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Our Traumatic Neurosis and Its Brain

Allan Young

Department of Social Studies of Medicine
McGill University
Montreal (Quebec), Canada

Argument

During the nineteenth century, physicians either discovered or invented a variety of clinical autobiography called "traumatic memory." Freud produced two versions of this memory, the final version in the 1920s. A revolutionary nosology (DSM-III), adopted in 1980, promised to extirpate Freud and the concept of neurosis from American psychiatry. However, it made a tacit exception for Freud's concept of traumatic neurosis, renaming it "posttraumatic stress disorder." The following decades have been a period of intense clinical and scientific interest in this disorder. An influential research program has investigated traumatic neurosis and its brain through variations in cortisol excretion. I describe the history of this program and examine its distinctive knowledge product: its running narrative of its achievements. The narrative's structure is analyzed and found to resemble a crossword puzzle constructed from heterogeneous kinds of inference, recalling *The Interpretation of Dreams*. My conclusion is that, far from extirpating Freud's neurosis, biological research has secured a place for it in today's post-Freudian psychiatry.

When the term "psychiatric trauma" is used today, it is generally in connection with the malady called *posttraumatic stress disorder* (PTSD). The idea that underlies psychiatric trauma is that disturbing experiences can create painful, persistent, and intrusive memories. Victims defend themselves by avoiding environments that might trigger recall, by driving the memories out of awareness, and by numbing themselves in order to reduce the memory's impact when it does enter consciousness. The combined effects of the trauma are psychological, behavioral, and physiological (autonomic nervous system arousal). This syndrome was first identified in the late nineteenth century; PTSD is a more recent phenomenon, dating to 1980 and the publication DSM-III (*Diagnostic and Statistical Manual of Mental Disorders of the American Psychiatric Association* – third edition).

In 1980, diagnosed cases of PTSD were limited mainly to American veterans of the Vietnam War. Two decades later, it is estimated that nearly one-fifth of American women and one-tenth of American men have had episodes of PTSD. Active cases in

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the general population in the United States are estimated in the range of five per cent. This would mean that nearly seven million Americans have diagnosable, but largely undetected, cases of PTSD (Breslau 1993). The disorder's prevalence in Africa, Asia, and the Balkans is calculated to be much greater. These numbers include war-related cases but also PTSD resulting from natural catastrophes, unreported domestic violence, and child abuse (Shalev et al. 2000, part III). Many of these people subsequently enter North America, Western Europe, and Australia as refugees and asylum seekers (Silove et al. 2000).

In less than a decade, PTSD had acquired a contagious quality, manifested variously in "transgenerational PTSD" (transmitted from parents or grandparents to offspring), "vicarious PTSD," "compassion fatigue," "secondary PTSD" (therapists "reexperience" patients' traumatic memory in their own dreams and mental images), and "factitious PTSD" (cryptomnesia, a psychological identification with someone else's traumatic experiences) (Figley 1995; Motta et al. 1997; Solomon et al. 1988; Yehuda, Beirer, et al. 2000). There has been a corresponding extension in the effects attributed to PTSD. In 1980, symptoms were limited mainly to dreams, intrusive images, phobias, numbing, difficulty concentrating, irritability, and so on. Today, a variety of bodily symptoms, notably localized pain, are associated with traumatic memory, mainly as signifiers of repressed or dissociated content (van der Kolk 1996; van der Kolk et al. 1996). PTSD is said to play a decisive role in the onset of other mental disorders, ranging from multiple personality disorder to schizophrenia, and somatic diseases (Pynoos et al. 1999). Researchers report "that women with histories of chronic sexual abuse had more immunological disorders than other women . . . [and] that people who were exposed to traumatic events as children were much more likely to develop lung disease, obesity, diabetes, heart disease, cancer and drug and alcohol addictions" (Cohen 1999, A21; also Kawamura et al. 2001). A recent article in the journal *Biological Psychiatry* adds PTSD's developmental effects to the list, and goes on to suggest that trauma-induced damage to the brain's hippocampus may impair the intellectual endowment of the American underclass. "Our inner cities are plagued by an epidemic of urban violence that affects our nation's children on a daily basis. The hippocampus plays a role in new learning and memory. If stress impairs the ability of children to learn, this could have important public health implications" (Bremner 1999, 802).

If these assessments are correct, the personal and social costs of PTSD are staggering. In 1998, the US National Institute of Mental Health (NIMH) launched an initiative to increase public awareness of the seriousness and pervasiveness of PTSD. At a news conference, the director of the NIMH described PTSD as a "frightening" mental illness whose victims "experience feelings of overwhelming fear and anxiety that are chronic, unremitting, and worsen progressively when left untreated." The good news is that "recent advances in neuroscience . . . have revealed how and where memories of fear are stored in the brain, and how traumatic experience alters brain structure." The director hoped that on-going research will

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"lead to the development of highly targeted treatments that will greatly improve the lives of [these] people" (quoted in Sharkey 1999).

A Traumatic Neurosis Is Reborn

Let us go back to 1980. The adoption of DSM-III was a revolutionary moment in the history of American psychiatry, an epistemological break with the past (Young 1995, ch.3). The editorial task force wanted diagnostic classifications to be symptom-based and empirical, and they rejected any references to invisible mental processes. Symptom-based classifications would be compatible with all of the major clinical orientations in American psychiatry, they claimed. The psychoanalytical community disagreed, on the grounds that psychiatric problems are products of dynamic processes that express themselves in the form of polymorphous symptoms. Disorders cannot be reduced to unvarying diagnostic criteria. Yet this is what DSM-III would demand.

