

Introduction

Christopher M. Filley, C. Alan Anderson, and David B. Arciniegas

The writing of a new textbook in medicine presents both an exciting opportunity and a daunting challenge. Whereas any contemporary medical field witnesses timely new developments that call for rapid dissemination, it is uncertain how much time busy clinicians and investigators can devote to reading an entire textbook, especially when ready access to a range of online resources is increasingly available. We have ventured forth nonetheless, with the goal of creating a novel synthesis of the strong intellectual and academic traditions of Behavioral Neurology & Neuropsychiatry (BN&NP).

The unification of the historically separate but parallel subspecialties of behavioral neurology and neuropsychiatry is a relatively recent event [1, 2]. These subspecialties were joined through the work of the American Neuropsychiatric Association and the Society for Behavioral and Cognitive Neurology to create the BN&NP subspecialty under the auspices of the United Council for Neurologic Subspecialties (UCNS). The goals of this effort included advancing and enriching this area of clinical practice and scientific research, in which the brain is recognized as the organ of the mind, as well as facilitating the continued growth of this subspecialty through standardization and accreditation of fellowship training programs and certification of its practitioners.

This development reflects a broader re-engagement between neurology and psychiatry more generally [3–5]. Traditional academic boundaries are being reassessed from all sides as medical progress continues. As we have observed and contributed to this process of gradual rapprochement [2], and because we apply an integrated model of BN&NP in our daily work as clinicians, educators, and scientists, the idea of producing this volume arose naturally. This book thus

embodies a summary of our thoughts and practice in these fields – as well as those of our colleagues – as developed over more than two decades of clinical care, education, research, and reflection. As an overture to what follows, some preliminary information will help set the stage.

Historical background

Neurology and psychiatry

Neurology and psychiatry are securely established medical specialties with well-demarcated areas of clinical and research expertise. Although it seems natural that their common interest in focusing on the brain would foster interdisciplinary ties, close collaboration between these fields and their practitioners are the exception rather than the rule. Many physicians – past and present – have promulgated various degrees of separation between the two fields and rigidly maintained that neurologists study the brain and psychiatrists study the mind. This split fosters a strict dichotomy that keeps apart the professions and professionals most concerned with the myriad and often disabling problems of human behavior. Some argue that neurology will remain separated from psychiatry because each does something unique [6, 7] – the former being “objective” and the latter “humanistic” – while critics respond by chiding the simplistic gap between “mindless neurology” and “brainless psychiatry” [3, 8].

These fields share common origins in Western philosophical and medical traditions [9]. Many Renaissance-era physicians were committed to the thesis that mental states are brain states, and that aberrations of mental functioning are the products of

a disordered brain. Cullen (1710–1790) was the first among such physicians to include the mental disorders in his taxonomy of brain illnesses, and was the progenitor of the term “neuroses.” In his classification of disease, the neuroses included the comata, adynamiae, spasmi, and vesaniae, with this latter group consisting of many of the classic “psychiatric” illnesses (e.g., mania, depression, psychosis, and dementia). His work influenced Coombe (1797–1847) in his classification of brain diseases into two major categories, “organic” and “functional.” Coombe intended these terms to sort diseases of the brain into two categories based on the presence or absence of localizable abnormalities. It does not appear to have been his intention to establish a system in which some brain diseases are considered “real” brain problems and others are not considered brain problems at all. Griesinger (1817–1868) subsequently advanced the thesis that even normal mental processes are the direct result of brain activity alone, echoing Hippocrates’ view that mental illness has its origin in the brain [10]. Griesinger viewed psychiatry and neuropathology as a single field with one language and one set of operative laws, and advised physicians to “primarily and in every case of mental disease, recognize a morbid action of that organ [the brain]” [11].

In the following 50 years, a host of European physicians began in earnest to examine the brain with respect to mental processes. A common body of work by pioneering physician-scientists of the nineteenth and early twentieth centuries – among them Theodor Meynert, Jean-Martin Charcot, Sergei Korsakoff, John Hughlings Jackson, Henry Harlow, Eugen Bleuler, Emil Kraepelin, Arnold Pick, and Alois Alzheimer – whose efforts were neither guild-specific nor dominated by concerns regarding the primacy of one or another medical specialty. Their efforts steadily advanced knowledge of neuroanatomy, neurophysiology, and neuropathology as applied to behavioral phenomena in the quest to understand the mind as a function of the brain. This unity of purpose was so pervasive that these physicians were typically referred to as neuropsychiatrists, heralding more formal developments in this direction a century later.

During this same period, however, neurology began to develop as an independent field of study, most notably after the formation of the National Hospital for the “Relief of Paralysis, Epilepsy, and Allied Diseases” in Britain in 1860. Concurrently, Charcot (1825–1893) and his students began concentrating on the “neuroses,” and pursuing a line of inquiry that turned the

interest of psychiatry at the beginning of the twentieth century toward introspection, reflection, and consideration of the person as a whole. Notably, as psychoanalysis became a more dominant force within psychiatry, this “person as a whole” became increasingly less whole with respect to a complete understanding of the neurology underlying neurotic conditions.

