

AN INTRODUCTION TO THE NEUROSCIENTIFIC WORKS OF SIGMUND FREUD¹

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Abstract

This paper presents a brief overview of Freud's extensive neuroscientific research, which spanned the years 1877-1900, and included such wide-ranging topics as neurohistology, neuroanatomy, psychopharmacology, clinical neurology and neuropsychology.

1. Introduction

I am at the moment busy editing Freud's complete neuroscientific works for publication in English translation, in four volumes. This is a very large body of work. Over a period of 23 years, between 1877 and 1900, Freud published more than 200 neuroscientific titles, including 40 original articles and six substantial monographs. However, a collected edition of these works — many of which are now very difficult to obtain, even in the original German — has never before been compiled. Only ten of these works have ever appeared in English translation, and still less in the other major languages. Most of them are not even listed in the *Standard Edition* bibliography of Freud's writings.

When one considers the enormous impact of Freud's work on 20th century science and culture, and the enduring fascination with his life and ideas, it is truly remarkable to discover that so large a portion of his scientific writings still remain untranslated and inaccessible.

If it were true that Freud's pre-analytical writings were obscure and insignificant in their own right, then this might have been less remarkable. But Freud's neuroscientific works are anything but obscure and insignificant. They are of considerable interest, from both the neuroscientific and

the psychoanalytical points of view. In almost every aspect of his work in the basic neurosciences, Freud made original contributions of note. This fact has long been acknowledged by neurological historians and Freud scholars alike. Also, those authors who have looked at these works from the vantage point of their relevance for psychoanalysis have shown that they might greatly enhance our understanding of Freud's intellectual and scientific development. Psychoanalysis as a whole is of course inextricably interwoven with the life and work of Sigmund Freud, and so we might reasonably expect that a greater familiarity with the genesis and early development of his ideas would improve and enrich our understanding of them. Indeed, it could even influence the scientific situation of contemporary psychoanalysis, and facilitate its future advancement and growth by undoing accumulated distortions, omissions and misconceptions. I personally believe that a proper understanding of the origins of some of Freud's most basic concepts in the neurological sciences may also facilitate the difficult task of those of us who are today attempting to reintegrate psychoanalysis with neuroscience. In any event, at the very least, greater familiarity with these works, as Freud himself wrote to Smith Ely Jelliffe in 1937, should "have some influence on those who still like to believe that I pulled psychoanalysis out of my hat" (Burnham & McGuire, 1983, p. 272).

In this paper, I would like to introduce you to Freud's neuroscientific writings, to give you a basic orientation to their scope, to their scientific merit, to their historical importance, and especially, to their implications for psychoanalysis. However I must say at the outset that because this is such a large body of work, I can inevitably only draw attention to a few selected themes. I thought that I might best use this paper to provide a *broad overview* of Freud's neuroscientific works as a whole — that is, to convey something of the *context* within which the better-known works, such as "the cocaine papers", "the aphasia monograph", the "Project" and the early writings on hysteria were situated.

In order to do so, I am going to classify Freud's neuroscientific works into thematic groups, and then say a few words about each of the major themes. As you will see, there was a definite chronological progression in these themes, as Freud shifted his attention to ever more complex subjects — starting with simple histological questions, and ending with the most complex problems of neuropsychology.

It would be helpful at this point if you could locate a bibliography

of Freud's pre-analytical writings, because what I am proposing to do is to take you on a sort of 'guided tour' through that bibliography.

2. Histological and anatomical research

The first phase of Freud's neuroscientific activity — stretching from 1877 to 1888 — was devoted to histological and anatomical research. The first of these works (which is not the first work listed in the bibliography, but rather the third one — listed as 1877*b*) was, in fact, not a piece of *neuroscientific* research. It was a study on the sexual anatomy of the eel. Its title in English translation is "Observations on the finer structure of the lobular organs of the eel, described as testicles". The testicles of the eel had been a puzzling anatomical problem for centuries, for no-one could *find* them — and this made it difficult to imagine how the species reproduced. In his study Freud dissected, in 400 specimens, an organ which seemed to be a likely candidate — but in his conclusion to the study, Freud declared that, to his great disappointment, he still could not definitely decide whether the organ he dissected was the elusive testicle or not. In fact, as we now know with hindsight, Freud had in this article actually become the first anatomist to describe the intersexuality of the primitive form of this animal, without, however, recognizing the significance of his findings. In being assigned this subject for his first piece of scientific work, Freud was made aware, from the very start of his career, of the central position that sexuality occupies in biological life. Also, is it not remarkable that the future discoverer of the castration complex began his research career by searching, without success, for the missing testicles of the eel ?

