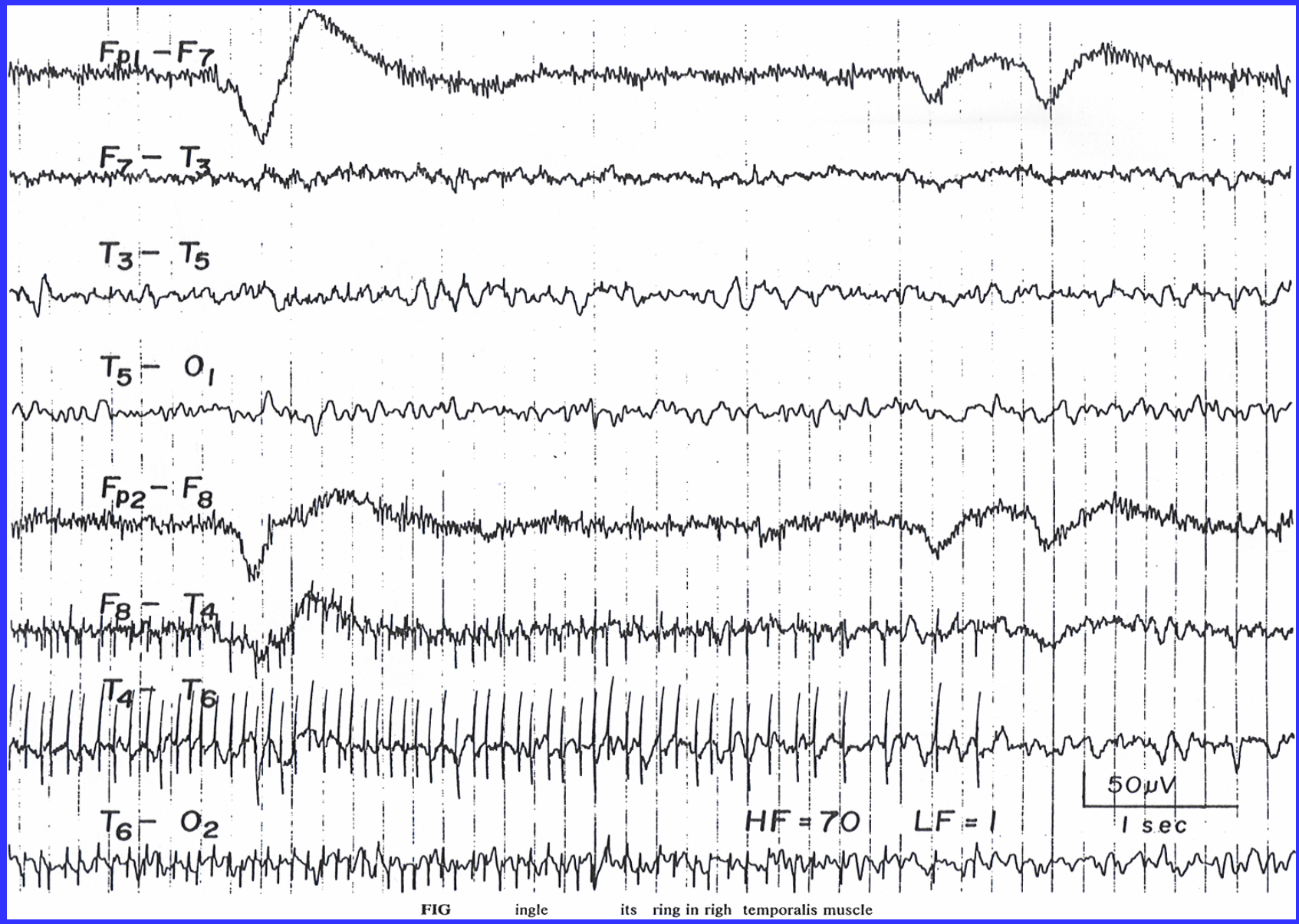
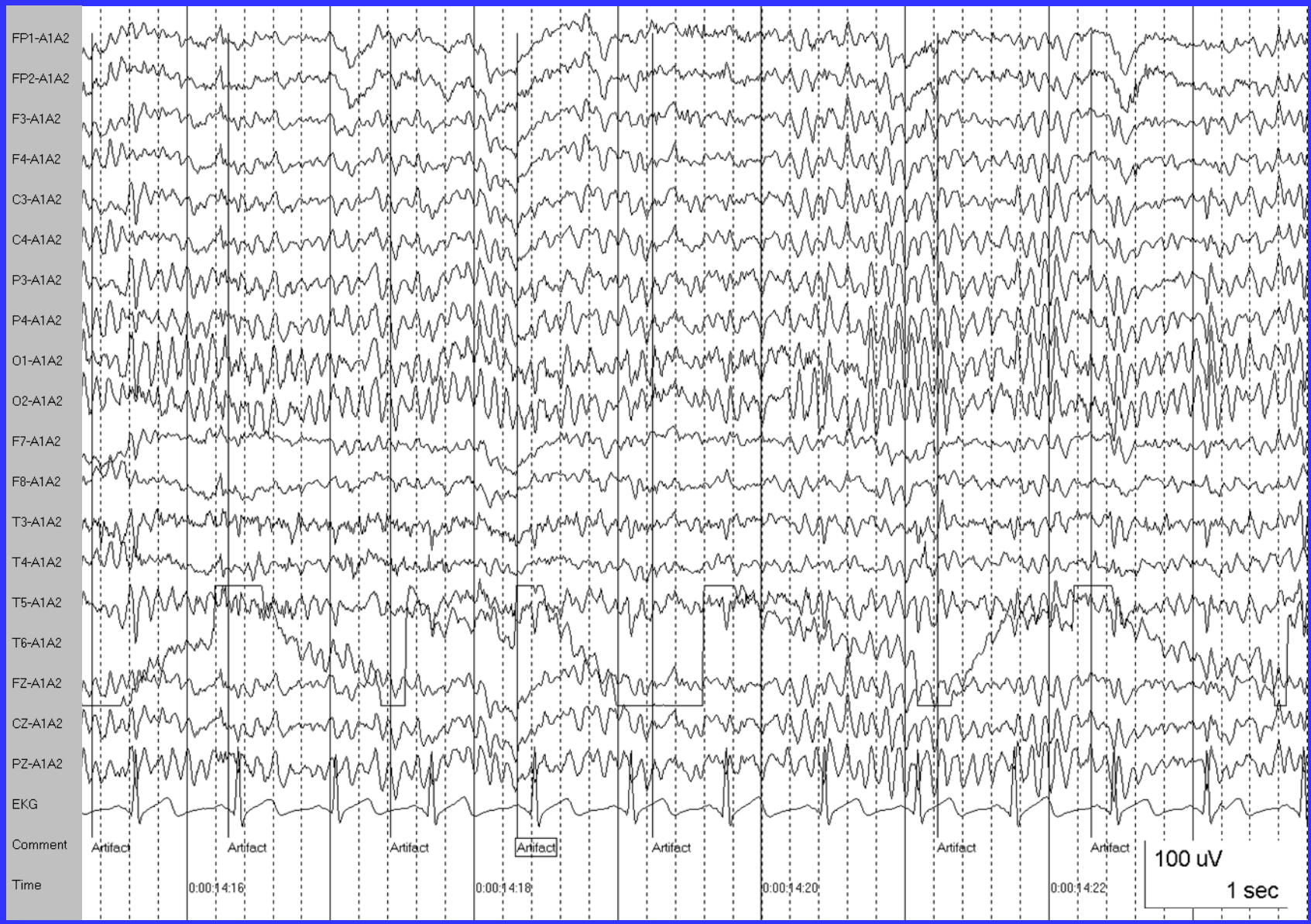