As the twentieth century progressed, neurology and psychiatry became polarized with respect to the focus and content of their studies. Neurology was interested in localizable pathology, the “organic” problems, and psychiatry focused on the functioning of an individual’s psyche, internally and interpersonally. These “functional” problems, whose consideration was divorced of their neurological bases, became the province of psychiatry. Interestingly, this was not the initial objective of Sigmund Freud (1856–1939), the progenitor of psychoanalysis. A neurologist by training, Freud was committed to a form of substance materialism: “Research has afforded irrefutable proof that mental activity is bound up with the function of the brain as with no other organ. The discovery of the unequal importance of the different parts of the brain and their individual relations to particular parts of the body and to intellectual activities takes us a step further...” [10].

Freud maintained that the science of his time could not establish clearly the relationship between the complex operations of mental processes and brain function. His theories therefore assumed a form of logical positivism in which he identified the concepts and mechanisms of mental operations from a purely psycho-philosophical perspective. Early in this endeavor, he offered cautionary notes on this approach: “Our mental topography has for the present nothing to do with anatomy... In this respect, then, our work is untrammelled and may proceed according to its own requirements. It will, moreover, be useful to remind ourselves that our hypotheses can in the first instance lay claim only to the value of illustrations” [10].

Freud (1895) [12] envisioned a future in which a scientific account of mental processes would be possible. However, de facto dualist perspectives on mind-body issues supplanted his early materialist positions on such matters and pervaded early and mid-twentieth century psychiatric practice and popular culture. Indeed, when previously “functional” disorders like general paresis of the insane (a form of neurosyphilis) were discovered to have an “organic” basis,

they were quickly eschewed as proper subjects of psychiatric study and treatment and taken up by neurology. As a result, the early part of the twentieth century witnessed the progressive movement of a significant part of psychiatry away from its neuropsychiatric foundations, and facilitated the continued division of neurology and psychiatry into separate disciplines.

As described by Hollender (1991) in *American Board of Psychiatry and Neurology: The First Fifty Years* [13], the unification of neurology and psychiatry under the American Board of Psychiatry and Neurology (ABPN) in 1934 had the potential to unify the fields. However, the manner in which the ABPN was created contributed substantially to the formal separation of psychiatry and neurology. In the early 1930s, a group of neuropsychiatrists within the Section on Nervous and Mental Disease of the American Medical Association (AMA) suggested that psychiatry and neurology be united under a common board of examiners for the purpose of establishing criteria and examinations for certification to practice in these medical specialties. Their explicit purposes were to recognize the common interests of these specialties in brain-behavior relationships, and to protect both the public and also the reputations of these fields by distinguishing qualified from unqualified practitioners.

In order to develop a board that would be widely accepted by the practicing clinicians of that time, the AMA solicited the participation of representatives from the American Psychiatric Association (APA) and the American Neurological Association (ANA) in discussions regarding the development of a unified examining board. In recommending a unified board, the AMA made clear its position that the content and practice of psychiatry and neurology overlapped substantially, and that both fields would be best served by an examining board that acknowledged their similarity.

Ongoing tensions between the fields with respect to public legitimacy and scientific dominance limited the ability of the participating psychiatrists and neurologists to work cooperatively on this task. Although the AMA representatives initiating these discussions were self-described neuropsychiatrists, the representatives from the APA and the ANA elected not to recognize neuropsychiatry as a field of practice. Instead, Hollender (1991) [13] notes that the APA and ANA representatives elected first to demarcate sharply the differences in training and certification between psychiatry and neurology and then argued over the order

in which the two fields should be represented in the Board's official title.

Despite their posturing, the ABPN administered the same examination to candidates in both areas for the first decade of its operations. Over time, and as a consequence of training differences driven by the ABPN guidelines, the examination became increasingly focused on the candidate's field of training. Nonetheless, 25% or more of the board examination content for each remains based on the other specialty's material. This continues to acknowledge, albeit implicitly, that much of what constitutes neurology and psychiatry is scientifically inseparable and the practice of both specialties requires a transdisciplinary knowledge base and skill set.

Nonetheless, the creation of ABPN left a legacy of an uneasy, if not occasionally hostile, alliance between psychiatrists and neurologists. Its creation also effected an apparent amnesia within these specialties for the historical and philosophical background that resulted in their regulation under a combined board. As noted earlier in this chapter, thought leaders in both fields occasionally call for reunification of psychiatry and neurology [3–5]. However, attempts to unite these fields are met with skepticism, at best, outside of a small number of academic and private institutions. Similarly, requests to the ABPN for the establishment of Added Qualifications in Neuropsychiatry have not thus far been successful.

Behavioral Neurology & Neuropsychiatry

The contemporary subspecialties of behavioral neurology and neuropsychiatry have taken separate but converging paths to their current positions. Behavioral neurology is widely held to have begun with the work of Norman Geschwind in the mid-twentieth century [14], who established a fellowship program at the Boston Veterans Administration Hospital while rising to the position of James Jackson Putnam Professor of Neurology at Harvard Medical School. Geschwind reintroduced and expanded on observations of brain lesions and behavioral disturbances made by neurologists such as Paul Broca, Karl Wernicke, Hugo Liepmann, Hienrich Lissauer, and Jules Dejerine in the previous century, and wrote a seminal paper on disconnection syndromes in 1965 that inspired a generation of research on brain-behavior relationships [15, 16]. With this foundation, behavioral neurology firmly took

hold; the lesion method of studying brain–behavior relationships proved highly productive [17] and the idea of distributed neural networks subserving cognition appeared as a major organizing principle in the field [18].

