Neurologists experienced in the interpretation of disease in terms of disordered action of the nervous system should be well suited to extend their field of interest to the more complex disorders of human behavior, including hysteria, delirium, ill-defined pain syndromes, unexplained fatigue, disorders of thought, atypical depression, and delusions. To illustrate the potential of neurology in approaching the more complex disorders of behavior, several examples from clinical neurology are presented in which phenomena calling for inquiry and analysis in neurological terms are described. The categories are temporal lobe epilepsy, delirium, drug toxicity, disease processes of the cerebrum, obscure pain, dyslexia, and hysteria. Inquiry into complex disorders of behavior is inseparable from the broad subject of normal mental activity, the neural organization subserving all human thought, emotion, and action. Because of this close association, the comment on hysteria includes an introduction to the important question of whether we humans possess a free will to choose our course of behavior.

In the domain of human affairs, it is a common dictum that it is the nervous system—the world of the mind, the exalted seat of thought and feeling—that provides the ultimate challenge for science. We are our nervous systems. For the neurologist, the gauntlet has been thrown.

Although neurology’s expertise lies particularly in motor and sensory spheres, there is, in addition, an unending procession of nervous conditions that challenge the neurologist to delve into the intricacies of the mental and emotional aspects of human behavior. The neurologist, backed by experience with nature's clinical experiments, should be in a good position to gain insight into the nature of abnormal phenomena and offer suggestions concerning the principles of human behavior.

The aim of this article is to illustrate this viewpoint by reviewing clinical examples that invite thinking beyond the usual bounds of neurological practice. Most of the categories are already well-known and are presented here to make a salient point. The section on hysteria is more detailed because the principle of absence of free will is examined.

Temporal lobe phenomena are presented first because they represent familiar examples of complex behavior. Then, in turn, the following categories are illustrated: delirium, drug toxicity, cerebral disease processes, pain, dyslexia, and hysteria. The list is not at all complete and is meant to serve as an introduction, a beginning.
vulsive therapy can dispel despondency for months or years. Herpes encephalitis involving the temporal lobe has been associated with classic mania. Who better than a neurologist to contemplate these remarkable events?

DELIRIUM

The drama of violent postoperative delirium provides insight into the slight insufficiency that may be associated with the alcohol withdrawal syndrome.

Case 1

A 74-year-old man underwent surgical resection of a tumor of the urinary bladder under general anesthesia. The procedure was well tolerated, but 8 hours after the operation, the patient became restless, confused, and combative. Four-limb restraints were required. After 24 hours, heavy sedation quieted him for only 15 minutes, after which struggling and shouting recurred. After 48 hours, his temperature was elevated, his pulse rate was increased to 135/min, and the blood pressure was falling. In this ominous situation, the administration of 4% ethyl alcohol intravenously was begun. When 60 mL had been given, the patient stopped struggling and shouting and within 10 minutes was responding verbally. Soon, he was fully cooperative, and further convalescence was uneventful. According to his family, the patient drank 28 or 56 g of whiskey at dinnertime every evening.

Case 2

A 72-year-old man fell off his chair onto the floor and, although fully alert, experienced great difficulty extricating his legs from the chair legs. He was taken to the hospital, where a computed tomographic scan showed bilateral chronic subdural hematomas. Emergency surgery was performed under general anesthesia. In the recovery room, he became unmanageable, despite the help of 5 assistants, and was shouting, fighting, attempting to get out of bed, and pulling out the intravenous lines. In this desperate situation, he was given 28 g of whiskey in 84 g of water from a glass. He made a wry face but 5 minutes later was quiet and cooperative. According to his family, this patient too had 28 g of whiskey with his dinner and another 28 g later in the evening.

A neurologist witnessing transformations like these develops a strong bias regarding the management of acute delirium tremens.