The DSM-III system quickly became the American standard for medical education, record keeping, insurance and billing, and publication in mainstream psychiatric journals. Psychoanalysts described DSM-III as an institutional *coup d'etat*, directed against them. If so, its most obvious victim was the concept of *neurosis*. DSM-III spends two pages to explain why the neurosis concept must be eliminated. Its reference point is Freud, who is said to have employed "neurosis" in two ways. He used it *descriptively*, for persistent or recurrent symptoms in a person whose reality testing is intact, in contrast with "psychosis." He used the term *etiologically*, for disorders rooted in mental conflicts. According to Freud, conflict arouses anxiety, against which the patient mobilizes defenses. The defenses are expressed clinically as symptoms. By editorial *diktat,* DSM-III limited neurosis to the descriptive sense. "Neurosis" is mentioned seven times in the main text, each time following the name of approved classifications, as in "Hypochondriasis (Hypochondriacal Neurosis)." The next edition, DSM-IIIR (1987), retains this convention. The current edition, DSM-IV (1994), deletes "neurosis" altogether, dropping it into the waste-bin of psychiatric history, along with "monomania" and "psychasthenia."

Or so it might appear. Freud's primary interest was in neuroses rooted in psychosexual conflicts. But this was not his only interest. Throughout his life, he was also intrigued by the *traumatic* kind of neurosis. It was the subject of his earliest clinical writing, in *Studies on Hysteria* (1893–95), and he returned to it throughout his life, in *Totem and Taboo* (1913), *Beyond the Pleasure Principle* (1920), *Group Psychology and the Analysis of the Ego* (1920), *Inhibitions, Symptoms and Anxiety* (1926), and *Moses and Monotheism* (1938). As described by Freud, psychosexual and traumatic neuroses are similar in many respects, notably in the role of memory in pathogenesis, the idea that symptoms are polymorphous adaptations to anxiety, the neurotic propensity to repeat past events, and the possibility of contagion (notably in the "transference neurosis"). Resemblance is strongest when the traumatic neurosis is chronic and its onset is delayed, occurring long after the etiological experience. And it was precisely these

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kinds of cases that dominated research and theorizing on PTSD at the time of DSM-III.

Although DSM-III does not mention Freud's notion of traumatic neurosis, the concept is there, among the anxiety disorders, renamed "posttraumatic stress disorder" (cf. the accounts in Van der Kolk and McFarlane 1996, and Yehuda 1999). The PTSD entry was the work of the Committee on Reactive Disorders. Its canonic text was Abram Kardiner's *Traumatic Neuroses of War* (1941). Kardiner's clinical vignettes were drawn from his experiences as a clinician treating chronic posttraumatic syndromes in a Veterans Administration hospital during the 1920s (Shephard 2000, 154–157). He had been psychoanalyzed by Freud a short time before taking this clinical position, and the book's conceptual framework is based on Freud's explanation of traumatic neurosis in *Beyond the Pleasure Principle* and *Inhibitions, Symptoms and Anxiety* (Freud 1920 and 1926; Kardiner 1959 and 1977; Leys 1996).

Freud and likewise Kardiner emphasized the role of neurophysiological alterations for the production of the traumatic neurosis and its arousal symptoms – hyperalertness, exaggerated startle response, irritability, sleep disturbances, and so on (as listed in DSM-III). But Kardiner disagreed with Freud about the neurological mechanism that is involved in the disorder. In *Beyond the Pleasure Principle*, Freud wrote that science knows nothing about the excitatory process produced by traumatic shock, but that we must assume that a great quantum of energy is created by the shock, and that it floods the "psychical system" and disrupts its normally quiescent state. The system is protected by a shield, a *Reizschutz*, that "binds" excessive energy in a state called "hypercathexis." However, in the case of traumatic shock, the individual's "mental apparatus" is caught off guard and fails to activate the protective shield in time (Freud 1920, 58–60).

Freud's disparaging remark about the state of scientific knowledge ignored experimental research on laboratory animals that was being conducted at this time on shock and the "emergency response" (Kitcher 1992). It is at this point that Kardiner departs from him, by disposing of the *Reizschutz* theory. *The Traumatic Neuroses of War* links posttraumatic arousal to the functioning of the autonomic nervous system and the evolutionary logic of the fight or flight response. Both Freud and Kardiner believed that traumatized patients experienced symptomatic dreams and intrusive images, and responded to environmental triggers. These conditions kept the patient in a state of constant anxiety, and they interpreted this arousal as a sign of *preparedness*. According to Freud, symptomatic anxiety alerted the mental apparatus, so that it would be ready to protect itself from energy overload and perturbation on the next occasion. This explains the compulsion to repeat the trauma; it is ego's effort to master the situation that originally laid him low. Kardiner believed that anxiety and arousal prepared the organism for physical activity – either to escape from danger or to destroy it. In this way, Kardiner's thesis removed the traumatic neurosis and the repetition compulsion from Freud's psychical system and transported them to the neurophysiology of the medical mainstream. (The extreme cases are an exception.

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According to Kardiner, these patients entered an epileptoid state, in which the ego contracts and closes itself off and the outside world.)

Troublesome Memories

William Cullen coined the term "neurosis" in 1769 as a label for nervous disease. It was soon attached to a ragbag of symptoms and "functional" conditions, presumed to originate in neural pathologies. By the 1870s, physicians had adopted the now familiar distinction between neuroses and psychoses, identifying psychosis with gross disturbances affecting reason, instinct, or will (Beer 1996). When the DSM-III editors adopted a "descriptive" definition of neurosis, they were proposing to freeze the concept at this point. They would simply ignore later developments, including Freud's reformulation of the traumatic neurosis and Kardiner's modernization of Freud's neurological account.

In principle, the new DSM system was neurosis-free. In practice, DSM-III gave new life to this same concept. This consequence was neither an accident nor an oversight. The editorial board knew exactly what was happening, and were persuaded to make this exception. The rebirth of the traumatic neurosis was the work of a segment of Vietnam War veterans and their supporters in the psychiatric community and Congress. They argued that traumatized veterans were entitled to specialized psychiatric care and disability pensions because they suffered from a disorder that was equivalent to a work-related illness. The DSM-III editor convened an appropriate committee. Its members wanted to construct a diagnostic classification that would, among other things, maximize the war veterans' eligibility for psychiatric services and disability pensions (Scott 1993). According to the standards set by the Veterans Administration, eligibility requires evidence that the sickness is "service-connected." It cannot be the result of a preexisting condition, particular to the patient.