Neuropsychiatry, on the other hand, flourished first as a discipline in the late nineteenth century as discussed above, but then fell into relative obscurity during the mid-twentieth century. Psychoanalytic theory and practice dominated psychiatry for the first half of the twentieth century, especially in the USA where psychoanalysts fleeing Hitler's Germany exerted much influence [19], and neurobiological correlates of behavior were relatively neglected. This situation began to change with the introduction of modern psychopharmacology in the 1950s that ushered in the field of biological psychiatry – a powerful stimulus for adopting a neurobiological model of mental function. In this setting, a neuropsychiatric approach to patient care began to reemerge and steadily gain momentum as physicians increasingly appreciated the neurologic bases of psychiatric disease and the psychiatric aspects of neurologic disease [19–22]. The organization of a professional association for neuropsychiatrists and the development of neuropsychiatry as a medical subspecialty derive from the efforts of many physicians, most notably Jeffrey L. Cummings, Randall B. Schiffer, and Stuart C. Yudofsky.

Two other factors also fueled the development of both behavioral neurology and neuropsychiatry; the rapid growth of neuropsychology, arising in large part from the influence of Alexander R. Luria in mid-century Russia [23], and the spectacular advances of neuroimaging from the 1970s onward that increasingly enabled precise structural [24] and later functional imaging of the brain [25]. These fields contributed cognitive measures and neuroradiologic techniques for detailed study of brain–behavior relationships that substantially augmented existing methods of clinical–pathologic correlation. With the advent of the twenty-first century, clinical neuroscience is flourishing, leading to thoughtful commentary advocating the closing, or at least narrowing, of the “great divide” that has existed between neurology and psychiatry [3].

Philosophical antecedents to Behavioral Neurology & Neuropsychiatry

The fluctuating relationship between the previously separate subspecialties of behavioral neurology

and neuropsychiatry derives principally from the challenges of investigating the human mind and its disorders in a medical context. At the root of this conundrum is the ancient philosophical question of the relation of mind and body, recast in the modern formulation of the mind–brain debate. What is the source of human consciousness – an ineffable, immaterial mind that exists apart from any physical structure, or the collection of nerve cells and chemicals known as the brain that accounts for all behavior? To many, it is inconceivable that the “gray and white gook” inside the skull could actually be conscious [26], and thus responsible for such cherished capacities as intelligence, creativity, and altruism. The towering influence of the seventeenth-century dualist philosopher Rene Descartes [27] continues today in our society – and even to some extent in medicine.

The era in which psychoanalysis dominated psychiatric practice created an intellectual environment in medicine that was sympathetic to dualistic thinking despite Freud's early career as a neurologist. While not avowedly dualistic in the philosophical sense, mainstream psychiatry for much of the twentieth century contrasted “functional” with “organic” disorders as a way of establishing a group of mental disorders in which brain structure and function were essentially irrelevant [3]. Psychiatry focused primarily on symptoms rather than signs, and as the metaphors of psychoanalytic theory captured public and professional imagination, the use of neurological examination and laboratory data in studying behavior diminished [3]. Simultaneously, neurology chose to care for those patients in whom structural brain disease could be detected, eschewing the unavoidable subjectivity of behavioral analysis in favor of the “hard” scientific data of the neurological examination, cerebrospinal fluid analysis, electroencephalography, and neuropathology [3].

As the influence of psychoanalysis began to recede in the mid-twentieth century, strong proponents of mind–brain unity questioned the authority of Descartes [28–30], and the dichotomy of mind versus brain began to lose ground in medical thinking. Neurology and psychiatry gradually became more inclined to share the view that the brain is central to human behavior, and by 1987 the organic–functional distinction was explicitly discouraged by the influential *Diagnostic and Statistical Manual of Mental Disorders* [31]. Nonetheless, vestiges of philosophical dualism persist in medicine, in part because the

study of behavior and the vexing emotional disorders commonly considered “psychiatric” are so complex. To cite a clinical example, the floridly abnormal behavior of many psychotic patients with normal conventional clinical neuroimaging and laboratory studies seems to some critics to undermine arguments asserting that this illness is neurobiologically based – how can such abnormal behavior derive from a person whose brain is structurally normal? Perhaps it is not a surprise that lingering dualism sometimes still impacts clinical thinking [32]. Modern neuroscience notwithstanding, the fact remains that disorders of behavior are the most challenging and among the most difficult to describe objectively.

The unifying foundation of BN&NP, however, is the shared philosophical position that brain and behavior are inseparable [2]. The organic–functional dichotomy cannot be maintained because all thought, emotion, and behavior are brain-based. Although traditionally trained behavioral neurologists tend to focus on brain disorders in which structural pathology is in some way demonstrable, and neuropsychiatrists hailing from general psychiatry are comfortable conceptualizing mental disorders as stemming from neurochemical deficits, all agree that higher functions – normal or abnormal – originate as neural events that involve the macro- or microstructure of the brain in the process of subserving mental operations. Thus, whereas the assessment and treatment of a person with Broca’s aphasia from an observable left inferior frontal lobe infarct differs markedly from that of an acutely psychotic schizophrenic individual with normal conventional neuroimaging, the underlying principle in dealing with both patients is the same: both syndromes involve an alteration of brain–behavior relationships that requires a thorough understanding of how the brain operates at all levels of analysis. The triage of patients into neurologic versus psychiatric settings should depend only on the evaluation and services required – such as a neurologic intensive care unit for emergent stroke treatment, or a locked psychiatric unit for acute agitated psychosis – and not on archaic notions of whether a patient has “organic” or “functional” disease.