DRUG TOXICITY

Case 1

In a period of 3 weeks, an 81-year-old woman, began to telephone her sister up to 12 times daily, having forgotten the previous calls. Each morning, she set the breakfast table for another sister who had died 1 year before. The patient’s right eyeball had been removed at the age of 2 years. As her main complaint, she reported 1 year of trouble with vision in her right eye. She thought she was in a foreign country. Her short-term memory (1 minute and 5 minutes) was almost nil. While in the hospital, she looked for her husband, who had been dead for 50 years. Neurological findings were essentially normal except for memory. The onset of amnesia could not be traced back further than 1 month. She was receiving 2 medications, triamterene with hydrochlorothiazide and propranolol hydrochloride. A trial withdrawal of one medication at a time was undertaken. When propranolol had been stopped for 4 days, memory began to improve and on the 10th day was normal.

Case 2

A 48-year-old man who had abused alcohol had been taking disulfiram for 5 months and had been abstinent. He gradually became slow and apathetic. He had vague headaches, and his balance became impaired. During the 5 days before admission, he lay in bed except for meals. Disulfiram was discontinued 1 day before admission. On admission, he was apathetic, aspontaneous, and unable to express a coherent thought. On the second day in the hospital, he was mute and unresponsive to conversation. His face was expressionless. He sat staring at the floor. He refused all tests. When this state persisted, he was scheduled for electroconvulsive therapy on hospital day 5. On the morning of day 5, he spoke a little and moved his limbs more. Electroconvulsive therapy was postponed, and steady improvement occurred without special therapy. On day 19, he was still laconic and slow, but eventually he made a full recovery. Disulfiram had produced a clinical replica of catatonic depression.

Case 3

An 85-year-old man was in the hospital because of a compression fracture of the lumbar spine following a fall. Pain was severe and was treated with oxycodone. On hospital day 10, the patient complained that he could hardly speak. In 25 minutes of searching for words, he was able to convey his idea that he had trouble thinking and stating his concepts. He tried to give the date for 4 to 5 minutes, until interrupted by the examiner. He tried using common words for 2 to 3 minutes before giving up. He seemed unaware of the magnitude and significance of the impairment. He could not write what he could not say. He recognized the desired word when it was suggested. There was no dysarthria, and his face was symmetrical.

He could repeat quickly and clearly. He quickly counted to 20 and back. He named 12 objects presented visually. He read aloud rapidly, with good comprehension. He spelled words correctly, obeyed complex commands, and interpreted pictures correctly using gestures. He named 7 vegetables in 40 seconds. He recalled a 7-point memory sentence at 10 minutes. By gestures, he identified items recalled from his breakfast 10 hours before and selected the correct date. There was no facial or limb apraxia. The syndrome was unfamiliar.

Oxycodone, which was the main medication, was discontinued. In 2 days, speech was almost back to normal. The patient was transferred to a rehabilitation hospital, where oxycodone was reinstituted. The identical syndrome recurred. Two years later, after hip surgery under spinal anesthesia in which fentanyl citrate was ad-
ministered, word-finding difficulty was prominent for 36 hours afterward. The syndrome was unusual in that the ideation-speech circuitry was selectively impaired.

With the advent of genomic analysis and proteomics, adverse reactions to medications may provide information that will allow dissection of brain functions based on chemical signature. One might envisage drug toxicity being studied at centers where patients' genomic analysis is known or could be undertaken.

**DISEASE PROCESSES INVOLVING THE CEREBRUM**

**Case 1**

In 1 week, a 78-year-old woman gradually became unable to discern if it was breakfast time or supper time. She misidentified her grandchildren. During her waking hours, she was almost constantly subject to florid alarming persecutory delusions—her family had drowned, people were being shot, her food was laced with strychnine, guns were aimed at her, doctors were murdering babies, she was a leper, there was a bomb in her room, and so forth. There were literally hundreds of different delusions. Delusional ideation interfered with cognitive testing, but most elements were found to be intact at one time or another. All laboratory study results were within normal limits. Electroencephalographic findings were slightly abnormal. The patient was observed in the hospital for 4 months, without appreciable change. Many different medications were effective only as sedatives. One month after discharge, the patient died from aspiration asphyxia. Neuropathological examination showed Creutzfeldt-Jakob disease.