To achieve this goal, the Committee on Reactive Disorders had to solve three problems. The first was epidemiological. In 1980, it was apparent that only a minority of those people exposed to trauma level events develop a posttraumatic syndrome. Subsequent epidemiological research has confirmed this impression. Less than a third of American combat veterans of the Vietnam War had developed PTSD. Rape is a more toxic experience, but a majority of rape victims do not develop PTSD. Other categories of events are less traumatogenic. A survey of the general population indicates that 31 per cent of people who are badly beaten get PTSD, for people who are shot or stabbed the figure is 15 per cent, for people involved in serious auto accidents it is 6 per cent, and for people involved in natural disasters it is 4 per cent. Within each category, only half of the individuals go on to develop the chronic or "complex" form of PTSD (Breslau 1993; Paris 2000).

During World War I, British and German army doctors made similar observations, and found an efficient explanation. The majority opinion was that the shell shock syndrome developed in soldiers who had a constitutional weakness or an acquired

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vulnerability. It was not the etiological event that explained shell shock, but rather the patient's *diathesis* (e.g. Young 1999). The diathesis was necessary for the onset of shell shock, and also intrinsic to pathogenesis. That is, it explained the disorder's characteristic features. This *is* a solution to the epidemiological puzzle, but it would not work for the Committee on Reactive Disorders. The way out of the problem was to find a functional equivalent for the diathesis. This was provided by the notion of "risk factor" – an attribute of *clinical populations*, such as socioeconomic status, social support, education, that simply correlates with the incidence PTSD or exposure to trauma-level experiences (e.g., Kulka et al. 1990, ch.5; Brewin et al. 2000).

The Committee's second problem was etiological. The posttraumatic syndrome is driven by a memory of a disturbing event. But is this memory invariably a memory of an event that the patient experienced? Some nineteenth-century experts, notably Jean-Martin Charcot and Herbert Page, believed otherwise (Micale 2001). This was also the opinion of army doctors during World War I. The German physician, Max Nonne, claimed that, in cases of shell shock, traumatic memory invariably distorted actual experience, even in instances where patients developed neurological symptoms. In some cases, the "memory" was an image of what patients feared would happen if they remained in the trenches. In other cases, it was the opposite: the "memory" and symptoms represented what a man unconsciously hoped would happen to him – a disabling injury rendering him *hors de combat* (Lerner 2000). Nonne did nasty things to his patients. He was a practitioner of an electrical torture perfected by his colleague, Fritz Kaufmann, and he believed that the army doctor's primary responsibility is to the Fatherland and the war effort. Psychological casualties had to be coerced back into combat. It would be a mistake to bundle his theories together with his repellent personality. Nonne's ideas about the malleability of memory are not ridiculous, and they found support in psychological research conducted after the war (Bartlett 1932). It is not simply a matter of the patient becoming "fixated" on a particular memory, since episodic memory is *a process* and not an object, like a photograph. Within this process, the past interacts and intermingles with the person's current life situation and is affected by his psychological and emotional state. At different times, he produces different drafts but, at each point, has perfect confidence in the current version. Clinical practices aimed at recalling or recovering the past can profoundly affect this process, and explanatory models acquired by the patient can have a similar effect.

With the help of Freud, this perspective can be extended to include the traumatized Vietnam War veteran. In 1980, the debut of PTSD, these veterans were long removed from their wartime experiences. Up to this point, very few of these men connected their current psychological problems to particular experiences in Vietnam. When they learned about PTSD, the connection became obvious – an epiphany in some cases. Freud wrote about a similar process in connection with Oedipal memories. He called it *Nachträglichkeit* or "belatedness." His idea was that there are certain experiences that are neither salient nor meaningful when they occur, but acquire a special significance later on, after the person gains some new bit of

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knowledge that allows him to reassess the original experience. And now he understands its "real" meaning and his memory of the event acquires an emotional potency that it did not originally possess. It becomes a disturbing memory but only belatedly (Laplanche and Pontalis 1973, 111–114).

The process of belatedness is different from *repression*, i.e. instances in which traumatic memory is pushed out of consciousness and then reexperienced, after a period of latency. The Committee on Reactive Disorders accepted the possibility of repression, as a form of "avoidance," but ignored the issue of belatedness. The more general question, concerning the malleability of memory, was not ignored. Rather, it was interpreted in a way that vindicated the eligibility of PTSD as a service-connected disorder. The point, now taken for granted by traumatologists, was that traumatic memories are not merely pathogenic, they are also *abnormal*. Normal memories are malleable, but traumatic memories are abnormal, precisely because they are changeless. This quality is the source of their pathogenicity, a point made in two classic studies of hypermnesia, Théodule Ribot's *The Diseases of Memory* (1883) and A.R Luria's *The Mind of Mnemonist* (1968). Traumatic memories are not only characteristically unmalleable, they are also capable of capturing events with cinematic and photographic accuracy, in the form of "flashbacks" and "flashbulb memories" (Sierra and Berrios 1999; Krystal et al. 1995, 249–258; see Silove 1998 for an inquiry into the evolutionary origins of these peculiar memories).

Thus the malleability of traumatic memory can be boiled down to three possibilities: [1] the DSM-III Committee was correct, PTSD is a product of indelible traumatic memories; [2] Charcot, Page, and Nonne were correct, patients can imagine their traumatic memories into existence; [3] Freud was correct, traumatic memories can be products of belatedness; [4] all three explanations can be correct, although not necessarily in the same way.

Most psychiatric clinicians, including the members of the Committee, would pick [4], if we agree to place apostrophes around the word "traumatic" in numbers [2] and [3]. The clinical and experimental literature on memory and memory distortion also favors number [4] (Ceci 1995; Loftus et al. 1995; Schacter 1995). But [4] is simply a restatement of the malleability problem, not its solution. What is needed is a diagnostic technology that will effectively discriminate between [1], [2], and [3], on a case-by-case basis. That technology did not exist in 1980 (nor today). The Committee resolved this problem by shifting the diagnostic center of gravity from the patient (and the memory process) to the etiological event, now defined in *quantitative terms*, as an overwhelming force. On examining a patient, a diagnostician would now look for a trauma-level event and a PTSD-like syndrome. Once these two were identified, the correct link – a pathological and abnormal memory – could be simply assumed (for a recent exception, see Southwick et al. 1997).