The next four papers that I would like to single out represented the actual beginning of Freud's *neuroscientific* career. I am referring to the works listed in the bibliography as 1877*a* (which was completed after the study on the eel, but published before it), 1878*a*, 1882*a* and 1884*f* (which was in fact written in 1882). These four works were all concerned with the *histology of the nerve-cell* — the basic unit of all nervous tissue. The following quotation from Jones (1953) describes the broader context within which these researches were set: "Together with the problem of the intimate structure of nervous elements (...) [there was the] question of whether the nervous system of the higher animals is composed of elements different

from those of the lower animals, or whether both are built of the same units. This topic was highly controversial at that time. The philosophical and religious implications seemed to be very disturbing. Are the differences in the mind of lower and higher animals only a matter of degree in complication? Does the human mind differ from that of some mollusc — not basically, but correlative to the number of nerve cells in both and the complication of their respective fibers? Scientists were searching for the answers to such questions in the hope of gaining definite decisions — in one way or another — on the nature of man, the existence of God, and the aim of life" (*ibid.*, p. 51).

To this vast and exciting field of research, these early studies of Freud's belong. And the contributions that Freud made really were fundamental. In the first two of these papers (1877a, 1878a), by studying the genetic migration and transformation of nerve cells in the spinal cord of a lowly fish called *Petromyzon*, Freud was able to show that a continuous series of subtle changes linked the nervous system of the invertebrate with that of the vertebrate. Previously, it was believed that a sharp anatomical division separated these two classes of animal. In other words, Freud discovered something of a "missing link" in these researches, and thus contributed to the great pool of data which finally established in the scientific community the conviction of the evolutionary continuity of all organisms. Freud also showed that traces of the phylogenetic migration and transformation of the nerve cells of this fish — over eons of time — could still be found in the spinal anatomy of the contemporary animal; for along the path originally traversed by the cells through evolution, Freud showed that some of the primitive forms of the cells had remained behind — fixated, as it were — in their phylogenetic development.

We may therefore legitimately trace back to these articles Freud's abiding commitment to *evolutionary theory*, and his belief in the persistence of primitive structures in the fully developed organism. This connection is underscored by the fact that Freud *himself* later referred to his research on the *Petromyzon* in order to illustrate the concept of fixation in his *Introductory Lectures on Psychoanalysis*, when he wrote: "it is possible in the case of every particular sexual trend that some portions of it have stayed behind at earlier stages of its development, even though other portions may have reached their final goal" (Freud, 1916-17, p. 340).

The second, and perhaps more important contribution arising from

the series of early histological papers that we are considering, was Freud's discovery of the essential *morphological and physiological unity of the nerve cell and its axon*. This paved the way for the neurone theory. At the time that Freud conducted these researches — and I must remind you that he was still a student at the time — the structural and functional relationship of nerve cells and nerve fibers was still highly controversial. Freud's observations led him to a novel viewpoint. In the final summary to his 1884f paper he wrote: "If we assume that the fibrils of the nerve fibre have the significance of isolated paths of conduction, then we would have to say that the pathways which in the nerve fibre are separate are confluent in the nerve cell: then *the nerve cell becomes the "beginning" of all those nerve fibers anatomically connected with it*. But I should transgress the limitations I have imposed on this paper were I to assemble the facts supporting the reliability of this assumption. I do not know if the existing material suffices to decide this important problem. If this assumption could be established it would take us a good step further in the physiology of the nerve elements: we could imagine that the a stimulus of a certain strength might break down the isolated fibrils so that *the nerve as a unit conducts the excitation*, and so on" (Jones, 1953, transl., p. 54, emphasis added).

These are the basic facts of the neurone theory — but the way in which Freud presented his findings here was far too cautious and reserved for him to actually be credited with the discovery of the neurone — and a full seven years would pass before Waldeyer and Cajal formally proclaimed its existence. So here, once again, Freud made observations of the greatest theoretical importance without actually allowing himself to realize it. Brazier (1959), in her standard work on the history of neurophysiology, also credited Freud with having adumbrated Sherrington's synapse concept — which completed our modern picture of the neurone. In a more recent monograph, published in 1991 by Gordon Shepherd (*The Foundations of the Neuron Doctrine*), an entire chapter is devoted to a discussion of Freud's contribution to the theory.

Today, of course, the neurone doctrine is no longer even described as a "doctrine"; it is the unquestioned cornerstone, and basic building block, of all neuroanatomical and neurophysiological theory. It therefore seems ironical that years later, when Freud turned his scientific attention to the problems of psychology, he was roundly accused of tending to leap too quickly from observation to theory. The fact that the young Freud did not

make this crucial discovery, it seems to me, either contradicts the accusation that he was inclined to jump too quickly from observation to theory, or otherwise it might explain why he was later inclined to do so!

