

The lateralising significance of hypergraphia in temporal lobe epilepsy

JKA ROBERTS, MM ROBERTSON, MR TRIMBLE

From the Department of Psychological Medicine, The National Hospital for Nervous Diseases, London

SUMMARY Six patients with hypergraphia and epilepsy are presented and their clinical features compared with other patients reported in the literature. It is suggested that hypergraphia occurs more frequently in patients with right-sided non-dominant temporal lobe lesions, in contrast for example to the schizophreniform presentation of left-sided lesions. Other features of psychopathology possibly associated with non-dominant lesions, including elation, hyperreligiosity and déjà vu experiences, are also discussed.

The study of inter-ictal behaviour in patients with temporal lobe epilepsy has improved our understanding of the different roles of the temporo-limbic structures in the dominant and non-dominant cerebral hemispheres of the brain. It has been suggested that an ictal focus in the dominant temporal lobe is associated with aggressive behaviour¹⁻³ and schizophrenia-like psychoses,³⁻¹⁰ although in the latter case only small samples have been used and others have failed to confirm such a relationship.¹¹

In the case of the non-dominant temporal lobe ictal foci have been associated with an inter-ictal affective disturbance, namely an intensification of emotions,¹² elation and depression,⁵⁻⁷ although others have failed to confirm this. That the non-dominant cerebral hemisphere may have a particular role in mediating emotional behaviour is suggested by work with non-epileptic patients. Studying patients with damage to this side of the brain Gainotti^{13,14} has shown their tendency to disinhibition, indifference and joking. Terzian and Ceccotto¹⁵ and Terzian¹⁶ have shown that intra-carotid sodium amytal administered to the non-dominant cerebral hemisphere produces a "euphoric-maniacal" reaction. Dimond *et al*¹⁷ examined a patient after the trunk of his corpus callosum had been sectioned and found he was unable to communicate his emotional feelings through his speech, and suggested that his right hemisphere had become unable to express its normal

functions. In addition Dimond and Farrington¹⁸ made the observation that split-brain patients tend to give an impression of euphoric mood and show emotional responses to unpleasant visual material mainly if this material is directed to the non-dominant hemisphere. Finally, Lishman¹⁹ studying patients with focal brain damage has shown an association between affective disorders and damage to the non-dominant cerebral hemisphere.

In contrast a few studies have shown an association between certain types of affective disturbances and disorders, and the dominant cerebral hemisphere. Terzian and Ceccotto¹⁵ and Terzian¹⁶ found a "depressive-catastrophic" reaction using left-sided intra-carotid sodium amytal, and Mnoukhine and Dinabourg²⁰ found a tendency to blunting of affect in children with damage to the dominant cerebral hemisphere.

In this paper it is our intention to present briefly the case histories of six patients with temporal lobe epilepsy and inter-ictal hypergraphia—the tendency towards extensive and in some cases compulsive writing—a condition first described by Waxman and Geschwind.^{21,22} We will then consider these patients in the light of Waxman and Geschwind's nine cases and demonstrate an association between this behaviour and an ictal focus in the non-dominant cerebral hemisphere. All these patients were seen in the Psychiatric Department at the National Hospital.

Case 1 Mr JK, a 30-year-old man, developed temporal lobe epilepsy after an attack of measles encephalitis at the age of 11 months. His attacks were preceded by an aura of déjà vu, a strange sensation all over his body and an unusual taste in his mouth. This was sometimes followed

Address for reprint requests: Dr M Trimble, The National Hospital, Queen Square, London WC1N 3BG, UK.

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by tonic-clonic convulsions. During his childhood his attacks were of variable frequency ranging from several a day to one every three months, and he was started on phenobarbitone, later being changed to phenytoin and primidone. At the age of 26 years a standard EEG was carried out which showed frequent spikes in the right temporal region with no other abnormality. His attacks remained erratic and at the age of 29 he was changed from phenytoin to carbamazepine and an EEG at this time showed sharp waves over the anterior and mid-temporal regions on the right, with generalised slowing. His fit frequency now became reduced and he began to express bizarre ideas. He felt there was a transmitter in the house next door that was interfering with his TV and radio. He complained of voices coming out of his radio and he experienced an electrical charge going through his bed at night. These ideas continued for about a year and he became anxious and developed various somatic symptoms which led to his carbamazepine being changed to phenytoin. He became more preoccupied with his delusions and so was referred to the Psychiatric Department at the National Hospital. At this time he had been clear of any form of seizures for over two months.