This diagnostic logic was insulated from criticism by a moral argument that had arisen in the 1960s, in the context of race relations. It was the idea that the victims of oppression are often held responsible, by their oppressors, for their own afflictions.

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In 1980, many Americans, including psychiatrists, believed that traumatized veterans were victims and not just patients. Their symptoms – "survivor's guilt," "impacted grief," "psychic numbing" – mirrored a state of existential loss that went beyond distress. It was not simply that these men suffered, they had also been victimized. Americans had sent them to Vietnam and now punished them in their hour of need. High on the culpability scale were psychiatrists who, in their childish ignorance of war, would deprive them of their service-connected disability (Young 1995, chs.4 to 7).

The Committee's final problem was to show that PTSD is essentially different from the disorders with which it occurs. DSM-III imposed a categorical approach on psychiatric diagnosis; each classification is defined by a unique set of features. However, the symptoms listed for PTSD are superficially similar to the symptoms of depression and generalized anxiety disorders (Breslau and Davis 1987; Deering et al. 1996; cf. Friedman and Yehuda 1995). PTSD is distinguishable from the other disorders because traumatic memory alters the meaning of its symptoms. Phobia (anxiety disorder) is transformed into "avoidance" and ruminations (depression) into "reexperiences." This was an important issue in 1980 because eligible veterans were invariably diagnosed with the chronic form of this disorder. And chronic PTSD occurs together with other disorders, usually depression, generalized anxiety disorder, panic disorder, and alcohol and chemical substance use disorders. In most of these cases, the onset of the symptoms preceded the PTSD diagnosis by several years. And so, a clinician might wonder, did an abnormal memory cause my patient's syndrome, or is this a depressed, anxious, and dysfunctional man who is being helped to construct a serviceable etiology?

The Committee produced a diagnostic classification tailored to the requirements of a designated patient population. They defined a traumatic event as causing significant distress to anyone, anywhere. DSM-IV (1994) redefined traumatic events. One of its messages is that similar events can be perceived by different people in different ways. A space is opened for subjectivity. DSM-IV also expanded the range of experiences that qualify as "traumatic." DSM-III had defined traumatic events as out-of-the-ordinary. DSM-IV included quite ordinary (but awful) experiences. How ordinary? Epidemiologists report that lifetime exposure rates to trauma-level events in the general population (USA) may be as high as 90 per cent (Breslau 1993). The textual differences between the two DSMs are significant, but the practical differences are not great. The DSM-III definition of traumatic event was routinely diluted by diagnosticians, even in the case of veterans. The DSM-IV revisions simply codified what had become a convention by the end of the 1980s.

Investigating PTSD

Research on PTSD has proceeded via four approaches. The first is exemplified by Judith Herman's popular book, *Trauma and Recovery* (1992). It aims at an empathetic

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understanding of the life world of traumatized patients, and a historical, political, and moral perspective on psychiatric discourse, institutions, and clinical practices. The second approach is epidemiological, focusing on populations rather than individuals and case studies. Its mode of analysis is statistical and it relies on standardized measures and instruments rather than clinical insight. The third approach is pharmaceutical. In the 1980s, VA psychiatrists conducted drug research on PTSD, without notable success (e.g. Friedman and Southwick 1995). In the 1990s, the market for PTSD drugs expanded and pharmaceutical companies have responded, hoping to obtain approval of the US Food and Drug Administration to extend their current antidepressants to include treatment of PTSD. Market expansion can be traced to four factors: the broadened definition of "traumatic events"; the emergence of a quasi-diagnosis called "partial PTSD," in which one finds the traumatic process without the full-blown syndrome; the increased importance of primary care physicians in diagnosing and treating common mental disorders, mainly with drugs; and the stigma-free nature of PTSD, compared with alternative diagnoses. The final approach is biological and concentrates on the neuropathophysiology and neuropathoanatomy of PTSD.

A Program and a Puzzle

The remainder of this paper is about a biological research program. The program begins in 1980s, at Yale Medical School, with a series of experiments directed by John Mason, a senior investigator in the neurophysiology of stress. In the 1990s, leadership shifts to Rachel Yehuda, a physiological psychologist, at the Mt. Sinai Medical School and the Bronx Veterans Affairs Medical Center (New York City).

I am using the term *research program* to identify a continuing series of linked experiments, conducted by a network of researchers, connected to one another through ties of co-authorship and as co-investigators and consultants on research grants. The projects that compose the program are linked in two ways. Earlier projects provide a platform for designing later projects. In time, the program grows more self-sufficient and inter-referential, supplying itself with new hypotheses and data needed for rescuing old hypotheses. Second, the program produces it own history – a running narrative of its projects and the matrix in which they evolved. The running narrative consists of multiple texts – fragments and drafts – published in research articles (inserted into opening and concluding sections) and overviews, with titles such as "Conflict between current knowledge about posttraumatic stress disorder and its original conceptual basis" (Yehuda and McFarlane 1995).

The structure of the running narrative can be compared to a crossword puzzle. I borrow this metaphor from Susan Haack, a philosopher of science: "How reasonable a crossword entry is depends on how well it is supported by its clue and any already completed intersecting entries; how reasonable those other entries are, independent of the entry in question; and how much of the crossword has been completed . . . .

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Progress in the sciences is ragged and uneven, and each step, like each crossword entry is fallible and revisable" (Haack 1999, 12, 13; see also Haack 1993, 81–93). I am going to depart from Haack's metaphor at three points. Haack refers collectively to "the sciences." I focus on just one discipline, "psychiatric science," and a single field, PTSD. I don't know whether my observations can be generalized to other disciplines and fields. Second, Haack intends her metaphor to represent how scientific knowledge grows via research. I have a different object. I want a metaphor that will help me describe how PTSD researchers represent their work (knowledge production) and why audiences find their narratives convincing. Finally, Haack assumes that scientific research has a trajectory, and she identifies it with progress. I don't make this assumption about the research program described here. The program's running narrative does have a trajectory and it does look like progress, but the program does not. (That is, I know no persuasive argument that leads to a different conclusion.) The program operates without a map or plan. "Knowing what to do next" consists mainly of investigating loose ends (the program's incongruous findings) and pursuing old hypotheses with new clinical populations and previously unexploited biotechnologies.