FIG ingle its ring in righ temporalis muscle

Electrode Artifact at T6



60 Hz Artifact

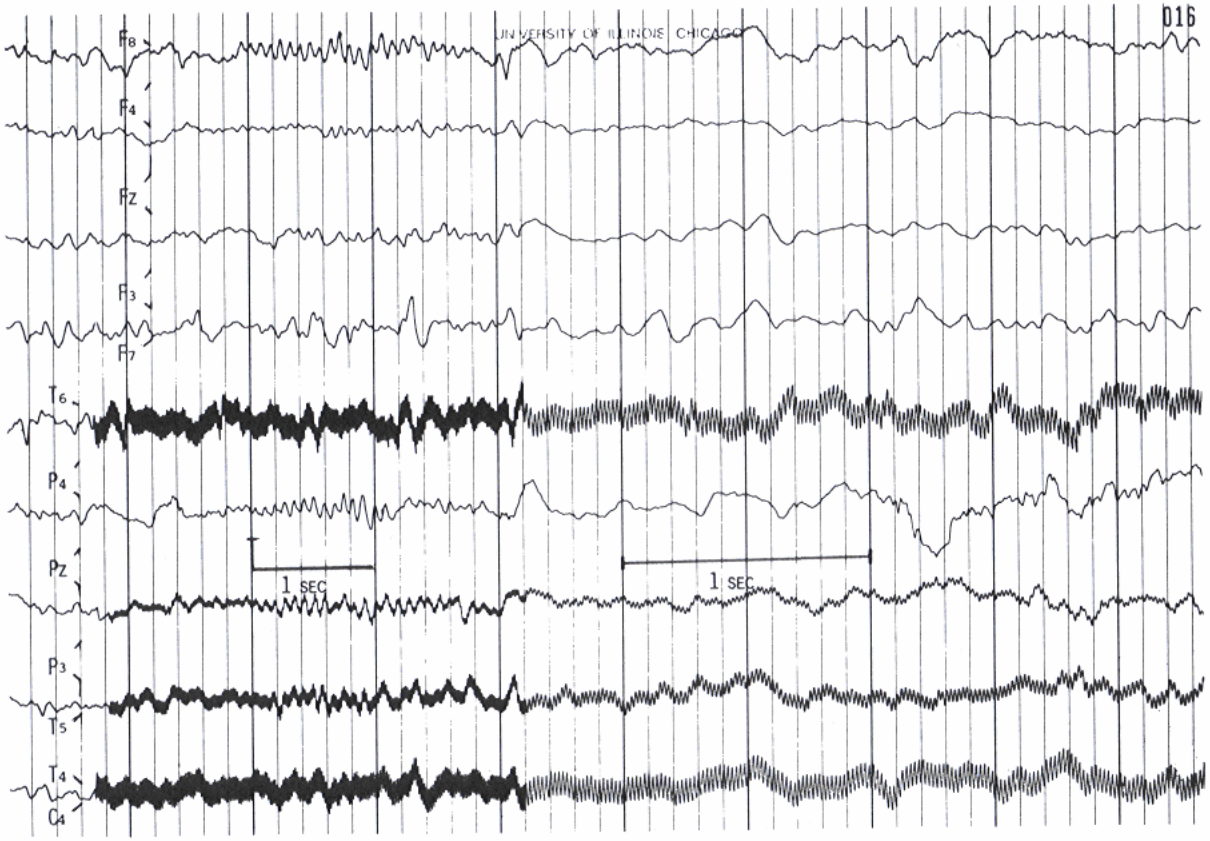


FIGURE 4.2 Sixty-cycle artifact. On the left the paper speed is the usual at 30 mm/sec, so the 60 cycle is so compact that it appears as a black line, but at the speed of 60mm/sec (on the right), each deflection can be counted and determined as 60 cycle artifact.