There was no family history of any neuropsychiatric disorder. Premorbidly he was inclined to be suspicious of other people and unable to establish enduring relationships. He had never had any girlfriends or any sexual relationship and claimed little interest in sex. His previous

physical and mental health was normal and there was no history of drug or alcohol abuse. On his initial interview he brought with him copious notes, written in several diaries, in tiny and meticulously neat style. These described the minutiae of his day-to-day experiences including a careful note of the details and timing of his seizures (fig 1). He said that he had other such records at home but did not regard his writing as anything unusual and was unable to describe when it started. He behaved normally and his affect was out of keeping with the persecutory delusions he described. His mood seemed to be one of serenity and his speech was circumstantial with a tendency to pressure of speech at times. Cognitive examination was normal. On admission physical examination was normal and he was right-handed. A standard EEG showed clear evidence of a focal right temporal epileptic disturbance with a run of focal right temporal spikes and runs of theta activity with phase reversals in the right mid-temporal electrodes. A WAIS verbal IQ was 90 and a performance IQ 94, and his performance on memory tests was normal. Serum anti-convulsant levels were within normal limits.

Case 2 Mrs WM, a 61-year-old housewife, was admitted for assessment with a history of having several grand mal seizures in the previous month. Her parents were related, her maternal grandfather being the same person as her paternal great grandfather, and her maternal aunt had died in hospital and had been diagnosed as suffering from schizophrenia. The patient had an extensive psychiatric history with recurrent episodes of depression since the age of 22 years. These episodes usually responded to antidepressant treatment but two years prior to her referral she developed an agitated depression which did not respond to treatment. On examination at the National Hospital she was found to be over-active, disinhibited, and restless, and would frequently walk around the ward scantily clad. Her mood was one of elation. Pressure of speech was present and her conversation switched from subject to subject but there was no evidence of thought disorder. She was noted to write profusely, producing scores of unconnected jottings on any piece of paper that she could find. She said that she had always had a tendency to write a lot. On other occasions she would sit in a chair and rock rhythmically back and forth and expound feelings of self-recrimination about her worthlessness and the misery she had caused her husband. She expressed the delusion that her neighbours had had fits and been into the same psychiatric hospital as her, and that her epilepsy was the fault of her neighbours. During her over-active periods she was seen to pray repeatedly and loudly to God. There was no evidence of impairment of consciousness and physical examination showed a sub-total alopecia, a lipoma over her right scapula and a grade 2 ejection systolic murmur at the apex of her heart. She was right-handed. A standard EEG showed a low voltage record with a well marked semi-rhythmical evolution of slow activity with sharp wave elements in the anterior quadrants of both sides, clearly resulting from a right fronto-temporal focus. On psychological testing her WAIS verbal IQ was 94 and her performance IQ was 100. Verbal and visual recognition memory tests were

MARCH 1980

STARTED REDUCTION OF TABLETS.

25 Tuesday UP. 10.45 AM (APPROX)

I DIDN'T WAKE UP EARLY AS I WANTED TO JANET STILL IN BED TO BE OFF.

SAID MILKMAN FOR SATURDAY. I WAS TO GO OUT TO GET EMPLOYMENT BUT I AM GETTING IN A MOOD THAT I DON'T CARE + WANT TO STAY IN HOUSE BUT SIT IN CHAIR IN LUNGEON + AM BORED AT DAY YESTERDAY'S DECISION WITH IT SEEMS + THERE WAS NO WAY TO IT THEN I WAS REFUSED + DECISION WAS MADE SINCE I WAS INTERVIEWED + I AM SURE OF THE WAY CERTAIN THINGS WERE KEPT FROM ME + I WANTED LIKE A CALIFORNIA NOT GIVEN TRUE FACTS.

JANET WENT TO MEET LINDA WHO CAME ON HER OWN + FINISHED BRUSH STRIKE AT STATION.