Individual temperament and interest will naturally influence the kind of clinical setting in which a physician may prefer to work, but the common principle that all patients in these settings have disorders of the brain must be honored if patient care is to be optimal and intellectual progress facilitated. Indeed, we

have described an integrated practice of BN&NP that fosters excellence in patient care, education, and research within a setting that explicitly avoids the arbitrary divisions that have often hampered collaboration between neurology and psychiatry [33].

The state of the field

The prospect of behavioral neurology and neuropsychiatry drawing together finds considerable support in academia. Textbooks of behavioral neurology [34–36] and neuropsychiatry [8, 37, 38] have proliferated in recent years. Annual scholarly meetings are held conjointly by the Society for Behavioral and Cognitive Neurology and the American Neuropsychiatric Association in order to disseminate new research findings and educate practitioners. Structural and functional neuroimaging, neuroanatomy, neuropsychology, neuropharmacology, neuropathology, clinical neurophysiology, and genetics are all receiving much-needed attention. Moreover, in a remarkable development, topics previously regarded as unapproachable for neuroscientists are being vigorously considered; accounts of the neural correlates of consciousness [39], ethics [40], and creativity [41], for example, are now regular reading for devotees of brain–behavior relationships.

However, postgraduate training in neurology or psychiatry exerts a powerful socializing force, and fellowship experiences in the higher functions of the brain modify but do not undo these fundamental affiliations. The development of an integrated core curriculum for fellowship training [2] and the development of the UCNS fellowship accreditation processes may create a structure within which a professional identity and practice as a subspecialist in BN&NP becomes possible. This comprehensive curriculum is derived from the traditions of neurology, psychiatry, behavioral neurology, and neuropsychiatry, while drawing heavily from neuroanatomy, neurophysiology, neuroimaging, neuropsychology, neuropharmacology, and internal medicine. A range of supplementary topics is also included, including neurosurgery, neuropathology, neurorehabilitation, neurogenetics, sleep medicine, forensic psychiatry, epidemiology, and public policy. Fellowship training in this subspecialty requires the participation of faculty from both the psychiatry and the neurology departments at each institution, and requires that these faculties possess expertise in this area and the ability to provide clinical training in a transdisciplinary manner. A minimum of one year is

required for fellowship training in BN&NP, and more time can be arranged as indicated by the individual fellow's interests and the availability of program resources.

Although many fellowship trainees may work in academic settings upon completing their training, community practice opportunities are emerging rapidly. Among these are: (1) the need for physicians prepared to care for patients with complex, multifactorial disorders of behavior that call upon the expertise of both neurology and psychiatry; (2) the aging of the population in industrialized countries that will render more people at risk for common late-life neurodegenerative disorders such as Alzheimer's disease (AD); (3) the continuing epidemic of traumatic brain injury (TBI) in times of peace as well as in war; and (4) astonishing advances in diagnosis and treatment of many neuropsychiatric disorders that formerly had mysterious etiologies, limited therapeutic options, and relatively poor prognoses. Certification in BN&NP will enhance opportunities by signifying special competence in these disciplines.

Future prospects

While gazing ahead is always fraught with uncertainty, some speculations about where the future will lead are warranted as this combined subspecialty moves ahead. One prediction likely to be met is that the intellectual vigor of these fields will stimulate much continued discussion and steady development of concepts.

A major goal of these two disciplines is the integration of structural and molecular paradigms in constructing a modern synthesis of brain-behavior relationships. As discussed above, those who think about structural brain lesions can learn from those whose emphasis is on abnormal neurotransmission, and surely the converse is true as well. How does the intricate neurochemistry of the brain map onto the familiar gyri, tracts, and nuclei to enrich our knowledge of distributed neural networks? Such a portrait will enable increasing sophistication of medical and surgical therapy based on manipulation of neuroanatomically localized neurotransmitter systems. A complete understanding of the brain as the organ of the mind requires the unification of knowledge from both traditions.

This approach may plausibly lead to the reintegration of Freudian thinking into the mainstream of medicine. Freud himself harbored the belief

that the phenomena of psychoanalytic theory – the unconscious, the id, ego, and superego, repression, transference, dream analysis, and the like – would someday find correlates in the brain, and that a neurobiological model of the mind would develop [10]. Such a synthesis may become more feasible with modern investigative techniques [42]. Subspecialists in BN&NP do not see a need to vindicate Freudianism – indeed, difficulty establishing the neural basis of psychoanalytic theory and its clinical efficacy has been a major source of criticism – but the notion that complex psychological processes have a basis in brain function is fundamental. Freudian concepts may not readily be seen to correlate with brain structures as our understanding increases; however, the behaviors Freud observed in his patients – like any other – should result from the operations of neural systems. As Geschwind aptly wrote: “It must be realized that every behavior has an anatomy” [43]. The ultimate goal is to understand how the brain mediates behavior, whether investigators use a model of structural cortical damage affecting language, or examine altered neurotransmitter systems that influence personality.