Drowsiness – Alpha attenuation, increased slow activity

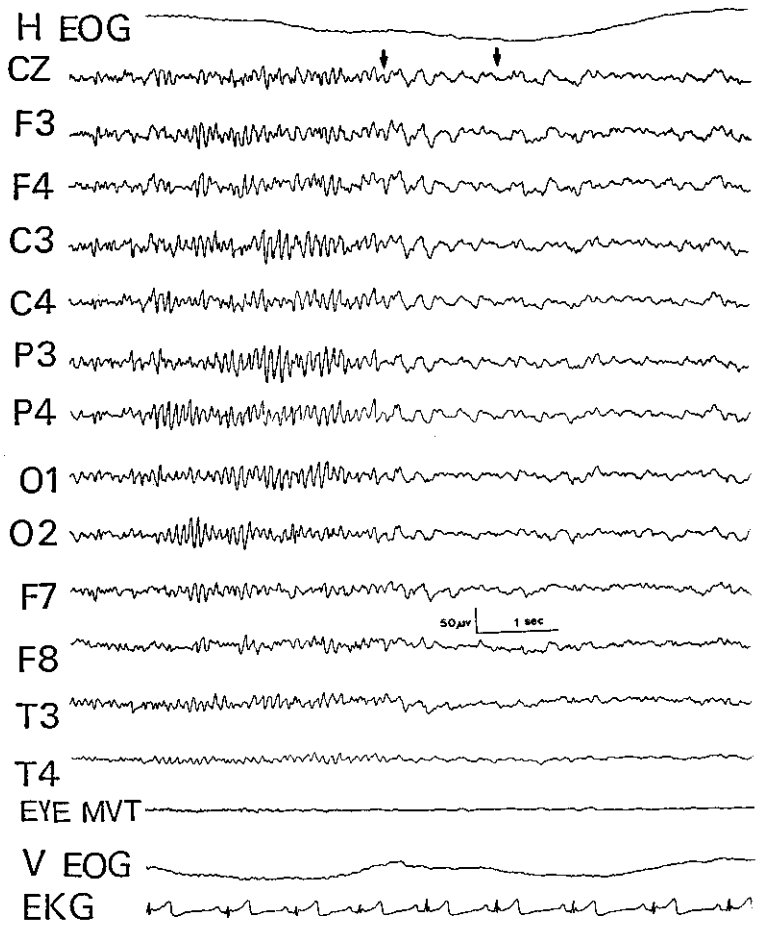
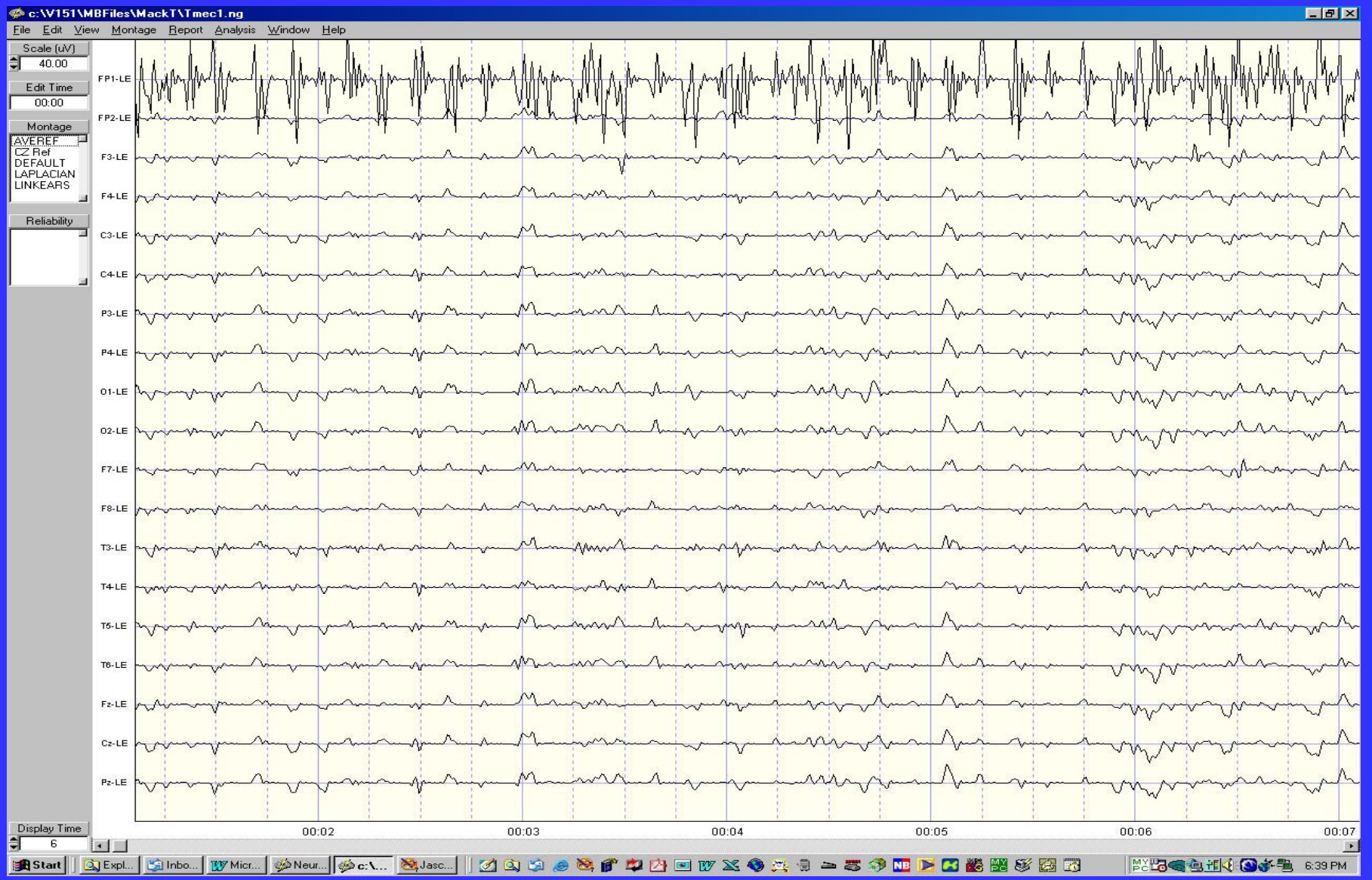


FIG. 71. *Generalized 3–5-Hz slowing (B.2).* A burst of generalized, 3–5-Hz frontocentral predominant slow activity occurs (between arrows) at alpha disappearance (first arrow) and leads into typical DR slowing. The frequency of this 3–5-Hz activity is a near harmonic of the alpha preceding it.