Two decades after Freud began these histological researches, when he built an elaborate model of the mind around the concept of the neurone, in his 1895 "Project for a Scientific Psychology", there was no hint of the fact — which must by then have been clear to him — that he could actually have played a seminal role in the development of that concept.

In the four histological studies that we are considering, incidentally, Freud also provided an early account of microtubule research — before microtubules were discovered — and he unwittingly became the first to report the phenomenon of nuclear rotation of neurones in culture (Triarho & del Cerro, 1985).

Next, I would like to draw your attention to a small set of *methodological* papers that Freud published during this phase in his work. In the first of these papers (which is listed in the bibliography as 1879c, and entitled — in English translation — "Note on a method for the anatomical preparation of the nervous system") Freud reported a new method of separating nervous tissue from the surrounding muscle and bone. In the following three articles (which are listed together in the bibliography as 1884b, 1884c and 1884d, and all of which carry roughly the same title, namely, "A new method for the study of nerve tracts in the central nervous system"), Freud described another new method — one for which he had high hopes. It was a staining technique that enabled him to better visualize nerve cells under the microscope. But, to Freud's great disappointment, the technique was never widely accepted. It seems that it was a difficult and fragile method — even temperamental. In Freud's hands it yielded a great wealth of observations and discoveries, but few of his colleagues had the sensitivity and patience to achieve comparable results. It could be said that a similar fate awaited the psychoanalytic method.

Freud had in fact also described a new method in one of the histological papers that I mentioned earlier (namely, the 1882a paper, which concerned the structure of the nerve fibers and cells of the river crayfish). In studying the nerve cells of the river crayfish, Freud became dissatisfied with the standard technique of observing dead cells under the microscope. He employed instead a new technique which enabled him to actually ob-

serve the internal workings of the living cell. By doing this, a host of structures and processes which had previously been invisible suddenly appeared before him. It is to this point perhaps that we may trace Freud's later awareness of the effects that the act of observation can have upon the object being observed. Herein, too, might lie the seeds of his later rejection of artificial laboratory methods, in favor of natural observation of the living subject in a controlled setting.

In any event, with all of these new methods, which greatly facilitated the anatomical discoveries that I shall now describe, Freud grasped the fact, so important for his later psychological work, that progress in science almost always flows from new methods of observation.

With these new methods, then, in his next three anatomical papers Freud painstakingly mapped out unknown territories in two small, densely packed, and extremely intricate parts of the brainstem, known as the medulla oblongata and the pons. These papers are listed on the following two pages of the bibliography, as 1885*d* ("Contribution to knowledge of the inter-olivary layer"); 1886*b* ("On the relationship of the restiform body to the posterior column nucleus, with observations on two fields of the oblongata"); and 1886*c* ("On the origin of the nervus acusticus"). With these three studies Freud progressed from the spinal cord upwards to the brain itself, and also from the individual nerve cell to groups or constellations of cells; and simultaneously he shifted from the animal to the human nervous system. In these studies Freud demonstrated the links between the posterior spinal columns and the cerebellum and he traced the termination and connections of the acoustic nerve in the medulla. These were outstanding contributions to basic neuroanatomy. He also formulated the theory that the sensory cranial nerve nuclei are homologous with the posterior nerve roots of the cord. He thus brought simple order to a once chaotic and opaque region of the brain. It is hard to imagine nowadays, when medical students simply learn the anatomy of the cranial nerves by rote from textbooks, that barely 100 years ago pioneers like Freud were laboriously developing new microscopic staining techniques, in order to be able to visualize, identify and classify these nerves within the impenetrable maze of cells and fibers that make up this highly complex part of the body.

In his work on the human brainstem, Freud's methodology was especially interesting, when considered from the vantage point of his later work. Instead of attempting to directly map out the masses of fibre-paths

within this densely compacted and immensely complicated part of the adult brain, Freud studied the much simpler patterns which can be easily visualized in the foetal and infantile brain — and then he methodically traced the later developments across increasingly more mature specimens. So here too, the genetic (or developmental) point of view is apparent, and the evolutionary approach was once again conspicuous in Freud's conceptualization of his results.²

Freud's last article on pure anatomy was published in 1888, and was entitled simply "Brain". It is listed as item 1888b2. It was a summary of the state of the art of nineteenth century brain anatomy and physiology. This article is important because, apart from the 1895 "Project", it is the only place where Freud ever published his views on the structure and function of the human brain as a whole. A comparison of these two works — the 1888 article on the brain and the 1895 "Project" — reveals many interesting facts, which I have discussed in a book that I published on this article in 1990, and therefore won't repeat here (Solms & Saling, 1990).