A topic sure to garner much attention is the continued application of functional imaging technology to understanding brain-behavior relationships. The lesion method has a time-honored tradition in behavioral neurology, and will continue to flourish, but what of functional magnetic resonance imaging (fMRI), positron emission tomography (PET), single-photon emission computed tomography (SPECT), and the like? Will these tools add significantly to the understanding of brain and behavior, or will they turn out to be no more than neo-phrenological instruments producing appealing but easily misinterpreted images? The impressive technique of fMRI has become the most promising of these modalities, about which thousands of research papers are now published every year, but fMRI remains limited by the extraordinary complexity of the brain's functional organization [44]. SPECT scanning has the advantage of being readily available, but has proven disappointing when applied to clinical disorders [45].

At the same time, much excitement attends the advances of structural neuroimaging, which is now disclosing details of neuroanatomy and neuropathology as never before. Exploiting the remarkable success of MRI, investigators are pursuing more detailed volumetric quantitation of cerebral structures with voxel-based morphometry [46], and measurement of the

chemical composition of brain regions has become possible with magnetic resonance spectroscopy [47]. The study of white matter, long relegated to the background of cognitive neuroscience as the cerebral cortex has dominated thinking and research, will now be feasible with diffusion tensor imaging [48], which is generating elegant depictions of white matter tracts in health and disease. White matter disorders in general will stimulate wide-ranging investigation as the importance of white matter for human behavior is increasingly appreciated [49, 50]. All of these techniques create a context in which the study of the structure of distributed neural networks can be integrated with an understanding of their functional connectivity and role in neurobehavioral health and disease.

Advances in genetics that are occurring at a rapid pace will also enhance understanding and clinical diagnosis of neurobehavioral disorders. Testing for autosomal dominant transmission in Huntington's disease is a straightforward and well-known example of how genetic analysis can be applied clinically [51], and the list of genetic diseases in which such testing can be considered is quickly growing. Genetic testing for AD, while only exceptionally providing definitive results for patients and families, is gradually improving [52], and may be able to identify presymptomatic individuals in whom dementia can someday be prevented. While these developments are encouraging, the reality that genetic diseases are, presently, for the most part irreversible provides a strong impetus for further study of the pathogenesis of neurogenetic disorders.

Nevertheless, treatment of patients with disorders of all types affecting behavior will surely come to be a major topic in the coming years. Many of the treatment options for patients with these disorders are based on scanty evidence, and convincing clinical trials are sorely needed. Randomized controlled trials for treatment of AD have been familiar to clinicians for decades, and serve as a model for large-scale investigation of treatments for a host of cognitive disorders. Traumatic brain injury occupies a major portion of the practice of many subspecialists in BN&NP and additional studies are needed to better define the best methods of neurorehabilitation. More study of neurosurgical interventions, such as for the treatment of neoplasms and hydrocephalus, will be helpful. More controversially, the oft-reviled area of psychosurgery may merit reconsideration as a treatment option for those with intractable and devastating disorders, particularly as modern surgical techniques permit

more precise procedures and research advances allow accurate evaluation of safety and efficacy [53]. The assessment of the efficacy of psychotherapy – recognized three decades ago to be a neurobiological phenomenon in which the brain undergoes synaptic change as in any other kind of learning [54] – is now feasible by functional neuroimaging [55], and is being further pursued. Evolving new modalities such as embryonic stem cell transplantation [56], gene therapy [57], deep brain stimulation [58], and transcranial magnetic stimulation [59] hold forth much promise. In the foreseeable future, basic science advances may disclose strategies for enhancing synaptic plasticity [60], stimulating remyelination [61], and promoting neurogenesis [62] – even in the brains of older adults.

Lastly, a host of issues with public policy implications spring directly from the advances of BN&NP. Some examples will prove illustrative. What are the sociopolitical implications of the study of aggression, violence, and war as neurally based behaviors [63]? Which individuals with brain disorders should be held accountable for criminal behavior and punished, and which should be exonerated and treated as patients? How is the question of free will to be addressed in light of modern technology? What are the implications for individuals who will be found to have genetic diseases for which no cure is available? Will new treatments for cognitive disorders involving the activation of endogenous or surgically implanted stem cells produce cures for dreaded diseases, or might they possibly result in grossly aberrant behavior from novel and unpredictable neuronal connections? What are the implications of detecting residual cerebral activity with fMRI in patients diagnosed with vegetative or minimally conscious state? While not presuming to answer such imposing questions, subspecialists in BN&NP are ideally suited to illuminate the issues and inform public discourse so that society can more rationally adopt meaningful solutions.

Whither Behavioral Neurology & Neuropsychiatry?