**Case 2**

A sophisticated unmarried businesswoman aged 61 years was admitted because she told her friends that 2 weeks before, over 2 days, she gave birth to 25 babies averaging about 15 cm long, mixed boys and girls. Nineteen survived. She nursed them, one breast yielding sweet milk, the other sour. Neurological findings were normal except for errors in subtracting 7 from 100 serially. The cerebrospinal fluid contained 30 lymphocytes per microliter. A glioblastoma involved 3 years before the patient attended our clinic. In the following 5 years, she was treated with various combinations of 6 analgesics and 8 antidepressants. Leading pain experts were consulted. With her physician's acquiescence, she consulted a Roman Catholic priest in her part of the country who had a reputation for impressive feats of healing. She later related, "I joined hands with my husband and daughter, he [the priest] said, 'and my child what is your trouble?' I told him I had a tumor of the brain this big [showing a circle of her index finger on her thumb]. He prayed, and I felt a little pea-sized thing drop down from the roof of my mouth into my throat. It choked me a little, and I fell to the ground. Perhaps I was unconscious a little while. My husband and daughter had severe headaches and vomited for 2 days." The patient had stopped all medication and reported that she felt much better. On examination, there were no pseudoneurological deficits. She was stylishly dressed and planning a European holiday.

In neither of these patients was litigation or monetary compensation a factor. It is a challenge to formulate a sound physiological or neurological concept of such clinical events. If humans are automatons, their nervous systems must run involuntarily, and a formula in common should be recognizable.

**THE CHALLENGE OF PAIN**

**Case 1**

For 4 years, a 53-year-old woman had disabling pain in the throat, upper chest, teeth, gums, tongue, and floor of the mouth. Exertion caused a burning feeling in the arms. Four weeks in a pain center failed to help. Neurological findings were within normal limits except for pseudoneurological weakness of the arms. Carcinoma of the breast was then discovered, and the patient underwent surgery and 2 years of chemotherapy. She said, "After I got the cancer, I really started to do good. I feel good. I used to come to you with so many complaints. I live normally."

**Case 2**

A 47-year-old woman had heaviness in the left arm for about 20 years, attributed to a cervical rib. The left leg became similarly involved 3 years before the patient attended our clinic. One year previously, she had developed pain above the left ear and, at times, had a feeling that blood was rushing through the left side of her face. Gradually, a feeling of pressure, pulling, tightness, and heaviness extended throughout the entire left side, face, arm, and leg. She could walk only 20 m. In the following 5 years, she was treated with various combinations of 6 analgesics and 8 antidepressants. Leading pain experts were consulted. With her physician's acquiescence, she consulted a Roman Catholic priest in her part of the country who had a reputation for impressive feats of healing. She later related, "I joined hands with my husband and daughter, he [the priest] said, 'and my child what is your trouble?' I told him I had a tumor of the brain this big [showing a circle of her index finger on her thumb]. He prayed, and I felt a little pea-sized thing drop down from the roof of my mouth into my throat. It choked me a little, and I fell to the ground. Perhaps I was unconscious a little while. My husband and daughter had severe headaches and vomited for 2 days." The patient had stopped all medication and reported that she felt much better. On examination, there were no pseudoneurological deficits. She was stylishly dressed and planning a European holiday.

**DYSLEXIA**

A 13-year-old youth had been unable to learn to read. He was referred to a center for remedial reading, but be-
cause of the prevalence of marijuana use and other
delinquencies, his parents discontinued that approach and
arranged for the boy to attend his local high school classes,
doing the best he could and being promoted each year
to be with his age-group. After 5 years at high school,
his reading skill was still about nil. His IQ was 127,
and he was capable in mathematics and chemistry if the tasks
did not entail reading.

At age 19 years, he entered the United States Navy,
serving in the Vietnam theater for 1 year. He was unable
to write to his family. At age 21, he began to look at
the sports pages of the newspaper for the first time. On
discharge from the Navy, he enrolled in college. After much
difficulty in the first year, he gradually improved and gradu-
ated with honors. With encouragement from his col-
leagues, he enrolled in medical school, where his perfor-
manace was average. He did well in his residency and has
become an excellent practitioner and a good physician.