I HAVE STARTED TO MISS OUT AFTERNOON TABLETS WHICH I AM CUTTING OUT AT OWN RISK FOR REASONS + AM UNABLE TO SAY + POSSIBLE CUTTING OUT OF ALL OF THEM IF POSSIBLE + WILL HAVE TO INFORM DR. + PLAN THINGS IN DUE COURSE.

CLIFF CAME TO SEE ME ABOUT 5 PM + HE SAID HOW JOBS WENT + TOLD HIM SHE TURNED ME DOWN + HE SAID LINDA WANTED TO ASK ME IT WOULD BE TO USE SERVICE + HE SAID LINDA WENT TO ASK ME AS IS STILL SLOW + THERE IT SEEM + HE SAID LINDA WENT TO ASK ME AS IF PINK PLAND (BANK IN SMALL) + ASKED TO KEEP ME UP TO DATE WITH THINGS + HIS WIFE'S PREGNANCY.

26 Wednesday UP. 9.04 AM (APPROX)

I TURN

I GOT UP EARLY AS GAS COMPANY COMING TO SET METER + HE SAID THIS MORNIG + I CALLED ON OUT + THEY CAME ABOUT 4.10 AM + I WAS WATCHING BUBBLE ON T.V + THEY TO ORDER NEW ONE.

I PHONED DR COURT TO ASK IF MEDICAL OFFICER COME TO ME ABOUT THE UP HAS CHARACTER + SAID HE DID + IT WAS SAFETY + CHILDREN COULD NOT BE BY FEET TO SUCH EXTENT AS I WAS WATCHING SUCH RISK BUT WOULD AVOID SUCH THINGS IF JOB FOR ME WITHOUT ANY PROBLEMS + GIVE ME A LETTER OF RECOMMENDATION + PEOPLE FEELS ON YOU + WORKING WITH ROAD OF DR SAID NOT TO GIVE UP WORK + HAVE A SHIRT JOB FOR ME TO DO IN CARPET WORK + WILL INFORM ME.

I HAD TURN IN LUNGEON AGAIN + I AM IN THE DON'T CARE MOOD + I AM GETTING THIS JOB IS HAVING AN EFFECT ON ME DEEPER + AM NOT LETTING MYSELF LOOSE INTEREST + I DON'T HAVE MUCH CHANCE OF WORK + WILL NEED TO PAY MY WAY STILL.

Fig 1 An example of the writing of Case 1. Enlarged from a diary 7.5 × 5 cm and written in pencil, it demonstrates the obsessional features of uniformity, neatness and attention to detail.

normal. She performed patchily on tests sensitive to frontal lobe impairment. All other investigations, including a CT head scan and an ECG were normal. Her behaviour remained disturbed throughout her admission and during this period she complained of a loss of sexual interest.

Case 3 Mr VG, a 36-year-old import-export salesman, began to have seizures at the age of 21 years, whilst in the Army. He experienced an aura of déjà vu followed by a feeling of something rising in his chest, and then was reported to look glazed and make repetitive sounds. Generalised tonic-clonic convulsions sometimes followed. At this time an EEG was reported to show a temporoparietal focus but the laterality of the focus was not stated. Bilateral carotid angiograms were normal on two occasions. He was started on phenobarbitone and his seizures continued at the rate of four per month. At the age of 32 he was reassessed and an EEG showed sharp and slow waves, following over breathing, in the right fronto-temporal area. At the age of 34 his seizures changed

DIEU EXISTE
 GOD EXISTS
 GOTT LEBEN LIGST

 2.15 A.M. MEXICO 21/9/1976
 WEDNESDAY 21/9/1976
 MITTWOCH 21/9/1976

 J'AI DEVOUTE DIEU ET
 LE PARADIS ET CELA GRACE
 A LA CHAETIENNE ET BONTE DE
 MA CHERE FEMME ^{MARIE} ET DE SA
 CHERE FAMILLE TRES CHAETIENNE ET
 AUSSI DE MA TANTE HENRIETTE
 ET DE MON ONCLE GUY SANS