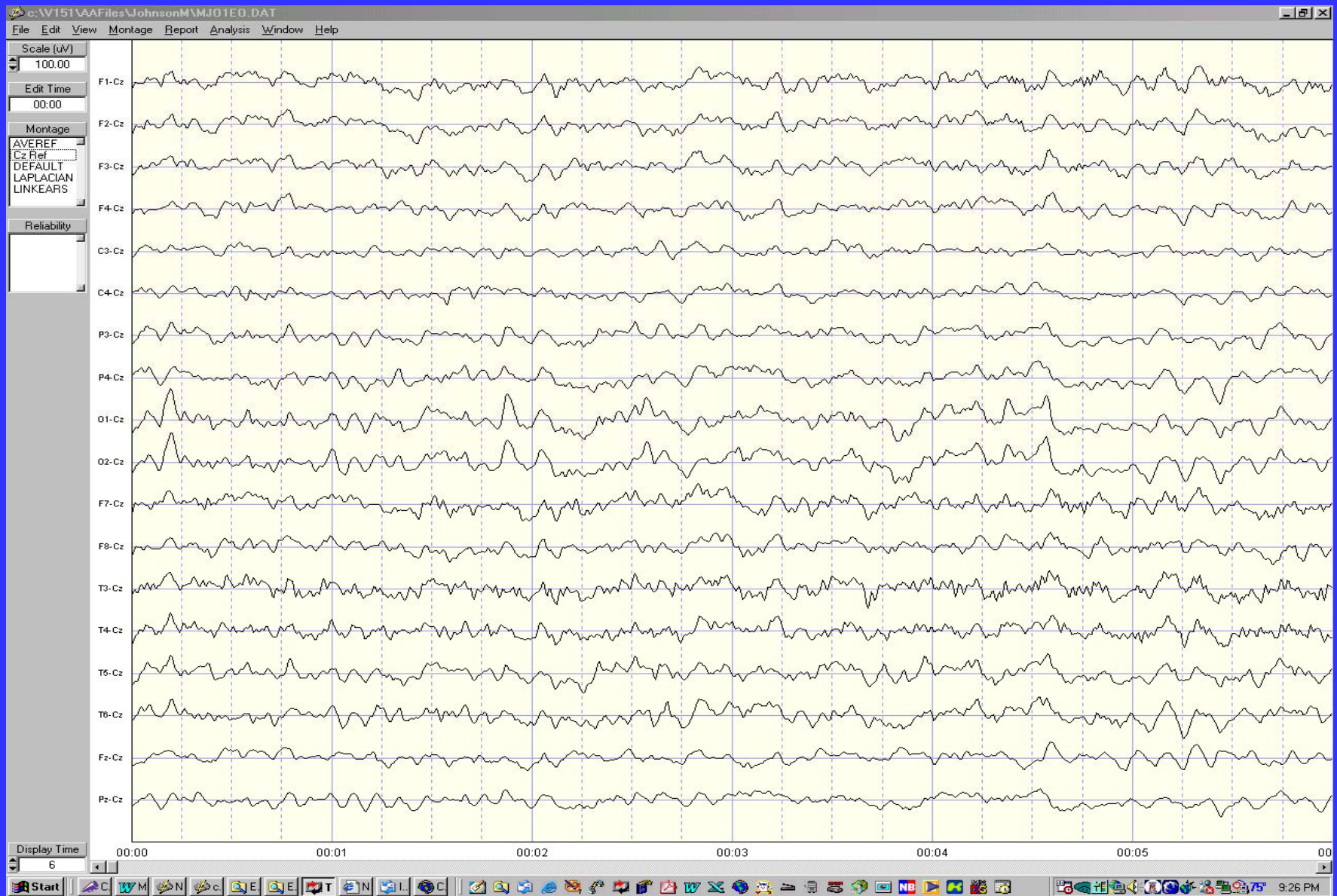
Interesting Situation

- "Acocdrnig to an elgnsih unviesitry sutdy the oredr of letetrs in a word dosen't mttaer, the olny thnig thta's iopmrantt is that the frsit and lsat ltteer of eevry word is in the crrecot ptoision. The rset can be jmbueld and one is stlil able to raed the txet wiohtut dclftfuiiy."

IS THIS PERSON REALLY ILL?



DELTA (for Barry Sterman)



Drowsiness – Generalized Sharp Burst Blocked by Arousal

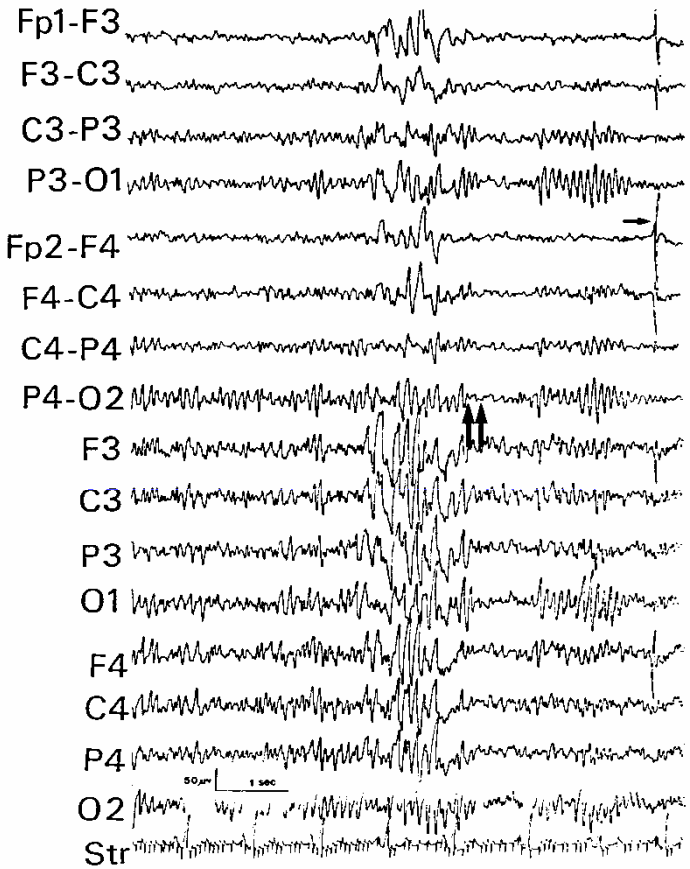


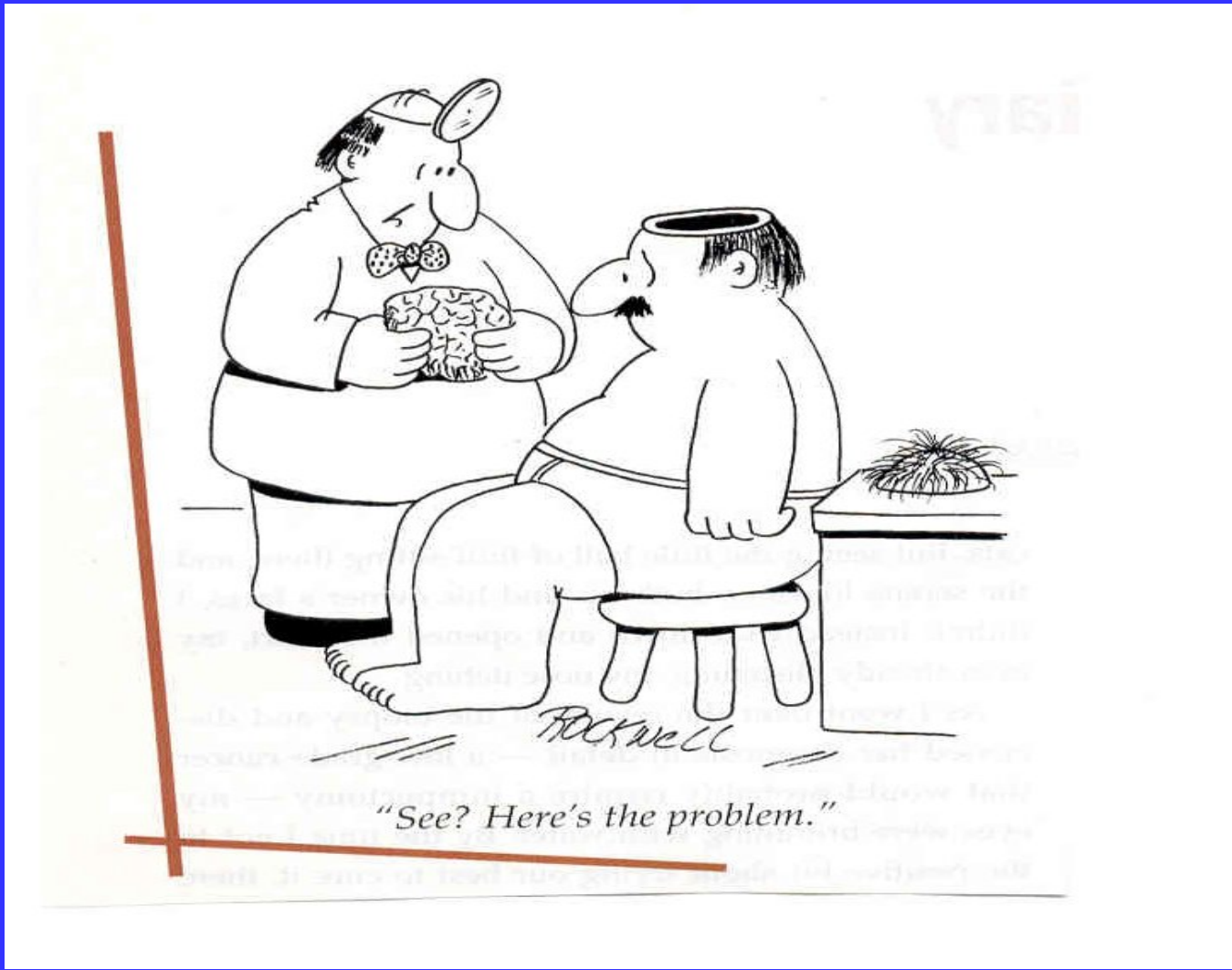
FIG. 47. *Generalized sharp burst blocked by arousal (A.4.a).* The same subject as in Figs. 45 and 46 shows another burst of this activity (same montage as in Fig. 46) blocked when the subject is asked to open his eyes (double arrows). The alpha reappears within 1 sec (with alerting), remains for about 1.5 sec, and then blocks when the eyes are opened (the horizontal small arrow points to the eye-opening artifact). Str is combined strobe flash marker and EKG channel.

