## Benign Sharp Events in the EEG

Those that at first glance may appear to be "epileptiform"

## False Positive Findings in Bipolar Recordings

- Some writers implicate bipolar recordings as a cause of false positive findings
- In some instances inward phase reversals can become equivalent to abnormality, more specifically an epileptiform abnormality
- EEG reports in the "abnormal" section, "There was a phase reversal in..." without specifying the event

## Misinterpretation of phase reversals

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5 Fp2-F8		~~~
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# Are both the left and right examples abnormal???

### Apart from ± 7 <u>Named Patterns</u> in "Training Manuals" there are...

<u>"Nameless fluctuations"</u> which seem to be very underestimated

These benign fluctuations of sharply contoured background rhythms – essentially variations of <u>alpha</u>

Most common over-read EEG pattern resulting in erroneous diagnoses of epilepsy.

## What are these "nameless fluctuations"?

### Variants of Alpha:

- Unusually sharply contoured
- Extending into temporal derivations
- Fragmented by drowsiness
- Poorly regulated alpha
- Admixed with theta

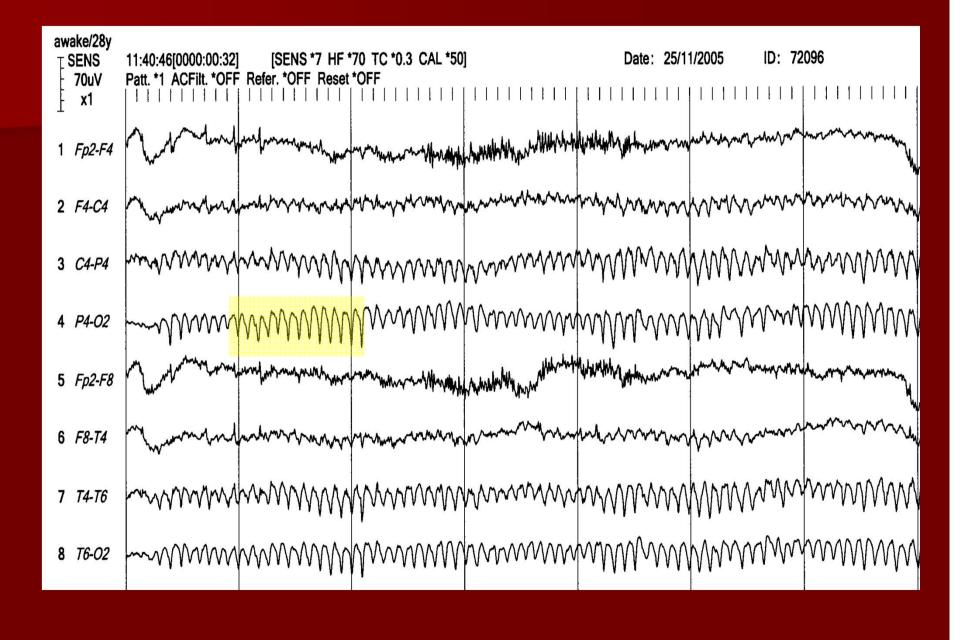
#### "Super" alpha is a rarity

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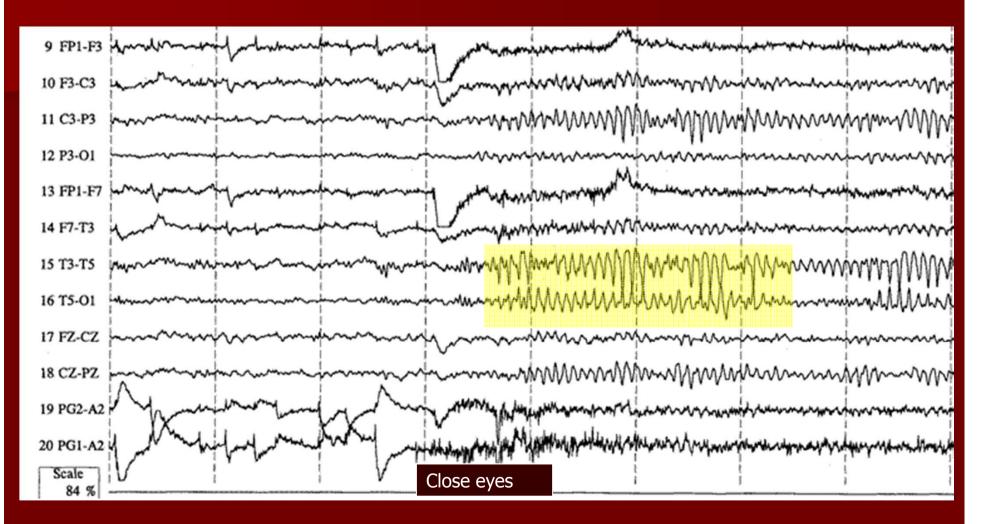
## Some neglected aspects of $\alpha$