Fig 2 Sample of writing from Case 3 showing the religious preoccupation which characterised the writing of this patient. The ritualistic element is shown here by his writing "God exists" in three languages. His tendency to write religious statements in this manner was evident in his other writings.

with his period of post-ictal impairment of consciousness becoming prolonged for up to two hours during which he would talk in English or French asking who he was and where he was. Around this time he had a religious conversion experience, seeing a flash of light and feeling a great strength spreading over him. He had a feeling of someone talking to him, who he thought was God, and there was an accompanying feeling of elation but this was soon replaced by a feeling of depression and a belief that he was going to die. He heard a voice say that he was not going to die and that he should go out into the streets and proclaim the existence of God, which he did. He continued to have these experiences at monthly intervals and began to write prolifically about them (fig 2). He had a grandfather with epilepsy but there was no other family history of neuropsychiatric illness. His early development was normal except for an episode of meningitis as a child, from which there was no apparent sequelae. He had never been a religious person until his current experiences and he did not drink alcohol or abuse drugs. His libido had been decreasing over the previous two years and he was now almost totally impotent. He was admitted for investigation of these experiences and on examination was found to be sad and complaining of general loss of interest. He found it difficult to get up in the morning and felt that his concentration as well as his memory had been deteriorating for the past two years. His affect was well preserved and there was no objective evidence of cognitive impairment. No psychotic phenomena were elicited. Physical examination was normal and he was right-handed. A lumbar air encephalogram showed some widening of the parietal sulci and a CT head scan showed a small calcified nodule lateral to the body of the right lateral ventricle. In addition, some widening of the cortical sulci was also seen. Psychological testing showed a WAIS verbal IQ of 94 and a performance IQ of 90. Tests of memory showed no impairment. A sphenoidal EEG recording showed 18 spikes of which 12 were in the right mid-temporal region and six in the left mid-temporal region, both sites being independent. He was discharged on carbamazepine, phenytoin and benuride. His seizures and conversion experiences continued over the next two years and his personality began to change. He became intensely religious and interpreted even his most trivial acts in light of religious values. He was constantly tormented by feelings of guilt and remorse and had a very negative outlook on himself and his achievements in life. He withdrew from most of his social activities. He remained hypergraphic.

Case 4 Mr MW, a 33-year-old man, had been subject to seizures since he was three years old. His aura consisted of flashing coloured lights in a wave pattern followed by déjà vu phenomena and simple auditory hallucinations. On occasions these auras were followed by generalised tonic-clonic convulsions. As a child he was started on a phenobarbitone and his attacks continued at a rate of two per week until his teens when his medication was changed to primidone and phenytoin in order to control an increase in his attack rate. At the age of 30 years he was referred for a psychiatric opinion because of excessive alcohol intake. He exhibited quasi-philosophical ideas

and a belief that he had healing powers. He had had this belief from the age of 28 years when he said that he had used his powers to cure a friend with a swollen knee. He regarded his aim in life to be a comfort and give solace to others and he had a marked interest in spiritualism. He also said that he sometimes had a compulsion to write but felt that this had been present ever since he could remember, though it was subject to periodic exacerbations. He described a compulsion to get his thoughts down before they were forgotten, and sometimes he wrote about his healing powers and at other times about non-religious personal matters. He had a particular penchant for writing poems. His maternal grandfather was an alcoholic but there was no other family history of neuropsychiatric illness. His early interpersonal relationships were disturbed and he tended to get into frequent fights at school. There was nothing of note in his medical or psychiatric history. He had never had much interest in sex and was quite happy to have sexual relations with his wife once every two months. When he was re-assessed at the age of 33 years he still had periods of compulsive writing. On examination of his mental state he showed marked circumstantiality of speech. There was no evidence of any psychotic phenomena, he was euthymic and cognition was normal. He was right-handed. On psychological testing a WAIS verbal IQ was 126 and a performance IQ was 120 and he performed normally on tests of memory. There was no evidence of any deterioration since his previous assessment. A standard EEG showed no evidence of any epileptic features or any temporal lobe abnormality. A CT brain scan showed a right parieto-occipital atrophic lesion which did not enhance with contrast media. This lesion appeared to be in communication with a focally dilated right trigone.