TYPICAL EEG RECORDING CONDITIONS

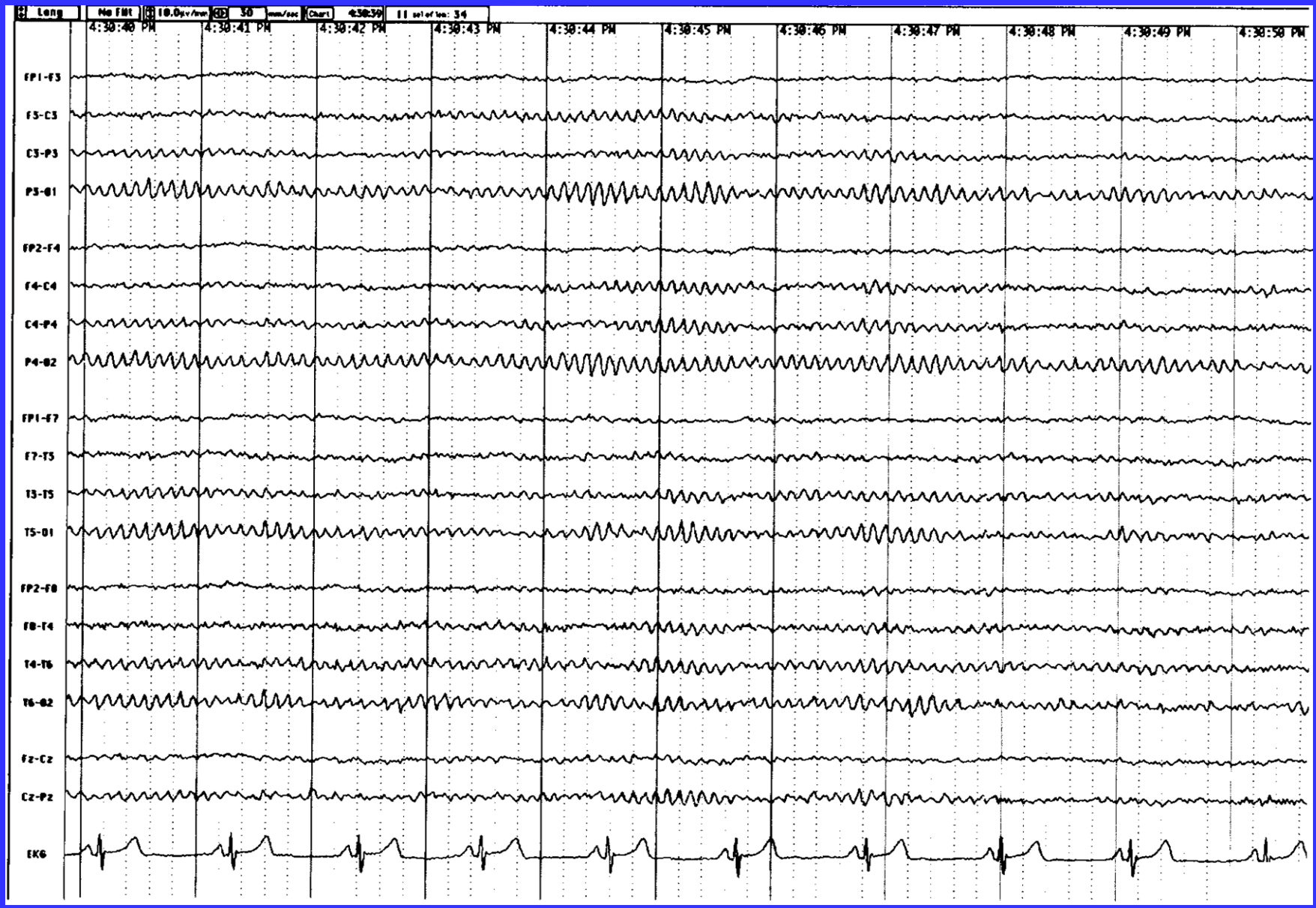
- Eyes closed resting
- Eye opening and closing
- Nearby noise
- Air handling problems: electrodes dry out or the opposite, sweat artifact
- Drowsiness and startle response

THE EEG GALLERY

Some times, We wish that….