As this book goes to press, several clinical neuroscientific principles enjoy wide support: the constructs of mindless brain and brainless mind are outdated, the descriptors organic and functional are no longer meaningful, and human behavior is usefully conceptualized as no more, or less, than the product of brain activity. From these statements, hard won

through much effort over many years, all physicians dealing with neurobehavioral or neuropsychiatric disorders can legitimately aspire to be both objective and humanistic. Behavior is a measurable neural phenomenon, but its understanding also requires an exceptional degree of interpersonal sensitivity and interpretive skill. Nowhere is the art of medicine more critical – objective data such as mental status test scores and neuroimaging findings must be adroitly combined with subjective assessment of the person suffering with the disorder. The notion that only those in neurology can lay claim to neuroscience, while only those in psychiatry can appreciate the whole person, is confining, inaccurate, and unproductive. But there remains the issue of what exactly is the subject matter of BN&NP.

A reasonable listing of the major disorders currently regarded as falling within the scope of this subspecialty includes the focal neurobehavioral syndromes (e.g., aphasia, apathy, orbitofrontal syndrome); delirium, dementia (e.g., AD), and major primary psychiatric disorders; neurological conditions with prominent cognitive, emotional, and behavioral features such as movement disorders, stroke, epilepsy, multiple sclerosis, and TBI [2]. Others can be added to or subtracted from this list, and physicians will naturally gravitate toward those disorders for which their training and inclination render them most suitable. Many subspecialists in BN&NP with primary training in neurology assume the care of dementia or stroke with focal syndromes, for example, while those with primary training in psychiatry take on schizophrenia, depression, obsessive-compulsive disorder, and the psychiatric sequelae of neurological conditions. Traumatic brain injury appears to be a special case, as subspecialists in BN&NP are increasingly committed to this common problem [64, 65]. As knowledge of brain–behavior relationships grows, these areas can be expected to evolve concomitantly, and with them practice patterns as well.

Despite the enthusiasm generated by the development of BN&NP as a subspecialty [1], uncertainty persists about the future organization and direction of the combined field. Will a single name for this discipline come to replace the combined moniker? If so, what should it be? Perhaps “cognitive neuroscience” would suffice, but does this adequately capture the disorders traditionally considered to be “emotional?” An alternative is “medical neuroscience,” which serves to distinguish it from the surgical neurosciences but its

referents may be too broad. Will neurology and psychiatry residences modify their curricula to reflect a converging interest in brain–behavior relationships? Will there be combined clinical services where “neurologic” and “psychiatric” patients with cognitive disorders are evaluated and treated as a single group with altered brain function? Many influential opinions will doubtlessly line up on all sides of such questions.

Whether some overarching category comes to encompass all the work in these fields remains to be disclosed, and we do not presume to make a prediction. For now, we believe this evolving alliance stands as a productive approach to bridge the gaps between neurology and psychiatry, body and mind, physical and mental. Whatever one’s perspective on the status of the subspecialty, continuing advances in understanding neuroscience as applied to patient care, education, and research demand attention. Given the powerful recent findings of neuroscience, adopting this attitude in clinical medicine seems eminently appropriate. Our attitude has always been that getting the work done is far more important than debating what to call ourselves.

About this book

We have noted, as have many before us, that neurology and psychiatry suffer needlessly from arbitrary interdisciplinary barriers, maintained by the power of tradition, that often impede intellectual progress. While differences between these fields clearly exist and will not soon disappear, their commonalities promise to further understanding of brain–behavior relationships as never before. BN&NP represents the flagship subspecialty that aims to find and develop the intellectual common ground that beckons so strongly to students of human behavior. The mind and the brain are but two constructs describing the same entity, and medicine and society are best served by acknowledging this fundamental principle.

This book reflects our view of the clinical neuroscience of behavior in the context of patients coping with a host of brain disorders, be they neurologic or psychiatric. Intended primarily for physicians and investigators entering the field or early in their careers, we hope the book can both inform and inspire its readers. Those farther along in their careers may also find information of value in these pages. We hope this book builds upon and extends the work of many previous volumes from which we have learned [8, 34–38] in a

comprehensive attempt to draw behavioral neurology and neuropsychiatry closer. We present this book in the spirit of promoting this effort for the good of our patients, our profession, and our world.

The structure of the book follows the core curriculum for fellowship training discussed above [2]. Included are major sections on structural and functional neuroanatomy, assessment, and treatments, reflecting the primary topic areas for fellowship training [2]. The book is intended to convey principles of BN&NP rather than to present an exhaustive account of disease states. Accordingly, condition-specific chapters are not presented. Instead, disorders will be introduced when they serve to illustrate the principles under consideration. Readers may recognize points made in our previous work that have served to build a foundation for this text [66, 67], but this book offers something new: our combined approach to this intriguing area, including the expert contributions of many colleagues who have graciously devoted their time and effort to this project, that we hope will serve as a model for productive transdisciplinary collaboration.