Case 5 Miss PM, a 25-year-old female, had been prone to outbursts of temper since her childhood. On entering her teens she remained disturbed and at the age of 18 years this required psychiatric treatment. Just prior to this admission she had collapsed whilst running in the street and developed a grand mal convulsion. Over the ensuing seven years she had several convulsions and was re-admitted for assessment of her neuropsychiatric problems. There was no family history of epilepsy or any other neuropsychiatric condition. She was a normal birth but showed delayed milestones and at school had difficulty keeping up with her peers. Since menarche, at the age of 10 years she had shown some preoccupation with male genitalia, though she had had little sexual experience. General physical examination was normal and she was right-handed. On mental state examination she was found to be talking continuously, with profuse gestures, describing past events in her life in great detail. Though markedly circumstantial there was no thought disorder present. She wrote profusely throughout her stay in hospital, usually about her experiences, in the manner of a diary. On occasions she wrote about her sexual preoccupations and her resentment towards her peers. Her mood varied between elation and outbursts of anger and depression. There was no evidence of any cognitive abnormality. A standard EEG showed slow waves of possible bilateral origin, mixed with low voltage spikes.

There were more prominent spikes in the occipital region during photic stimulation. The EEG was felt to be more in favour of generalised than focal epilepsy. Psychological testing showed a WAIS verbal IQ of 99 and a performance IQ of 98. She was prescribed phenytoin and subsequently discharged.

Case 6 Mr GT, a 48-year-old unemployed clerk, was admitted for investigation of psychosis associated with epilepsy. His seizures began at the age of 26 years and the aura consisted of a feeling "as if he was falling into a hole in the world" which was sometimes followed by clonic movements of the left half of his body with subsequent involvement of the right half. He had been treated for this with phenytoin and carbamazepine. At the age of 40 years he was admitted to a psychiatric hospital with a psychotic illness and was diagnosed as suffering from schizophrenia. There was no family history of any neuropsychiatric disorder. There was a vague history of him drinking alcohol excessively in the past but nothing else of note in his past medical or psychiatric history. On examination of his mental state he was found to be over-active, rambling to himself and claiming to be Jesus Christ. He said that he had got a message through a Spirit which he heard talking to him inside his head. He said that it had power over his speech pattern and was trying to control his thoughts. He described auditory hallucinations hearing the voice of a Spirit inside his head but there were no visual hallucinations or evidence of thought disorder. His affect was well preserved and he was euthymic. He described a compulsion to write and showed his writings. They consisted of a detailed record of his experiences, including the most trivial events, and prayers and diagrams with a religious theme. On examination he was right-handed and there was a bruit audible over the right fronto-temporal region of his skull. A CT head scan showed a right hemisphere arteriovenous malformation deep within the right temporal lobe and the thalamus. The lesion enhanced and appeared to drain into a dilated vein of Galen. An EEG showed short and long runs of medium voltage mixed irregular delta and theta activity in the right temporal region. Psychological testing showed a WAIS verbal IQ of 123 and a performance IQ of 103. Performance on verbal and visual recognition memory was dull normal. Anticonvulsant levels were within normal limits.

Discussion

In tables 1 and 2 the salient features of these cases are documented with those of Waxman and Geschwind's 1974 and 1975 series, for comparison. In the combined series the cases are referred to as patients and numbered 1 to 15 for ease of reference. The first patient in Waxman and Geschwind's 1975 series is excluded as she had already been reported in their 1974 series. Laterality of the EEG foci are based on pre-operative EEGs in those cases where surgery was carried out.

Obsessive-compulsive features were marked in

Table 1 Features of cases previously described and those in this presentation: laterality

Series	Hand preference	Sex	EEG	Other lateralising features
Waxman and Geschwind (1974)				
Patient:				
1	R	F	Bitemporal spikes R > L	L sided twitching during seizure L lateral ventricle enlarged on LAEG
2	R	M	Bitemporal spikes L > R	
3	R	M	R temporal spikes	
4	R	M	Bilateral slow waves and R temporal sharp waves	
5	Ambidextrous	M		
6	R	M	Bitemporal spikes	L temporal horn enlarged on LAEG
7	R	M	R temporal spikes	L fronto-temporal atrophy on skull x-ray
Waxman and Geschwind (1975)				
Patient:				
8	R	M	R temporal theta slowing	
9	R	M	Normal	
Roberts, Robertson and Trimble (1981)				
Patient:				
10	R	M	R temporal spikes	
11	R	F	R fronto-temporal sharp waves	
12	R	M	Bitemporal spikes R > L	R frontal calcified nodule on CT scan
13	R	M	Normal	R parieto-occipital atrophic area on CT scan
14	R	F	Bilateral occipital spikes	
15	R	M	R temporal slow activity	R hemisphere AVM