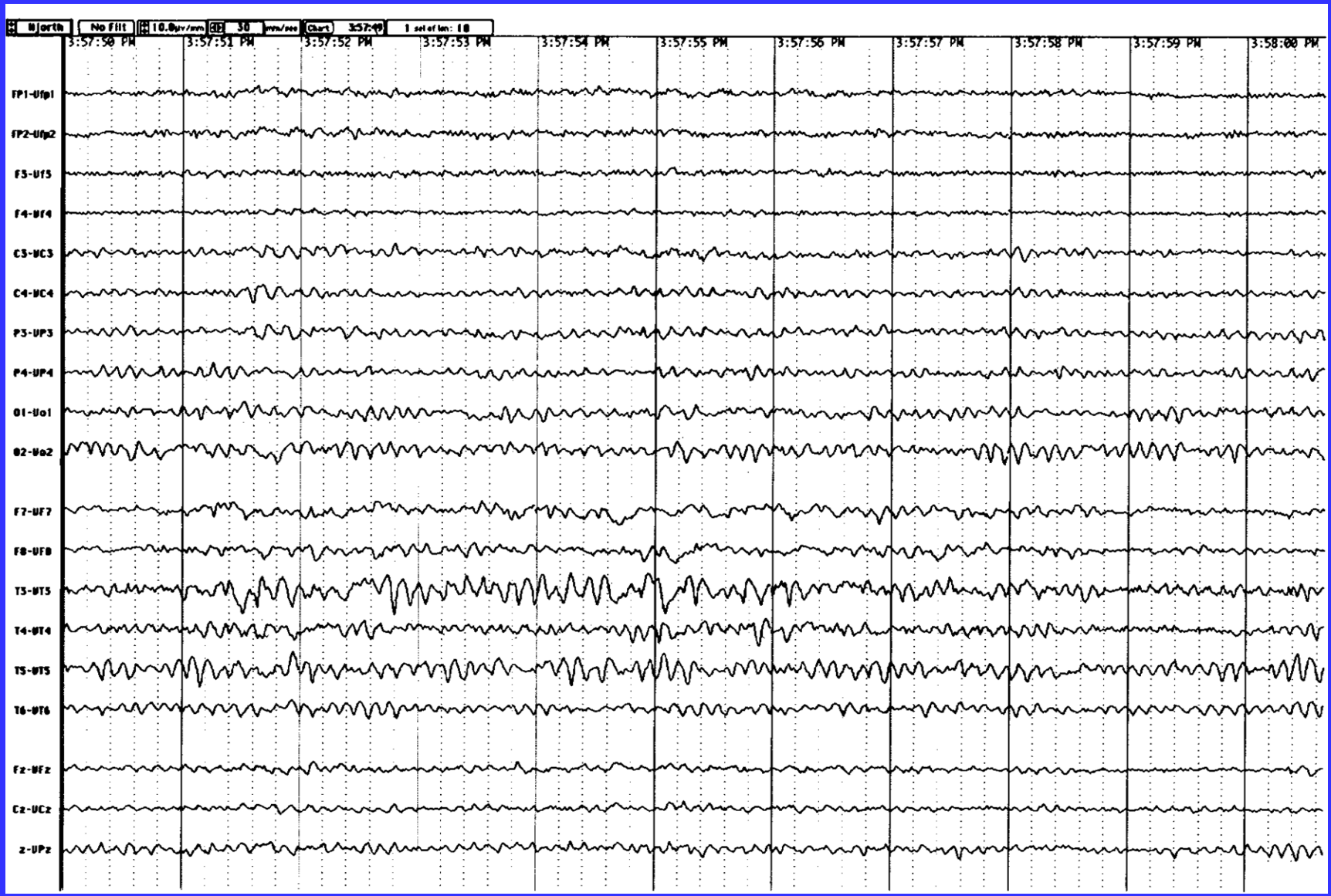
Normal Adult Female EC



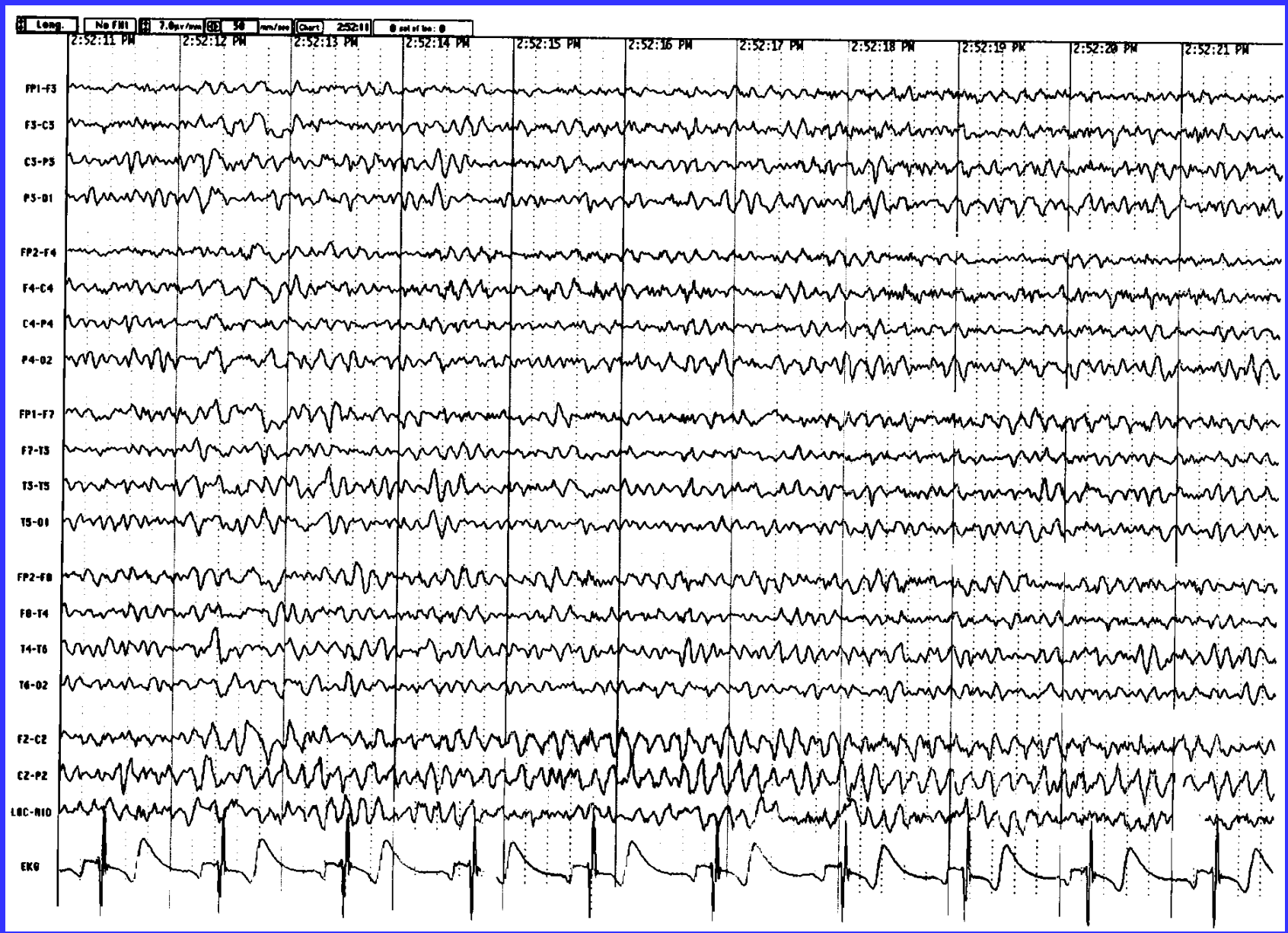
Post Concussion Syndrome (EO)