There is nothing so disturbing to a young nervous
system as to ask it to do something it cannot do. The neu-
ral substrate of reading develops or matures according
to different timetables in different individuals. Patience
and understanding are necessary.

**HYSTERIA**

**Case 1**

A woman with temporarily impaired vision was given fi-
nancial aid by a local government agency during her re-
cuperation. When she was fully recovered, the financial
aid was discontinued, after which the patient reported
that she had become totally blind. She behaved accord-
ingly. Under special test conditions, visual acuity was
found to be 20/20.

**Case 2**

A middle-aged man fell while boarding an airplane. He
may have been unconscious for a few seconds. After-
ward, the patient's memory was impaired. His disability
health insurance was generous. When a reduction in the
compensation was proposed, his symptoms became worse.
When asked to recall the memory sentence "Tom and
Bill went fishing; they caught 3 black bass," he an-
swered, "Some chaps with monosyllabic names were
engaged in a recreation in which the number of items was
slightly in excess of the number of chaps." When asked
to try hard to remember the names, he suggested 12 mono-
syllabic male names, but not "Tom and Bill." When his
balance was tested, he required support in standing and
kneeling. When placed on all fours (on his hands and
knees), he slowly rolled over onto his back with all 4 limbs
in the air like a tortoise on its back, unable to move un-
aided. On completion of the examination, he left walk-
ing unaided.

**Case 3**

A young woman had lost her balance 7 years previously
and, being unable to walk unaided, had crawled on her
hands and knees in looking after her household and her
children. It was explained to her that her balance needed
training. Accordingly, a newspaper delivery boy's cloth
bag was hung from each shoulder across her body. While
standing supported, books of various sizes and weights
were placed in one or the other bag, depending on the
side to which the subject tended to topple. Finally, with
a sheet of paper on one side or the other to achieve a per-
fect balance, she walked 18 m unassisted.

Hysteria, the condition in which such disorders oc-
cur, continues to puzzle clinicians, and no satisfactory
mental explanation has been achieved. The chain of events
leading to the clinical state is obvious to observers but
not to the patient. Whether the deficit involves amne-
sia, paralysis, imbalance, pseudoseizure, or blindness, the
precipitating circumstances can usually be identified—
prospect of monetary gain, an intolerable personal situ-
atation, imminent military engagement, a prior intercur-
rent illness, or psychosis, etc. Yet, hysterical patients claim
that they have no idea how the symptoms and pseudo-
neurological signs originated. This is a most puzzling fea-
ture of hysteria.

In tackling this incongruity, a fundamental question
in human biology comes up for consideration, namely, to
what extent do humans have voluntary control over their
own behavior? It is generally accepted that we do not have
control over the succession of our thoughts as they stream
by, but is it not different for our actions? All persons have
the natural impression that they are in charge of their be-
behavior, to do what they choose to do and refrain from do-
ing what they choose not to do. Libet et al, however, dem-
onstrated under experimental conditions that, when subjects
were invited to make a willed movement of their right hand
whenever they wished to, an electric brain wave (the
Bereitschaftspotential) appeared over the left hemisphere
second later and is interpreted by the person as having pre-
ceded the act. The experimental situation obviously influ-
ences the mental state of the subject and could have an effect
on the electrical tracing.

However, the same conclusion is reached when it
is realized that every thought of acting, every intention,
and every feeling of being inclined to act must first be
created by nervous system activity. How else could they
arise? Ideas would have to arise without a physical ba-
sis. The temporal primacy of nervous system activity is
a basic tenet.

From these observations, so-called willed acts are
preceded by nervous system activity that we become aware
of with a slight delay, resulting in the false impression
that the act was personally willed. The concept of a willed
act as it is commonly accepted becomes untenable.