Table 2 Features of cases previously described and those in this presentation: clinical

Series	EEG focus	Déjà vu aura	Metaphysical interests	Decreased libido	Obsessive-compulsive features in writing	Psychiatric features
Waxman and Geschwind (1974)						
Patient:						
1	R > L	---	---	++	---	Schizophrenia-like psychosis
2	L > R	---	---	++	---	Aggression
3	R	---	---	---	++	
4	R > L	---	++	---	---	Aggression
5	—	---	++	---	++	
6	B	---	---	---	++	Aggression
7	R > L	---	++	---	---	Paranoid and bizarre behaviour
Waxman and Geschwind (1975)						
Patient:						
8	R	---	---	---	++	Aggression
9	—	---	---	---	---	
Roberts, Robertson and Trimble (1981)						
Patient:						
10	R	++	---	---	+	Schizophrenia-like psychosis
11	R	---	+	---	++	Manic-depressive
12	R > L	+	+	+	+	Religious conversion experiences Schizophrenia-like psychosis
13	N	+	+	+	+	Aggression
14	B	---	---	---	---	Aggression. Hypomanic features
15	R	---	+	---	+	Schizophrenia-like psychosis

relation to these patients. There was a compulsion to write (patients 1, 4, 6, 8, 13), a ritualistic quality (patients 1, 2, 12) and a meticulousness and attention to detail (patients 2, 3, 5, 6, 10, 15) in the writings of these patients. Previous authors have studied the inter-ictal writings of patients with epilepsy and noted prominent obsessional features including preciseness, order and detail.²³⁻²⁵ In a careful graphological analysis of the inter-ictal writings of epileptics, Massignan²⁶ drew attention to their lack of originality and their monotony (this was also noted by

Leibel, quoted by Massignan) who commented on how their writings reflected the personality traits of the patients. However, far from showing unoriginality some of these hypergraphic patients showed creativity, producing poems (patients 1, 4, 8, 9, 13), drawings (patients 8, 14) and one patient was in the process of writing a novel (patient 7). There is insufficient detail to assess the quality of the writings described in Waxman and Geschwind's papers, but in patient 14 the art work produced was regarded as above average by a number of indifferent observers

and is clearly more than the sketchings of an unskilled person.

In these 15 patients all but patient 5 were right-handed. There is a significant excess of right or predominantly right-sided EEG foci (Binomial test, two tail, $p < 0.05$), when compared with a random distribution of right and left-sided foci. In no patient is there a localised left-sided ictal focus. There is evidence of abnormality localised to the right hemisphere only in six cases (patients 3, 8, 10, 11, 13, 15) but no cases with left hemisphere localisation. Though these cases are selected, they are selected for hypergraphia and epilepsy, not for laterality of focus. In patient 13, for example, the scan abnormality was completed unexpected and was found after the patient had been selected because of his hypergraphia. In fact, though the evidence varies, it appears the tendency is for ictal foci to be predominantly on the left side of the brain in populations of epileptic patients under psychiatric care.^{8 27}

Bear and Fedio¹² did not find the personality trait of hypergraphia significantly separated patients with temporal lobe epileptic foci on the right, from those with foci on the left side of the brain. They did, however, find that this trait discriminated epileptic patients from non-epileptic patients, as did Sachdev and Waxman.²⁸ The latter authors had insufficient patients with lateralised temporal lobe foci to be able to identify any relationship between laterality of focus and hypergraphia. There are several reasons why Bear and Fedio may have failed to identify such an association. Firstly, hypergraphia may not lend itself to quantitative assessment as a trait, but may in fact be an "all or none" phenomenon. Secondly, the low number of cases so far reported in literature, and the authors' clinical impression, suggest it is a relatively uncommon sign and so could be missed in Bear and Fedio's small sample of 27 patients with lateralised temporal lobe foci. Finally, they did not state the hand preference in their patients, and thus their division into left and right temporal lobe foci may not accurately represent distribution of laterality of cerebral dominance. This is particularly important as several authors have noticed a raised incidence of left-handedness amongst temporal lobe epileptics.^{2 8 29}