Closed Head Injury – Beaten in altercation with police

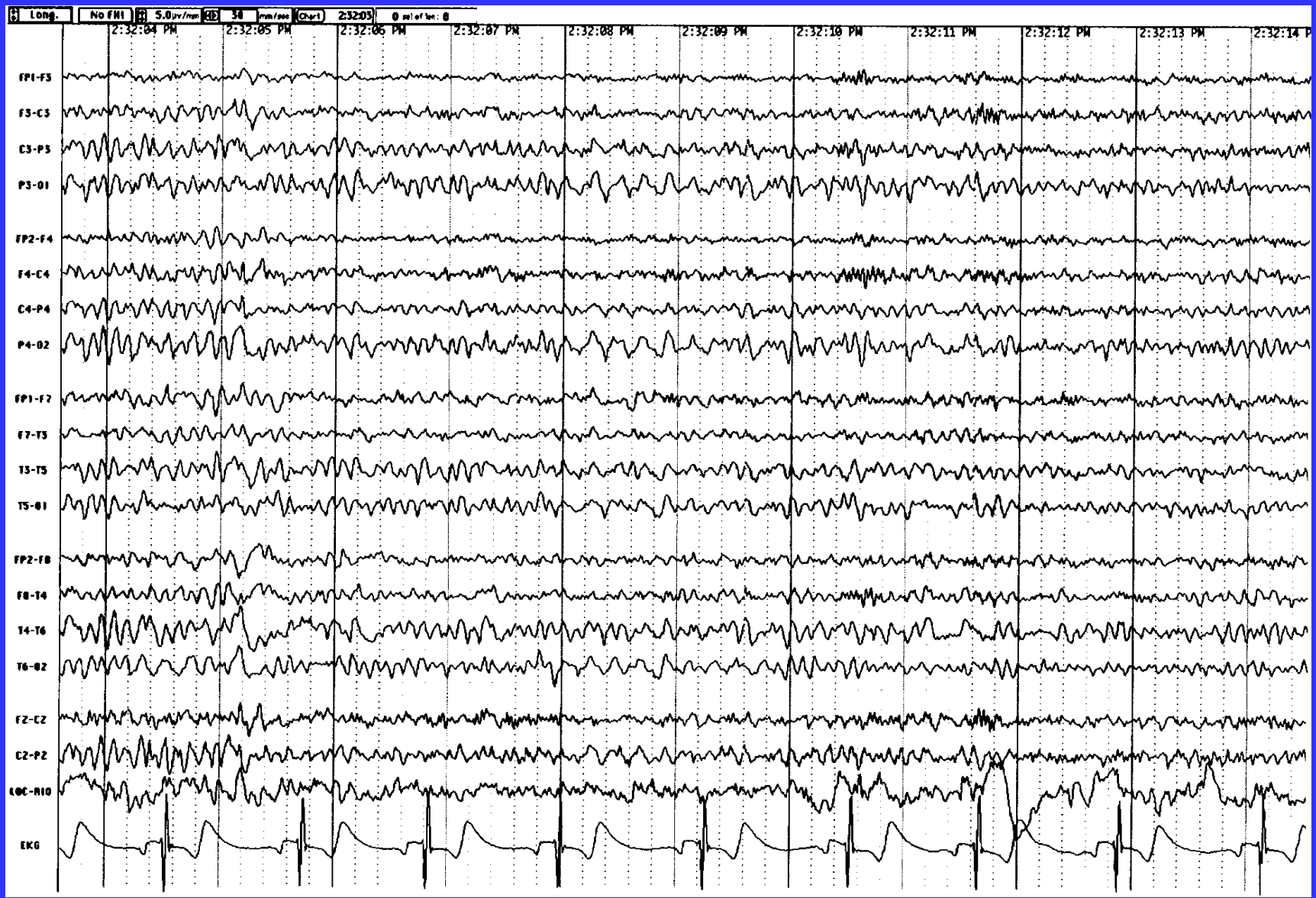
Psychiatric Inpatient with Fluent Aphasia