References

1. Silver JM. Behavioral neurology and neuropsychiatry is a subspecialty. *J Neuropsychiatry Clin Neurosci*. 2006;18(2):146–8.
2. Arciniegas DB, Kaufer DI, Joint Advisory Committee on subspecialty Certification of the American Neuropsychiatric Association, Society for Behavioral and Cognitive Neurology. Core curriculum for training in Behavioral Neurology & Neuropsychiatry. *J Neuropsychiatry Clin Neurosci*. 2006;18(1):6–13.
3. Price BH, Adams RD, Coyle JT. Neurology and psychiatry: closing the great divide. *Neurology* 2000;54(1):8–14.
4. Martin JB. The integration of neurology, psychiatry, and neuroscience in the 21st century. *Am J Psychiatry* 2002;159(5):695–704.
5. Yudofsky SC, Hales RE. Neuropsychiatry and the future of psychiatry and neurology. *Am J Psychiatry* 2002;159(8):1261–4.
6. Sachdev PS. Whither neuropsychiatry? *J Neuropsychiatry Clin Neurosci*. 2005;17(2):140–4.
7. Pies R. Why psychiatry and neurology cannot simply merge. *J Neuropsychiatry Clin Neurosci*. 2005;17(3):304–9.
8. Cummings JL, Mega MS. *Neuropsychiatry and Behavioral Neuroscience*. Oxford: Oxford University Press; 2003.
9. Arciniegas DB. Neuropsychiatry – an introduction and brief history. In Arciniegas DB, Beresford TP, editors. *Neuropsychiatry: An Introductory Approach*. Cambridge: Cambridge University Press; 2001, pp. 3–12.
10. Encyclopaedia Britannica Inc., University of Chicago, Hutchins RM. *Great Books of the Western World*. Founders' edition. Chicago, IL: W. Benton; 1952.
11. Griesinger W. *Mental Pathology and Therapeutics*. 2nd edition. New York, NY: William Wood & Company; 1882.
12. Freud S, Strachey J, Freud A *et al*. *The Standard Edition of the Complete Psychological Works of Sigmund Freud*. London: Hogarth Press; 1953.
13. Hollender MH. *American Board of Psychiatry and Neurology: The First Fifty Years*. Deerfield, IL: American Board of Psychiatry and Neurology; 1991.
14. Schachter SC, Devinsky O. *Behavioral Neurology and the Legacy of Norman Geschwind*. Philadelphia, PA: Lippincott-Raven; 1997.
15. Geschwind N. Disconnexion syndromes in animals and man. I. *Brain* 1965;88(2):237–94.
16. Geschwind N. Disconnexion syndromes in animals and man II. *Brain* 1965;88(3):585–644.
17. Damasio AR. Behavioral neurology – research and practice. *Semin Neurol*. 1984;4(2):117–19.
18. Mesulam M (editor). Behavioral neuroanatomy. Large-scale neural networks, association cortex, frontal systems, the limbic system and hemispheric specializations. In *Principles of Behavioral and Cognitive Neurology*. 2nd edition. Oxford: Oxford University Press; 2000, pp. 1–120.
19. Caine ED, Joynt RJ. Neuropsychiatry... again. *Arch Neurol*. 1986;43(4):325–7.
20. Yudofsky SC, Hales RE. The reemergence of neuropsychiatry: definition and direction. *J Neuropsychiatry Clin Neurosci*. 1989;1(1):1–6.
21. Trimble MR. Neuropsychiatry or behavioral neurology. *Neuropsychiatry Neuropsychol Behav Neurol*. 1993;6(1):60–4.
22. Benson DF. Neuropsychiatry and behavioral neurology: past, present, and future. *J Neuropsychiatry Clin Neurosci*. 1996;8(3):351–7.
23. Luria AR. *Higher Cortical Functions in Man*. 2nd edition. New York, NY: Basic Books; 1980.
24. Turner R. Magnetic resonance imaging of brain function. *Ann Neurol*. 1994;35(6):637–8.
25. Raichle ME. Visualizing the mind. *Sci Am*. 1994; 270(4):58–64.
26. Searle JR. *Minds, Brains, and Science*. Cambridge, MA: Harvard University Press; 1984.