- Most prominent in occipital area in 65% of adults
- In the other 35% voltage higher in parietal or posterior temporal regions.
- Mixing  $\alpha$  and  $\beta$  can make the  $\alpha$  appear sharp.
- In a extensively quoted study of "overread" EEG patterns the above accounted for 80% of errors

## Sharply profiled alpha



## Sharply profiled alpha and also maximal posterior temporally



## Fragmented alpha

awake/drowsy/47y	Page 1
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More awake

#### More drowsy

#### Poorly regulated compared to well-regulated alpha

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16 75-01	m	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	m	m	m	white	mon	manner	m	home	m	m	www	n	m	m	w	m	nn	S	~~~~~	~~~	$\sim$
17 Fz-Cz			m	m				m						~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	han		m	m		m			
18 Cz-Pz			man	m	man		wann		man	min	m	m	m	m	mm	m	mn	nn	w	m	m	money	~~~
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19 <i>PG2-A</i> .	menunty	11-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1	an marine	-	the manufactures and	-	we want	Imm m	inter and a start of the start	and the second	mon	m	mon	many	m	and steastly	mur anna	month	mon	www.ras	m	time	and some
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## Usual Culprits in False Positive EEGs – "Text" Books & Review Papers

- 1. Wicket waves/"spikes"
- 2. BSSS (benign sporadic sleep spikes)
- 3. RMTTD (rhythmic mid-temporal theta of drowsiness)
- 4. 14 & 6/s positive rhythm/"spikes"
- Usually maximal temporally

- Hypnagogic hypersynchrony (esp. / with spikes)
- 6. Hyperventilation-induced slowing
- 7. 6/s "phantom" spike and wave

Typically Widespread

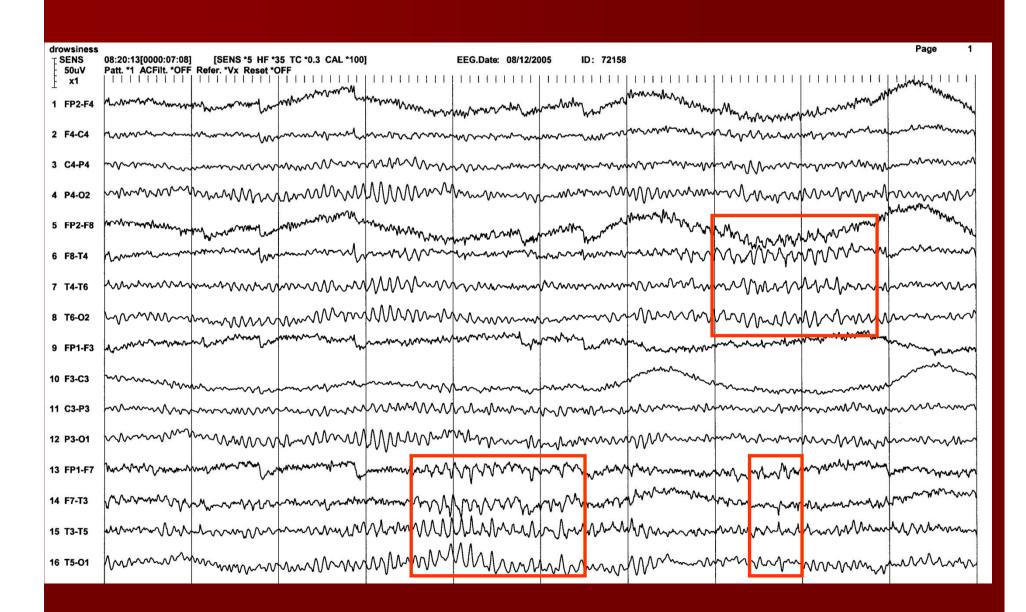
#### Wicket waves/rhythm 6-11 Hz, arch-shaped, medium-high voltage waves, maximal temporally, often alternating between right & left.

awake/drow	/sy/42y 14:41:02[0000:04:35] [SENS *10 HF *70 TC *0.3 CAL *50] Date: 2/3/2014 ID: 19696	Page 1
100uV x1	Patt. *1 ACFilt. *ON Refer. *OFF Reset *OFF Name	
1 <i>Fp2-F4</i>		
2 F4-C4	men man and the second se	
3 <i>C4-P4</i>		
	manness Mannes	
5 Fp2-F8	when a second when the second se	montematic
	where we want the second secon	
7 T4-T6	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	mmmmm
8 <i>T6-O2</i>	Man Marken Ma	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
9 <i>Fp1-F3</i>	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	
10 <i>F3-C3</i>	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	
	menter and the second s	
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16 <i>T5-01</i>	harmon har and har	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