The puzzle metaphor is organized around three key terms: clue, entry, and intersection:

Clues consist of predictions (based on theories and earlier findings) and loose-ends (surprises revealed by previous research).

Entries consist of findings and interpretations. A *completed entry* is unopposed by any important group of experts.

An *intersection* is a point at which sets of findings obtained from different sources are found (or made) to concur. Intersections are created from the following sources: research conducted at different sites using similar technologies and populations (e.g. a replication study); research employing similar technologies on different populations (e.g. combat veterans compared with rape victims; depressed patients compared with PTSD patients); research employing complementary technologies on a shared object (e.g. researchers count glucocoritcoid receptors on leucocytes and later measure cortisol excretions after a dexamethasone challenge, in order to confirm cortisol hypo-excretion in association with PTSD); and analogies between different populations observed in different contexts (e.g., stressed rats analogized with stressed human subjects).

The project's running narrative is unlike a real crossword puzzle in two respects. The narrative is permanently incomplete, since entries and intersections continue to ramify, fed by continuing research within the program and by new links to other programs and publications. Second, in real crossword puzzles, clues are permanent and entries are tentative, until entire sections are completed. (Clues are printed and entries are penciled.) The situation is reversed in the running narrative. Entries (findings) are relatively permanent and it is the clues (hypotheses and loose ends) that can change. As we shall see, there is a point in the history of the research program, around 1995, when the clues undergo a wholesale revision.

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Representing Things

In the program's running narrative, research findings represent things. For instance, measurements of cortisol hypo-excretion represent a type of physiological abnormality. The job of the narrative is to construct *believable* things by intersecting findings. Findings are linked to things in various ways, most commonly through standardized instruments and practices, e.g. self-reported symptoms (findings) are linked to diagnostic classifications (things) via protocols. Connections are made in other ways too, including a kind of inference called *synedoche*, where a part is made to stand for the whole. Here is a schematized example (see Yehuda 1998 and Yehuda, Resnick, et al. 1993 for narratives, and Sapolsky 1996 and Bremner 1999 for background):

There are three research teams: A, B, and C. Team A is composed of stress researchers who work with laboratory animals. Teams B and C belong to our PTSD research network. Team A's research connects hyper-excretion of cortisol to neuronal death in the hippocampus (part of the brain's episodic memory system) via a shadowy pathogenic process. Team B's research shows that PTSD patients are hypo-excreters of cortisol. Team C's research shows that hippocampi in the PTSD group are smaller than in the control group. In the narratives that follow, Team B's findings are intersected with A's. The similarity is that cortisol excretion deviates from the norm in both cases. Team C's findings are intersected with A's. The similarity is that the size of the hippocampus deviates from the norm in both cases. And finally, B's cortisol findings are connected with C's hippocampus findings via the shadowy process identified by A. Thus the research conducted by Teams B and C have linked PTSD to an underlying pathophysiological process located in the hypothalamic-pituitary-adrenal axis.

But hold on a minute. Team A's experimental subjects are hyper-excreters, but Team B's subjects are hypo-excreters. Also, damage to the hippocampus is associated with memory loss but PTSD is associated with hypermnesia (indelible memories). There is no contradiction at this point, however, since the intersections are based on synedoche rather than Aristotelian logic. Both hypo- or hyper-excretion are made to stand for the same thing, an unidentified pathophysiological process. Likewise, both hypermnesia and hippocampus-linked memory loss can stand for the same thing, an unidentified trauma-linked memory system abnormality.

The program's research narratives and overviews are sewn together by scores of intersections and interpretations. In effect, every citation represents a new intersection. The connections are heterogeneous: positive and negative analogy, synecdoche, logical inference, convention, and so on. Every narrative has a trajectory, sometimes several, going from past to present and ending with a pay-off. A trajectory corresponds to a line of reasoning called *abduction*, or "reasoning to the best inference." Abduction is a *holistic* form of inference in that the strength of any single link or intersection obtains from its position within a matrix of intersections, i.e. the crossword puzzle.

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Prehistory: Walter Cannon and Hans Selye

It is time for *my* history of the research program and its running narrative. In this history, I will describe the program as going through the following stages. First, researchers discover a biological "trace" (cortisol) that moves PTSD to the hypothalamic-pituitary-adrenal (HPA) axis. Second, the trace permits the researchers to create an "epistemological thing" (hypocortisolism) around which the program and the running narrative are now organized. Third, clues are rewritten and the moral valence of the traumatic neurosis is reversed, going from normal to abnormal.

Before describing the history, a necessary bit of prehistory. Walter Cannon's investigations of the fear response are the research program's *terminus ad quo*. The fear response consists of bodily changes that permit the organism to complete the fight-or-flight behavior pattern. Neural impulses travel along sympathetic pathways to the adrenal glands, which are stimulated to secrete adrenalin (epinephrine). This is released into the bloodstream, and circulates to target organs, including the liver, which now releases sugar into the blood. This is transported to the organs required to exert themselves during the emergency response: heart, lungs, central nervous system, and skeletal muscles.

The response represents a catabolic run on the bank, and must be short-lived. In a celebrated experiment, Cannon demonstrated what happens when the response goes on too long. An experiment with a cat: neurons connecting the cerebral cortex are severed from the rest of its nervous system, and the cat is transformed into a "remnant" (Cannon's term). The remnant is induced to enter a state of "excessive activity of the sympathico-adrenal," paralleling what happens to an ordinary cat (or human being) during the fight-or-flight response. In the experiment, however, the process goes on and on and there is no return to the physiological *status quo ante* (homeostasis). The remnant's blood pressure gradually drops and eventually its heart stops beating.

Cannon imagined two possibilities: [1] fight-or-flight succeeds and the organism returns to homeostasis or [2] the response is prolonged to the point of systemic failure. Hans Selye, widely regarded as the father of physiological stress research, argued for a third possibility, namely that the organism might respond to a noxious stimulus (somatic, psychological) by *adapting* to it rather than struggling. The body then shifts to a new steady state, different from homeostasis. The new state is imperfect and causes excessive "wear and tear." This is the source of stress-related disease. Sometimes the organism makes mistakes and fails to discriminate between harmless and dangerous intrusions. The body's allergic response to hay fever pollen is an example.