In Bear and Fedio's study the two personality traits which were found to be significantly associated with right temporal lobe foci were obsessionalism, which has already been demonstrated to be manifest in the writings of hypergraphic epileptic patients, and elation. In this current series, elation of mood has been seen at some time in all but two of the cases (patients 13 and 15). Whether or not this disturbance of mood was present in the other cases described by Waxman and Geschwind, it not clear. The only case

in which a close temporal relationship was found between elation and hypergraphia, was patient 11. When this patient was elated she also exhibited hypergraphia and hyper-religiosity, and complained of a reduction in her sexual drive. It is possible that such a relationship was missed in other cases due to an inadequate documentation of changes in mood.

Hyper-religiosity was present in nine cases (patients 1, 2, 5, 7, 8, 9, 11, 12, 15) and comparable metaphysical beliefs in two cases (patients 4 and 13). Usually these beliefs are reflected in the patient's writings and it may be significant that the only patient who wrote on sexual matters (patient 14) was the only patient with any evidence of hyper-sexuality. All the other National Hospital cases, possibly excluding Case 15, and patients 1 and 2, suffered from hyposexuality at one time or another, a frequent inter-ictal finding in temporal lobe epilepsy.^{21 22} As patients do not as a rule volunteer information about their sexual drive, it cannot be assumed to be normal in patients 3 to 9.

It is also noteworthy that seven of these cases (patients 1, 4, 8, 9, 10, 12, 13) had déjà vu experiences as part of their aura and Penfield and Perot³⁰ have drawn attention to the fact that these experiences are frequently the result of a discharge from, or stimulation of, the non-dominant hemisphere of the brain. Despite this it is possible that this aura was present in other patients in this series but was missed as it was not specifically enquired for.

The mechanism of hypergraphia is obscure though this paper provides support for Waxman and Geschwind's suggestion^{21 22} that hypergraphia reflects an alteration in affective responsiveness in the presence of relative intellectual preservation. Elation of mood is associated with an ictal focus in the non-dominant temporal lobe¹² and may play a part in the production of hypergraphia, by stimulating psychomotor activity and thus predisposing certain patients to communicate, in writing, their unusual beliefs, ideas or experiences. In contrast depression would be expected to lead to psychomotor slowing and a reduction in written output. Likewise, dysfunction of the dominant cerebral hemisphere would be prone to lead to a reduction in written output³¹ and so make this symptom less likely to be associated with the dominant cerebral hemisphere. Linguistic changes have been shown in association with damage to the non-dominant hemisphere³² but these changes tend to be subtle and affect generalisation and conceptualism.

The association between the right temporal lobe and hypergraphia, elation and déjà vu phenomena, contrasts with the clinical picture seen in psychosis with left-sided lesions. Several authors have recently noted a significant association between certain types

of schizophreniform psychosis and left temporal lobe foci. Of a series of 24 patients with psychosis and epilepsy examined by Trimble and Perez,¹⁰ a Present State Examination led to a Catego diagnosis of nuclear schizophrenia in only those with temporal lobe epilepsy, and the majority had left-sided or bilateral ictal foci. The diagnostic features of nuclear schizophrenia are based on Schneiderian first-rank symptoms, in particular disorders of thought and hallucinations.

In conclusion it is clear that it is necessary to carefully document more cases of hypergraphia in association with epilepsy, for comparison with those cases already described and in order to identify correlations between this sign and other psychiatric symptoms and signs. Further confirmation of the value of hypergraphia in identifying the laterality of the main ictal focus in epileptic patients is needed. In addition, writing forms a permanent record of the patient's ideation and motor activity, and may provide insight into the patient's thought processes, as well as a valuable record of them.

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