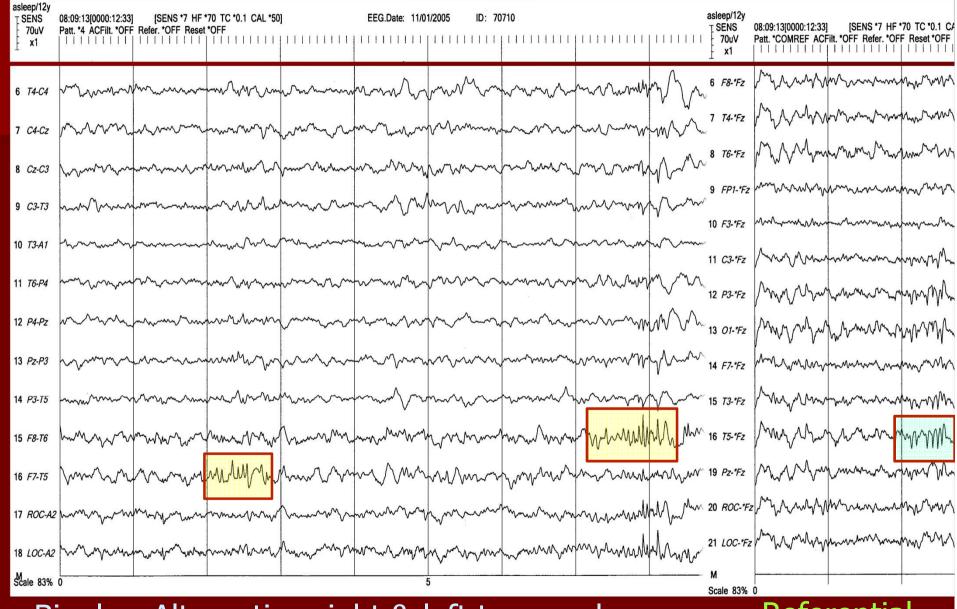
## What's the problem?

- Can be confused with epileptiform spikes or sharp waves.
- Johns Hopkins Neurophysiology re-analyzed EEGs from other units.
- 54% of wicket waves had been misinterpreted as "epileptiform" & contributed to misdiagnosis of epilepsy.
- What these patients really had: Syncope, nearsyncope, psychogenic non-epileptic seizures, hyperventilation syndrome, migraine etc.

#### Wicket waves left and right temporally



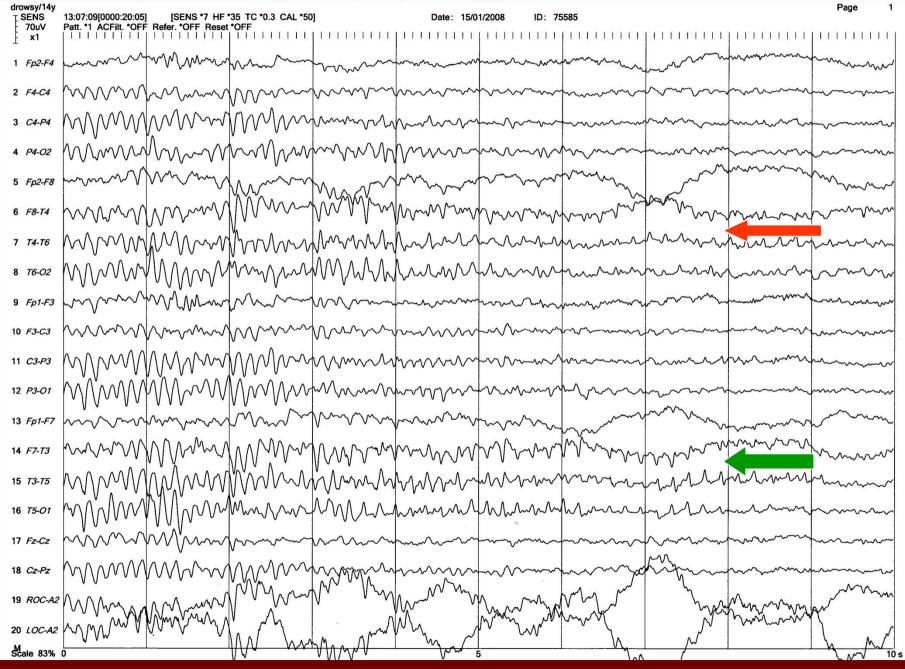
#### Another rare culprit: 14/s & 6/s positive bursts