Selye criticized Cannon for failing to go beyond the sympathetic-adrenal pathway, to the pathway that runs from hypothalamus to pituitary to adrenal cortex, at which point cortisol is secreted. Cortisol complements the effects of adrenalin during fight-or-flight reactions. It increases cardiovascular and pulmonary tone, lowers sensory thresholds (and increases sensitivity), inhibits anabolic processes such as inflammation,

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blocks energy storage, and mobilizes energy storage sites. Cortisol is released more slowly than adrenalin and continues to be secreted for longer period. Like adrenalin, it is a useful substance for researchers, since it circulates in the blood and leaks into the urine and saliva, and is easily collected and measured.

Stage One: The Road to Cortisol

The initial research was conducted by John Mason in 1986. He compared levels of catecholamines (epinephrine and norepinephrine) and cortisol levels in two groups: combat veterans with PTSD and individuals diagnosed with either bipolar disorder, major depression, paranoid schizophrenia, or undifferentiated schizophrenia. Mason anticipated finding higher levels of catecholamines and cortisol in the PTSD sample, consistent with the "increased sympathetic nervous system activity" associated with this disorder. In the experiment, the PTSD catecholamine levels were elevated, but the cortisol levels were significantly lower than in the other groups, except for the men with paranoid schizophrenia. This is a puzzling finding in a disorder that is driven by fear (fear of intrusive traumatic memories, fear built into traumatic reexperiences). Cortisol levels go down when they ought to go up; catecholamines and cortisol go in different directions when they should go in the same direction.

A solution is at hand. Mason cites (intersects) previous studies indicating that cortisol excretion can be suppressed in chronic fear situations through psychological mechanisms. In that work, researchers measured cortisol levels in women waiting for breast tumor biopsies and parents of children dying of leukemia (Friedman, Mason, and Hamburg 1963; Katz et al. 1970; Wolff et al. 1964). Significant differences in levels were found within each group, and a "chronic suppressive effect" was observed to occur among the people who deployed effective psychological defenses – especially denial. Here is a possible solution to the puzzle, since denial is also part of the symptomatology of PTSD (encoded as "avoidance" and "emotional numbing"). The plausibility of this explanation is strengthened by the finding that paranoid schizophrenia is also associated with lowered cortisol. This opens the way to a further psychological inference:

> While paranoid features are not clearly included in the DSM-III criteria for PTSD, several reports have called attention to the possibility that such features may be an important component in this disorder. The prominent use of projection and themes of mistrust of others, especially those in authority, have been impressive to some observers . . . . The notion of many soldiers adopting a paranoid stance as part of consolidating an idealized mental construct for otherwise unacceptable involvement in combat . . . might also be viewed as relevant in the postcombat period as a self-vindicating framework. (Mason 1986, 148)

Now for the "puzzling dissociation" observed to occur between the catecholamine and cortisol excretions in the PTSD men. If psychological mechanisms can suppress

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cortisol, why do they have no effect on the catecholamines? The Yale researchers considered three strategic options.

Option one was an effort to revise and update ideas about the fear-response. The argument was made that the "fear" that drives PTSD is not a unitary emotion, but a constellation that includes anger, guilt, uncertainty, and uncontrollability. It is safe to assume these feelings are tuned to multiple, interdependent neurophysiological pathways. Further, endocrine research involving violent convicts and suicidal individuals suggests that the catecholamines (epinephrine and norepinephrine) are tuned differently. If so, it can be assumed that cortisol is plugged into still another system and distinctive pattern of psychological and inhibitory mechanisms. Option one would require the investigation of enormously complex multiple, interdependent neurophysiological pathways. It was not the basis for a practical program for studying PTSD, and it was rejected.

Option two was to exploit the clinical value of this "puzzling dissociation." Preliminary findings indicated that the high/low configuration yields a diagnostic hit rate for PTSD of about 90 per cent. Measurements of cortisol and catecholamines might prove to be an effective way to identify false positives and, more specifically, factitious cases of PTSD. This option would shift the focus from research into the pathobiology of PTSD onto purely clinical interests. And so it was ignored.

The final option, the chosen course of action, was to forget about catecholamines and the puzzling dissociation that they entailed. The plan would be to concentrate entirely on the connection between PTSD and cortisol. Psychological determinants would likewise be set aside. There would be no more talk about defenses, denial, paranoia, and illusions of omnipotence and immortality. "Adaptation" would remain the watchword, but the term would now be understood in physiological terms – not as a relation between mind, body, and the outer world, but as adjustments taking place within the hypothalamus-pituitary-adrenal (HPA) axis. In essence, the third option would move research in a direction taken by Cannon, in his work with decorticated cats. There would be two differences. While Cannon observed his subject ("sham rage") through the body of an individual animal, the PTSD researchers would observe their subject (hypocorticolism) through aggregates of bodies. And while Cannon wished to identify his newly created object, calling it a "remnant," the PTSD researchers would leave their decorticated object nameless.

Stage Two: Hypocorticolism and Neuronal Death

Cortisol would now serve as the focus of research (see Yehuda, Giller, et al. 1991 and 1995; Yehuda, Kahana, et al. 1995; Yehuda, Lowy, et al. 1991; and Yehuda, Southwick, et al. 1990). It would become a "trace," a term proposed by Hans Jorg Rheinberger. "If epistemic things do not intrinsically display recordable marks that transform them into machines that become themselves productive, tracers are introduced into them: radioactive makers, fluorescent dyes, pigments, anything that