It could be instructive to analyze hysterical behav-
ior as though it arose involuntarily, automatically. In hys-
teria associated with monetary reward, the desire of an
individual to gain money is so natural and the prospect
of losing an advantage so unnatural, so contradictory to
the welfare of the organism, that there is created in the nervous system, reflexly, the reaction of demonstrating or emphasizing disability, especially on neurological examination. This reaction is so basic that it is hardly registered in ideation and awareness. The individual remains unaware of the neural event. The action probably is normal, judging from its universality. One of the basic drives of humans is acquisition, to acquire, and it is unnatural to decline monetary gain. Similarly, a soldier facing danger may reflexly become blind or paralyzed, without the neural process registering in consciousness. Or, an individual in an intolerable personal quandary “forgets” his or her personal identity and whereabouts. The alternative explanation of such events is that the individual considers the situation and deliberately chooses the course of events. But, if nervous system activity is in no case willed, such an explanation could have no validity.

There is an important point that could cast doubt on the interpretation just offered, and that is the failure of physicians to show the hysterical trait. Janet said it was because physicians know that such behaviors do not occur. If that is true, a “mental event” does occur in physicians who act to prevent the reaction of disability.

Malingering would also of necessity be involuntary, and the validity of the theory would appear to have met a full challenge again. However, a possible interpretation is that, in the malingerer, the mental transaction of disability does register, but the thought of deceit or lying is introduced, a course of action which the patient of disability does register, but the thought of deceit or lying is introduced, a course of action which the patient is aware of, although it is unwilling.

**COMPLICATED PERSONAL BEHAVIOR WITHOUT INSIGHT**

A remarkable example of complex behavior being carried out by sophisticated persons without their being aware of their contribution is recorded in the literature on autism. It involved the activities of “facilitators” in the instruction of uneducable children with autism. A facilitator simply touched the sleeve or supported the right hand or forearm of the autistic child, enabling the child to use a typewriter keyboard to type on a computer screen. With this arrangement, many seemingly mindless children typed out messages, indicating totally unsuspected intelligence, sophisticated opinions, and deep feelings. Skeptics, under controlled conditions, demonstrated that what was being typed was knowingly or unknowingly the work of the facilitators, who maintained that they were completely unaware of their participation or contribution. In more than 60 instances, a child typed out allegations of sexual abuse by family members. The facilitators denied being aware of the fabrication. It is certain that many intelligent instructors provided complex answers and, in some cases, falsely alleged serious offenses, unaware of having any corresponding thoughts themselves, let alone guiding the children’s hands. Strongly felt wishes elicited complex action without insight. There may be a parallel with hysterical disability.

**GENERALIZATION**

The neural organization underlying human behavior is complex beyond the imagination. Action is determined by inherited neurophysiological tendencies, maturation, training, experience, and the ideational-emotional circumstances of the moment. If the process were automatic, it should be possible to recognize rules or principles at work. The challenge is to improve our current analysis and explanation of behavior. Labeling the process as “automatic” is only the beginning.

The important role of suggestion and example coming from the environment must be appreciated. In the automaton paradigm, the manner in which clinical conditions are interpreted and thought about would change, for example, in hysteria, compensation neurosis, paranoia, panic disorder, stress, bulimia, puzzling pain disorders, autism, and Tourette syndrome. Patients cannot willfully create symptoms.

Areas of individual and social behavior would require rethinking, including child rearing, disciplining, schooling, and acquisition of faulty habits, such as obesity, smoking, addiction to alcohol and other drugs, and gambling. Social behavior—for example, lying, delinquency, homicidal rampage, and the terrible tragedies of teenagers—would be viewed in a new light. Explanatory language would be revised.

It is hardly possible for us to conceive of our being automatons. It is likely that we will keep that impression. Individuals will still believe they are responsible for their actions because it was they who carried out the actions.

**CONCLUSIONS**

This article has touched on several themes suggesting avenues by which neurologists might seek, in the manifestations of neurological disorders, clues to the organization of human cerebral function. Hughlings Jackson, Penfield, Wolff, Lhermitte, Geschwind, Cummings, and others have shown the way. Neurology abounds in phenomena created by nature’s experiments that invite the attention of neurologists interested in the neural activity that underlies or, more accurately, that is human experience.

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