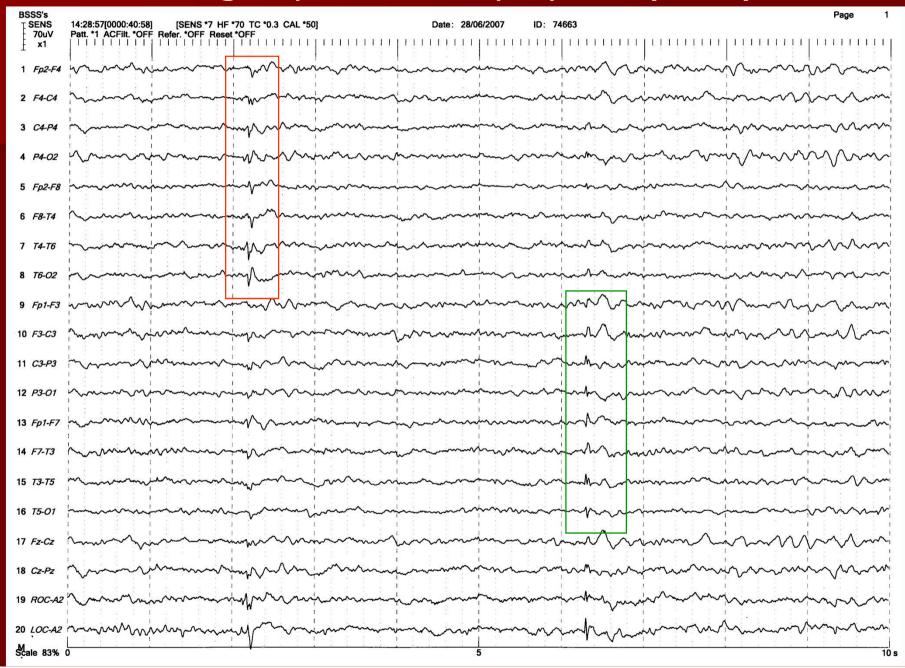
Bipolar: Alternating right & left temporal

Referential

#### **Rhythmic Mid-Temporal Theta of Drowsiness**



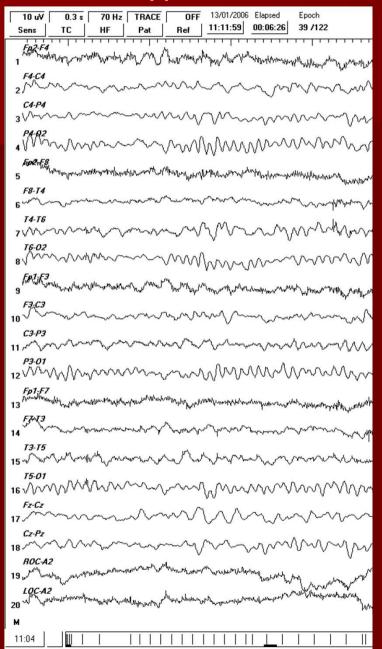
#### Benign Sporadic Sleep Spikes (BSSS)

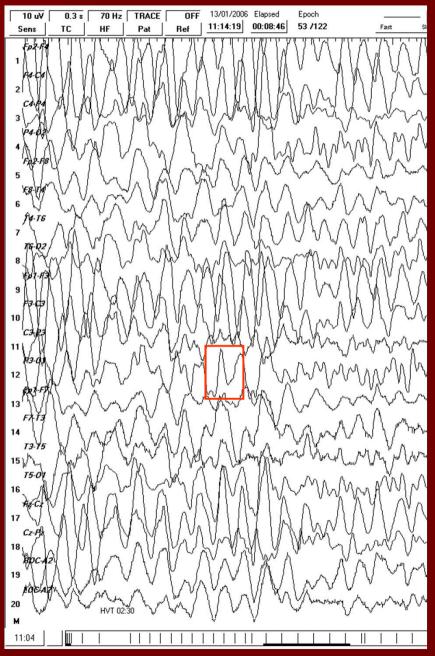


#### Hypnagogic hypersynchrony (with spikes)



#### Hyperventilation-induced slowing (adult)





#### 6 Hz spike and (theta) wave ("phantom" spike and wave)

awake/21y				Page 1
T SENS	10:39:06[0000:16:40] [SENS *7 HF *35 TC Patt *COMREF ACFilt *OFF Refer *OFF Rese	*0.1 CAL *50] L*OFF	Date: 01/12/2009 ID: 79289	
70uV x1	Patt. *COMREF ACFilt. *OFF Refer. *OFF Rese			
1 <i>Fp2-A2</i>	mmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmm	mmmmmmmmmm	montherman	mun man have to man man man and the second
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12 <i>P3-A1</i>	mmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmm	······	mmmmmmm	mon man and a second se
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21 <i>LOC-A2</i>		and the second s	EYES ARE CLOSED	month and and the second second
Scale 83%	0		5	10

## The MAULSBY Guidelines for Assessing Spikes (1971)

**5.** Ignore spikes which can be explained by simple alterations in the voltage of existing background rhythms or by superimposition of fast, usually beta, activity.