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gives inscriptions" (Rheinberger 1997, 110). This epistemic thing would be a biological structure or process particular to PTSD. The research program's point of departure is the fight-or-flight response and the attendant hypersecretion of cortisol. Previous research showed that prolonged overexposure to cortisol can lead to neuronal death and the atrophy of parts of the brain, especially the hippocampus. Ordinarily, the fear-response is short term and cortisol secretion is down-regulated via feedback mechanisms built into the HPA axis. No harm is done. Evidence produced by these researchers indicated that PTSD is different in this respect; fear is chronic and cortisol falls to an unusually low steady state. There is no ready-made explanation for this phenomenon, and the PTSD researchers propose that there is a negative feedback mechanism that protects the brain from hypersecretion of cortisol in cases of unrelenting fear. This is the first time that this mechanism has been proposed, and the grounds for its existence are functional rather than experimental. The mechanism would provide a selective advantage to those organisms that possess it. While the new steady state is adaptive in the medium run, it is pathogenic in the long run. The similarities with Selye's understanding of the stress response should be obvious:

> Glucocorticoids [cortisol] initiate the suppression of metabolic, immune, and neural defensive reactions that normally occur in response to stress; the failure of the HPA axis to respond to stress by increasing circulating glucocorticoids has been associated with potentially deleterious consequences such as tissue damage . . . . In patients with PTSD, there may be other consequences associated with suboptimal stress-induced glucocorticoid secretion. (Yehuda, Southwick, et al. 1990, 368)

In a series of experiments conducted over the next decade, the research program shows that this condition, which the running narrative calls "hypocorticolism," occurs in various PTSD clinical populations (rape victims, earthquake victims, holocaust survivors), and excretion follows a distinctive circadian pattern. These same patients are associated with distinctive variations in cortisol receptor sites, and an unusual response to a dexamethasone challenge (a technique assessing physiological self-regulation of cortisol excretion).

From this point forward, differences observed between PTSD and control groups are consistently pathologized. Inter-group variations are treated not merely as aggregate differences, but signifiers of abnormality. It is an abnormality without an essence, a spectral pathology that operates as an epistemic thing. And it is this thing that justifies characterizing cortisol excretion in PTSD patients as evidence of "abnormally sensitive negative feedback." If the researchers were to abandon their belief in this pathology, they would have only setpoints established by clinical endocrinology, for hormonal sicknesses like Addison's Disease. Within these setpoints, the cortisol excretions of PTSD patients simply merge into a normal distribution and become invisible.

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Whatever the spectral pathology may be, it does not correspond in any obvious way to the physical condition or fitness of the individuals participating in the research. It is visible only as an aggregate property. For example, research published in 1991 compared urinary cortisol in sixteen veterans with PTSD (inpatients and outpatients) and an equal number of normal veterans. All values (PTSD, controls) fall within the range that endocrinologists define as "normal." There is a substantial variation within each group, and PTSD values fall within the range of the normal group, except for two patients who are marginally lower. Nevertheless, there is a statistically significant difference between the mean values of the groups. The difference is described as "chronic cortisol suppression" and it is said to be evidence of a "dysfunction" in the HPA axis particular to PTSD.

"Dysfunction" implies that something is either pathogenic (causing symptoms) or deleterious (causing disability or distress). In phase two, the running narrative includes no findings to indicate that hypocorticolism produces harm. Nor does the narrative indicate how hypocorticolism might contribute to PTSD symptoms, such as reexperiences or avoidance behavior. So hypocorticolism is not "dysfunctional" in this sense either. All we are told is that hypocorticolism is associated with PTSD, and PTSD is a source of distress and disability. Does this association make hypocorticolism a dysfunction?

If hypocorticolism is not a dysfunction in any generally accepted sense, it is merely a difference without a distinction. The running narrative seems to include many loose ends or unexamined assumptions. But this is true only if we proceed, as an epistemologist might, one intersection at a time, applying standards of logical inference at each step. This is not how the running narrative proceeds, nor how its narrative texts are read. It is constructed from heterogenous intersections, including synedoches and analogies, and each entry is locked into a matrix of ramifying entries and intersections, a proportion of which correspond to "completed entries," i.e. taken-for-granted interpretations often imported from other fields, such as neurophysiology.

Stage Three: Diathesis and Abnormality

When the running narrative changed in the mid–1990s, it was not because of loose ends. On the contrary, the original crossword entries remained the same (see Yehuda 1999 and 1998; Yehuda, Bierer, et al. 2001; Yehuda and McFarlane 1995; and McFarlane and Yehuda 1996). It was the clues to which the entries correspond that were rewritten. The change was sudden and unexpected outside the program's inner circle. Its initial appearance was in a 1995 article in the *American Journal of Psychiatry*, in which Yehuda and McFarlane argued that PTSD may not be a continuation of the "normal stress response" after all, but evidence of a diathesis. In which case, PTSD is an abnormal response to situations with which other people cope without suffering disabling effects. The diathesis theory shifts PTSD's center of gravity from the

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traumatic event to the traumatized patient – precisely the move that the PTSD committee had resisted in the months leading up to the publication of DSM-III.

The spectral pathology vanishes. The direct evidence of its existence had been a trace (cortisol). In the revised narrative, the same trace is evidence of a diathesis. But there is more evidence. Epidemiological findings accumulating since 1980 indicate that only a minority of people exposed to trauma-level events went on to develop PTSD. While these findings might complicate the pathology thesis, they are a straightforward vindication of the idea that PTSD is a product of a diathesis.

A further complication. Chronic PTSD is never seen in the pure state, but always in the company of other mental disorders. Researchers who want to study pure PTSD, must refine it in the same way that research chemists must refine substances that are not found in a state of nature. PTSD is often diagnosed with major depression, and their respective symptoms are easily confused. In contrast to PTSD, however, major depression is associated with higher rather than lower levels of cortisol. (The comparison is between aggregates.) One obvious interpretation of this finding is that PTSD and depression are products of different pathophysiologies. The fly in the ointment is the down-setting mechanism that is the basis for believing in PTSD's spectral pathology. You will remember that, in the case of PTSD, cortisol suppression was assumed to be an evolutionary adaptation to the threat of neuronal death. Fine. Why then is the body so wise in cases of PTSD (shifting a potentially dangerous hyper-response to a chronic hypo-response), but stupid and self-destructive in cases of depression (unremitting hyper-response)?