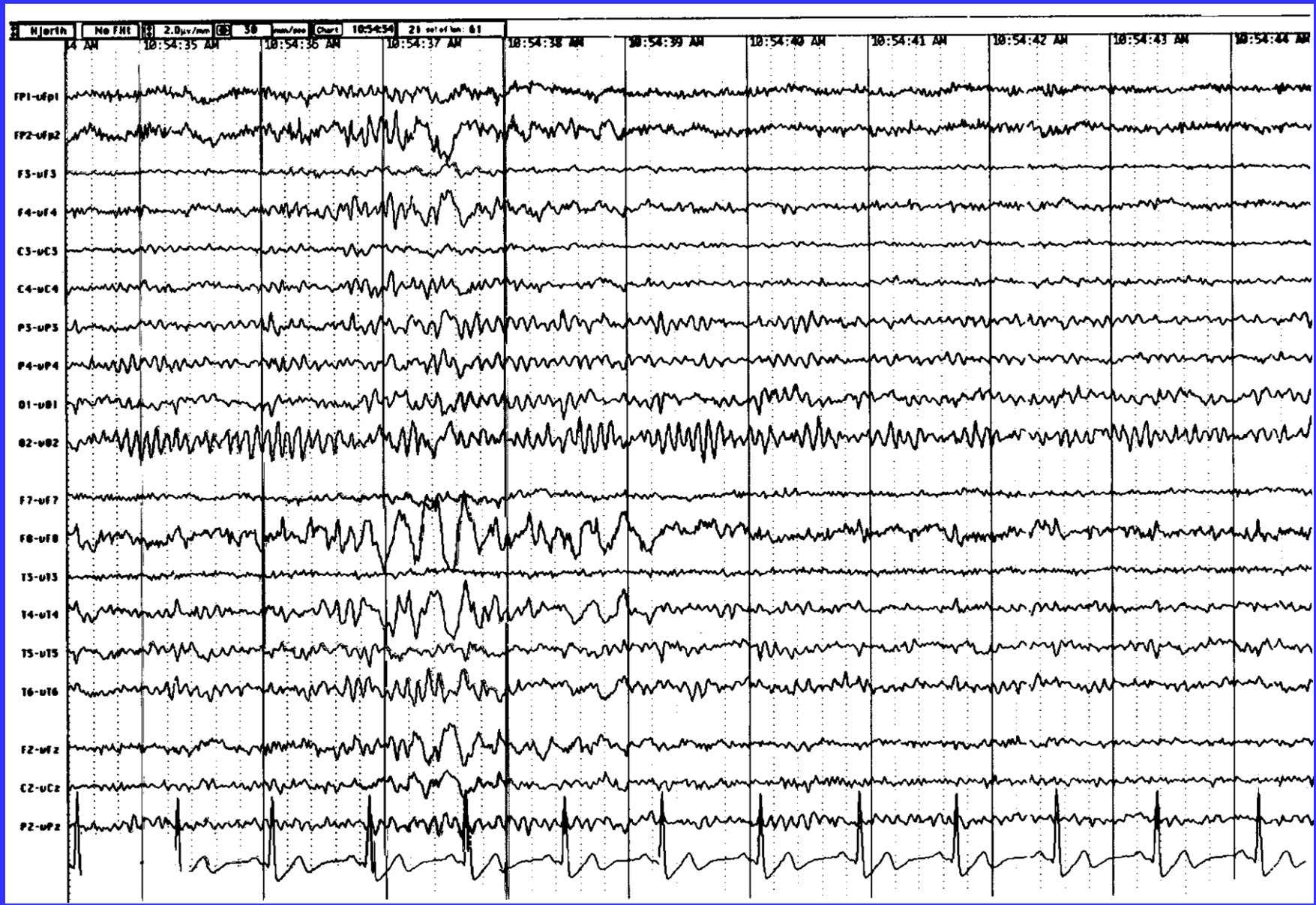
Championship Boxer EC



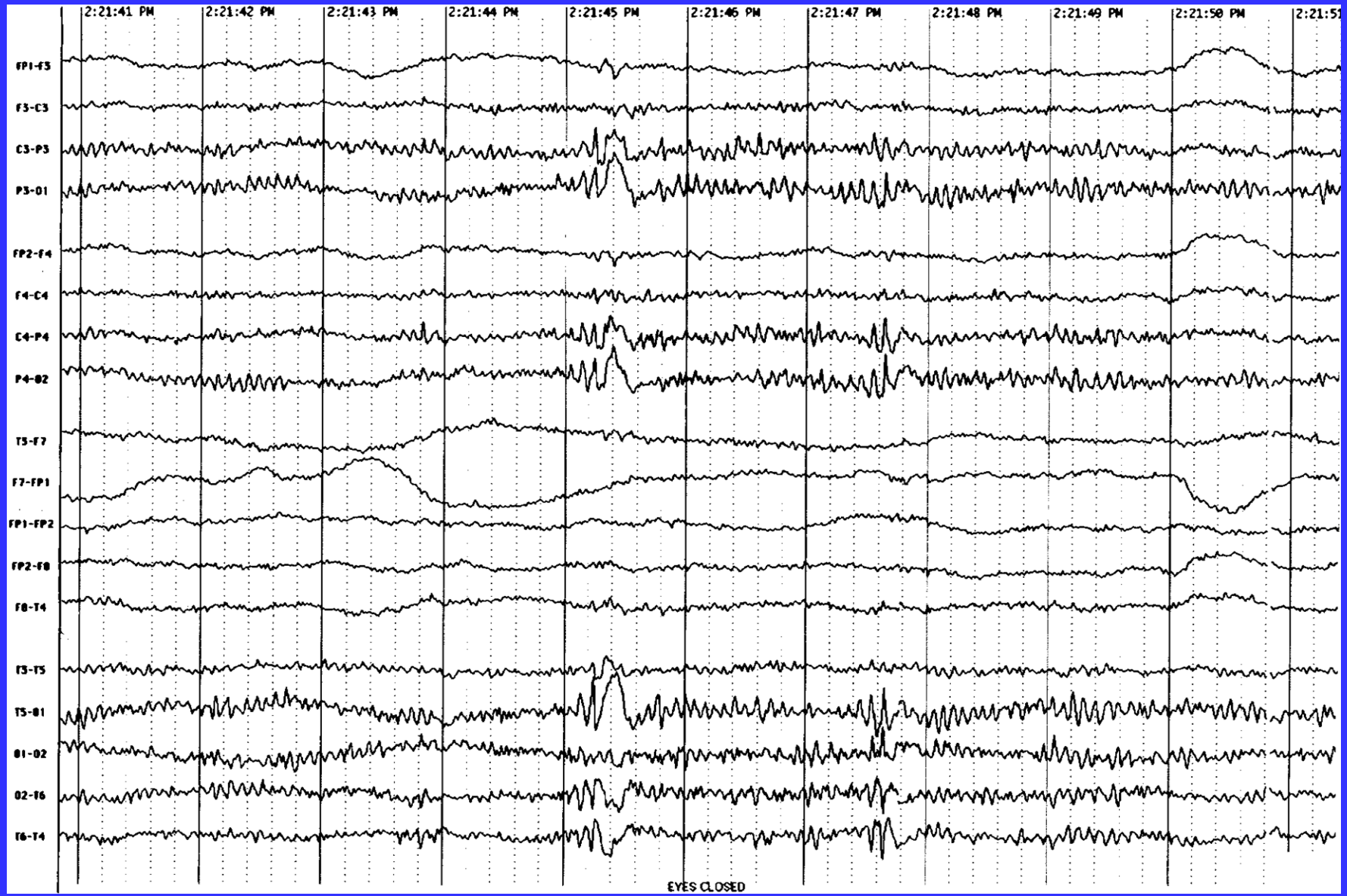
Championship Boxer EO



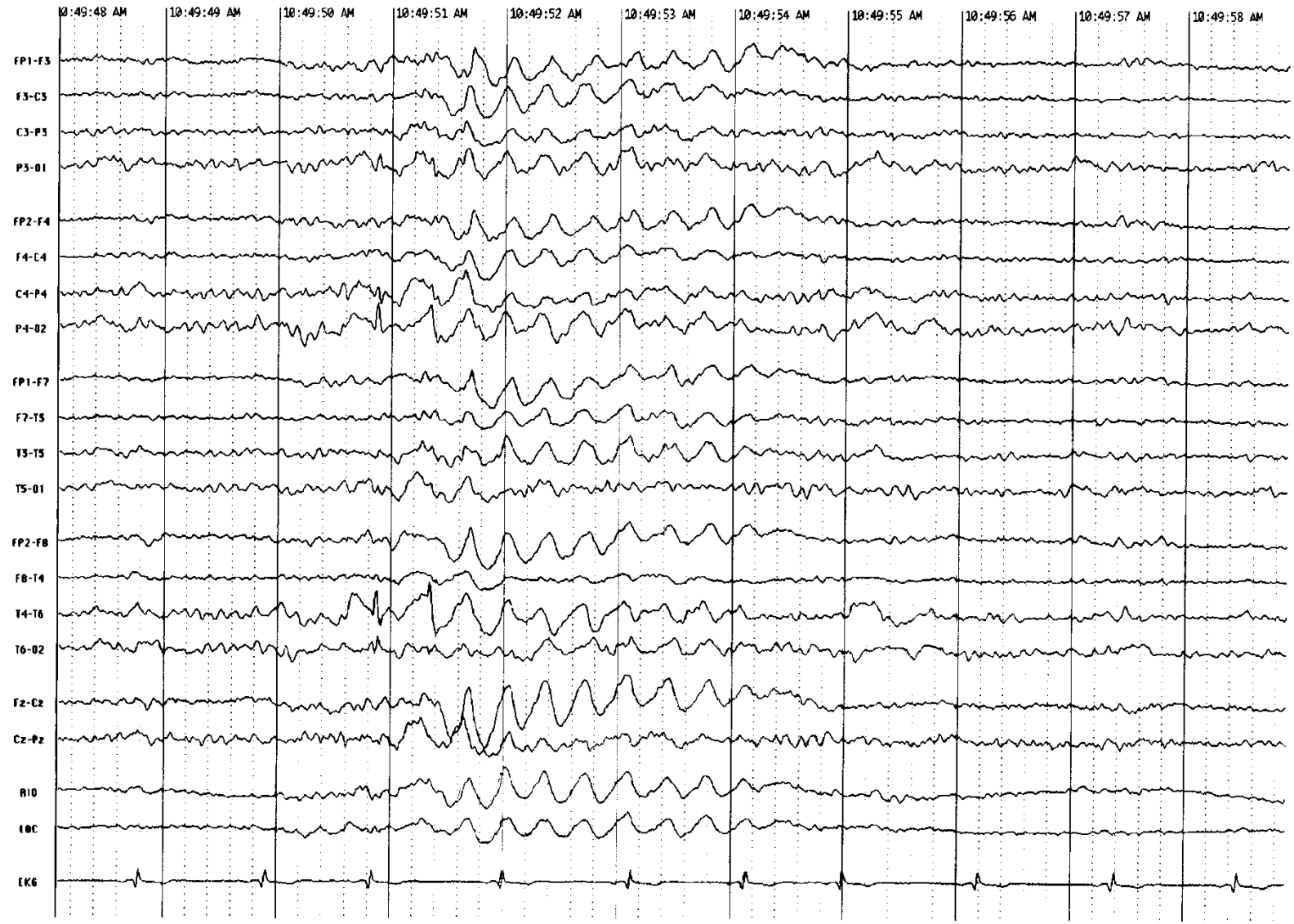
Left hemispherectomy with right sided paroxysmal slow activity



Occipital Spike and Wave – Adult female



Right Posterior Spike and Wave - teenage female



Now

to

Dick
Tracy