27. Descartes R. *Discourse on Method*. 2nd (rev.) edition. New York, NY: Liberal Arts Press; 1956.
28. Damasio AR. Descartes' error and the future of human life. *Sci Am*. 1994;271(4):144.
29. Churchland PS. *Neurophilosophy: Toward a Unified Science of the Mind-Brain*. Cambridge, MA: MIT Press; 1986.
30. Dennett DC. *Consciousness Explained*. 1st edition. Boston, MA: Little, Brown and Co.; 1991.
31. American Psychiatric Association. Work Group to Revise DSM-III. *Diagnostic and Statistical Manual of Mental Disorders, Third Edition Revised: DSM-III-R*. Washington, DC: American Psychiatric Association; 1987.
32. Miresco MJ, Kirmayer LJ. The persistence of mind-brain dualism in psychiatric reasoning about clinical scenarios. *Am J Psychiatry* 2006;163(5): 913–18.
33. Filley CM, Arciniegas DB, Wood GV *et al*. Geriatric treatment center: a contemporary model for collaboration between psychiatry and neurology. *J Neuropsychiatry Clin Neurosci*. 2002;14(3):344–50.
34. Devinsky O. *Behavioral Neurology: 100 Maxims*. 1st edition. New York, NY: Mosby-Year Book; 1992.
35. Feinberg TE, Farah MJ. *Behavioral Neurology and Neuropsychology*. New York, NY: McGraw-Hill; 1997.
36. Rizzo M, Eslinger PJ. *Principles and Practice of Behavioral Neurology and Neuropsychology*. Philadelphia, PA: W.B. Saunders; 2004.
37. Yudofsky SC, Hales RE. *The American Psychiatric Publishing Textbook of Neuropsychiatry and Clinical Neurosciences*. 4th edition. Washington, DC: American Psychiatric Publishing; 2002.
38. Schiffer RB, Rao SM, Fogel BS. *Neuropsychiatry*. 2nd edition. Philadelphia, PA: Lippincott Williams & Wilkins; 2003.
39. Crick F. *The Astonishing Hypothesis: The Scientific Search for the Soul*. New York, NY: Scribner and Maxwell Macmillan International; 1994.
40. Gazzaniga MS. *The Ethical Brain*. New York, NY: Dana Press; 2005.
41. Heilman KM. *Creativity and the Brain*. New York, NY: Psychology Press; 2005.
42. Carhart-Harris RL, Mayberg HS, Malizia AL, Nutt D. Mourning and melancholia revisited: correspondences between principles of Freudian metapsychology and empirical findings in neuropsychiatry. *Ann Gen Psychiatry* 2008;7:9.
43. Geschwind N. The borderland of neurology and psychiatry: some common misconceptions. In Benson DF, Blumer D, editors. *Psychiatric Aspects of Neurological Disease*. New York, NY: Grune & Stratton; 1975, pp. 1–8.
44. Logothetis NK. What we can do and what we cannot do with fMRI. *Nature* 2008;453(7197):869–78.
45. Wortzel HS, Filley CM, Anderson CA, Oster T, Arciniegas DB. Forensic applications of cerebral single photon emission computed tomography in mild traumatic brain injury. *J Am Acad Psychiatry Law* 2008;36(3):310–22.
46. Ashburner J, Friston KJ. Why voxel-based morphometry should be used. *Neuroimage* 2001; 14(6):1238–43.
47. Ross B, Michaelis T. Clinical applications of magnetic resonance spectroscopy. *Magn Reson Q*. 1994;10(4): 191–247.
48. Assaf Y, Pasternak O. Diffusion tensor imaging (DTI)-based white matter mapping in brain research: a review. *J Mol Neurosci*. 2008;34(1):51–61.
49. Filley CM. *The Behavioral Neurology of White Matter*. 2nd edition. New York, NY: Oxford University Press; 2012.
50. Schmahmann JD, Pandya DN. *Fiber Pathways of the Brain*. Oxford: Oxford University Press; 2006.
51. Myers RH. Huntington's disease genetics. *NeuroRx*. 2004;1(2):255–62.
52. Howard KL, Filley CM. Advances in genetic testing for Alzheimer's disease. *Rev Neurol Dis*. 2009;6(1): 26–32.
53. Anderson CA, Arciniegas DB. Neurosurgical interventions for neuropsychiatric syndromes. *Curr Psychiatry Rep*. 2004;6(5):355–63.
54. Kandel ER. Psychotherapy and the single synapse. The impact of psychiatric thought on neurobiologic research. *N Engl J Med*. 1979;301(19): 1028–37.
55. Linden DE. How psychotherapy changes the brain – the contribution of functional neuroimaging. *Mol Psychiatry* 2006;11(6):528–38.
56. Khanna A, Shin S, Rao MS. Stem cells for the treatment of neurological disorders. *CNS Neurol Disord Drug Targets* 2008;7(1):98–109.
57. Okada T, Shimazaki K, Nomoto T *et al*. Adeno-associated viral vector-mediated gene therapy of ischemia-induced neuronal death. *Methods Enzymol* 2002;346:378–93.
58. Schiff ND, Fins JJ. Deep brain stimulation and cognition: moving from animal to patient. *Curr Opin Neurol* 2007;20(6):638–42.
59. Rossini PM, Rossi S. Transcranial magnetic stimulation: diagnostic, therapeutic, and research potential. *Neurology* 2007;68(7):484–8.

60. Wieloch T, Nikolich K. Mechanisms of neural plasticity following brain injury. *Curr Opin Neurobiol.* 2006;**16**(3):258–64.
61. Franklin RJ, Kotter MR. The biology of CNS remyelination: the key to therapeutic advances. *J Neurol.* 2008;**255**(Suppl. 1):19–25.
62. Zhao C, Deng W, Gage FH. Mechanisms and functional implications of adult neurogenesis. *Cell* 2008;**132**(4):645–60.
63. Filley CM, Price BH, Nell V *et al.* Toward an understanding of violence: neurobehavioral aspects of unwarranted physical aggression: Aspen Neurobehavioral Conference consensus statement. *Neuropsychiatry Neuropsychol Behav Neurol.* 2001; **14**(1):1–14.
64. Kelly JP, Nichols JS, Filley CM *et al.* Concussion in sports. Guidelines for the prevention of catastrophic outcome. *J Am Med Assoc.* 1991;**266**(20): 2867–9.
65. Arciniegas D, Adler L, Topkoff J *et al.* Attention and memory dysfunction after traumatic brain injury: cholinergic mechanisms, sensory gating, and a hypothesis for further investigation. *Brain Inj.* 1999;**13**(1):1–13.
66. Filley CM. *Neurobehavioral Anatomy.* 3rd edition. Boulder, CO: University Press of Colorado; 2011.
67. Arciniegas DB, Beresford TP. *Neuropsychiatry: An Introductory Approach.* Cambridge: Cambridge University Press; 2001.