The diathesis simply dispenses with the idea that low aggregate cortisol excretion is a biological adaptation. In the revised narrative, cortisol continues to function as a trace and its epistemic thing remains a pathogenic mechanism linked to PTSD. The change is that cortisol now signifies and measures "dysregulation" rather than "down regulation." The character of the pathogenic mechanism is left wide open, and is able to intersect nearly any research finding, so long as it distinguishes PTSD from other disorders. Differences between PTSD and depression are now unproblematic, since cortisol can be low in PTSD and high in depression without violating any evolutionary logic. Anything is possible.

Among the possibilities explored in the latest draft of the running narrative is a global theory that accounts for the comorbidity associated with chronic PTSD – that is to say, a theory of *multiple diatheses*, each linked to the onset of a disorder that commonly occurs together with PTSD (major depression, generalized anxiety, panic disorder) and whose symptoms are easy to confuse with PTSD's. The basic idea is that these disorders are responses to stressful environments. In each case, a diathesis determines a response's special neurophysiological pathway, thus justifying taxonomic boundaries between classifications. The PTSD response runs along partly shared pathways, and this explains the similarities observed between PTSD and the symptoms of the co-occurring disorders. If the multiple diathesis theory turns out to be true, the phenomenon of PTSD comorbidity may be false. The case that is

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diagnosed today as PTSD in combination with major depression and generalized anxiety may be, in actuality, undiluted PTSD.

This is the point reached by the running narrative today. Where will it and its research program go from here? One possibility is a project permitting researchers to leapfrog the messy neurophysiology of PTSD. Following the precedent of Comings et al., they might link the trace (cortisol), its epistemic thing (hypocorticolism), and the PTSD diathesis to a gene:

> Our previous studies have shown a significantly increased prevalence of the D_2A1 allele in individuals with attention deficit hyperactivity disorder (ADHD), Tourette's syndrome, conduct disorder, posttraumatic stress disorder (PTSD), and substance abuse . . . . Such individuals also show increased susceptibility to stress. The majority of subjects with PTSD have problems with alcohol or drug abuse. The National Vietnam Veterans Readjustment Study . . . reported a significant positive correlation between PTSD and various childhood and family variables such as conduct disorder and drug abuse, a mental disorder in a relative, dropping out of school, and other problems occurring prior to entering the military. These observations led us to postulate that genetic variants of the DRD2 gene might be one of the biological risk factors for susceptibility to PTSD. (Comings et al. 1996, 368–369)

Conclusion

Why did researchers wait until the 1990s to consider the possibility of a PTSD diathesis? The idea had been around for a long time, since the days of Charcot. But the original version of PTSD was tailored to meet the needs of a particular patient population, Vietnam War veterans. They required a service-connected disability and this precluded a diathesis. By 1995, the political situation had changed. The veterans' rights to compensation and psychiatric care are entrenched. No VA bureaucrat or clinician would be so reckless as to challenge the service-connected status of PTSD today.

The moral implications of the diathesis are clear nevertheless. Rachel Yehuda writes that the problem with biological susceptibility to PTSD is that "it de-emphasizes the centrality of the trauma as the true cause of posttraumatic symptoms and potentially invalidates the experience of survivors or, worse, blames them for their legitimate reactions to these events" (Yehuda 2000, 35). Is this outcome inevitable? One solution, proposed in the same narrative, is to think of PTSD in terms of thresholds, rather than a dichotomy between normal and abnormal. People with high vulnerability would have correspondingly low thresholds, and everyday events could be traumatic. Further, it would be a mistake to assume that the diatheses are always genetic. We must be prepared to look into the patient's past, where we may find some undiscovered trauma to which the "sub-threshold" patient had been exposed while she was still quite normal. In this case, the diathesis would be the result

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of trauma, and the "validity" of the survivor's experiences would be vindicated. This solution works even in certain cases where a hereditary weakness seems obvious. For example, you will recall the project that found that Holocaust survivors with PTSD are also hypo-secreters. More recent research indicates that their untraumatized children also carry traces of PTSD's epistemic thing, hypocorticolism (Yehuda, Bierer, et al. 2000). "But even if the diathesis for PTSD were somehow "biologically transmitted" to the children, the diathesis is still a consequence of the traumatic stress in the parent. Thus, even the most biological explanation for vulnerability must at some point deal with the occurrence of the traumatic event" (Yehuda 2000, 37).

The moral implications of reinterpreted PTSD remain ambiguous. And ambiguity helps to explain the positive attitude of PTSD clinicians to the diathesis thesis. When asked to identify "cutting edge research" on PTSD, many clinicians put the HPA program at the top of the list. When Yehuda gives presentations at psychiatric meetings, they attract large and enthusiastic audiences of clinicians. Yet many of these same clinicians continue to believe that PTSD is a normal response to abnormal situations. For them, the normality versus abnormality issue is much less salient than the biological evidence of PTSD's epistemic thing.

The committee responsible for constructing DSM-III's version of PTSD could choose from a variety of historical sources. They chose Freud's traumatic neurosis and modified it. What an irony. Freud is now officially dead and buried (Crews 1995), but one of his lesser creations – the traumatic neurosis – survives. It not only survives, it prospers. And this happens not *despite* the DSM-III revolution, but *because* of it. The revolution cleansed the new nosology of neurosis, a concept deeply rooted in our cultural consciousness. One space was left open, and PTSD filled it. Within it, there emerged a new language of compassion and self-awareness, replacing the sufferings of the soul with the vicissitudes of memory (Young 2000). With this language, the knowledgeable clinician can communicate with her patients empathetically and without condescension, consoling grief and mollifying distress, across borders and cultures. Or so it is widely believed (see Bracken 1998 and Summerfield 1999 and 2001 for critiques).

The biological science of PTSD has contributed to this development by preserving a place for the traumatic neurosis, by confirming its individuality, as something different and discontinuous from the disorders with which it co-occurs and is often confused (cf. Deering et al. 1996; Andrews 1996). In the meantime, hypocorticolism is taking on a life of its own. Researchers operating outside the PTSD field associate it with a variety of somatic disorders, including chronic fatigue syndrome, fibromyalgia, other chronic pain syndromes, rheumatoid arthritis, asthma, and various allergies (see Heim et al. 2000 for a review).

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