I should also mention that this article cannot be attributed to Freud with certainty, because it was unsigned. However internal evidence demonstrates beyond any reasonable doubt that at least the anatomical half of the article was written by Freud. I will only say about this article that, despite the fact that it was a mere encyclopedia entry, Freud used the opportunity to develop an entirely new theory of human brain anatomy, to replace the established anatomical theory of his esteemed teacher Theodor Meynert. Almost none of Meynert's anatomical teachings have survived — and they are today mockingly referred to as "brain mythology" — whereas Freud's alternative theory, by contrast, is broadly compatible with modern neuro-anatomical views. Freud then went on to develop this anatomical model further, in his famous 1891 monograph "On Aphasia" — which I shall discuss in a little more detail in a moment. Freud actually wrote a book manuscript on his anatomical model in 1886, which was never published, and which therefore doesn't appear in the bibliography; but a copy of it survives to this day in the Library of Congress in Washington.

3. The Cocaine Episode

At the same time as Freud was completing his anatomical studies,

he also published a series of six articles on the alkaloid cocaine. These pioneering and controversial studies have been discussed widely, and will therefore be better known to you than Freud's anatomical research. So I will not dwell on them here; I will just mention the bare facts.

The first paper (entitled simply "On Coca", and listed as item 1884e) was the major work in this series. It is — as Jones (1953, p. 90) said — a literary masterpiece, "couched in Freud's best style, with all his characteristic liveliness, simplicity and distinction, features for which he had little scope in describing the nerves of the crayfish or the fibers of the medulla". The paper sets out to summarize everything that was then known about this obscure drug from South America, but the most interesting section is a narration of a number of observations in which Freud studied the effects on himself of taking cocaine. He writes of "an exhilaration and lasting euphoria (...) an increase of self-control (...) and vitality and capacity for work (...) without any of the unpleasant after-effects brought about by alcohol" and he writes that "absolutely no craving for the further use of cocaine appears even after repeated taking of the drug" (Jones, 1953 transl., p. 91). He went on to describe cocaine's possible therapeutic usefulness in the treatment of, amongst other things, neurasthenia, melancholia and morphine addiction; and he formulated an exacting theory of its neurochemical action. These suggestions and formulations establish Freud — as Robert Byck (1974) has acknowledged — as one of the founders of psychopharmacology.

In the last, fateful paragraph of this monograph Freud added the following words: "The capacity of cocaine to anaesthetize cutaneous and mucous membranes suggests a possible future use — and some additional applications of cocaine based on this anaesthetic property are likely to be developed in the near future" (*ibid.*, emphasis added).

And indeed they were. But it was Carl Koller, not Freud, who developed them — to great acclaim. Thus Freud once again narrowly missed fame at an early age, as he later wrote in his *Interpretation of Dreams*, "I had not been thorough enough to pursue the matter further (Freud, 1900a, p. 170). All of the drug's other therapeutic promise came to nothing — and Freud finally had to reproach himself for having hastened the death of a dear friend by inculcating in him a severe cocaine addiction, and he was accused by some of his colleagues of having introduced to the world "the third scourge of humanity", the other two being alcohol and morphine. The

complex and ambivalent feelings aroused in Freud by the whole episode are chronicled in his celebrated dreams of "the botanical monograph" and "Irma's injection". Nevertheless, there can be no doubt that in the sentences from the final paragraph of the work, which I quoted just now, Freud at least predicted the local anaesthetic properties of cocaine.

Most of Freud's other cocaine papers were but summaries or elaborations of the first work. These are listed in the bibliography as 1884*h*, 1885*a*, 1885*b*, 1885*e*, 1885*f* and 1887*d*. Only two of them deserve special mention here. The 1885*a* paper (entitled "Contribution to Knowledge of the Effects of Cocaine") represents the first and only experimental study that Freud ever published. I agree with those who say that it was a bad and poorly-controlled experiment. Freud's talents clearly did not lie in this direction; which is interesting in view of his later remarks about the uselessness of the experimental method in psychology.

The last paper in the cocaine series (which is listed as item 1887*d*, under the title "Craving for and Fear of Cocaine") was Freud's belated rejoinder to all of the criticisms that were levelled against him by his colleagues, when the tide of medical opinion turned against cocaine. It must be said that this is a disappointing work, full of excuses and rationalizations. In it Freud constructs an elaborate and unconvincing theory of the lability of the cerebral blood vessels to account for the unpredictable action of cocaine, and he lays the blame for all its ill-effects on the innocent hypodermic needle. Here Freud's guilt-ridden dream of "Irma's injection" again comes to mind.

As I said earlier, quite a lot has already been said about these papers, on what they communicate about Freud's personality, his ambition, his over-reliance upon the singular fact, and so on, and I will not go into all these matters here. I will only mention two further points. Firstly, it is interesting to read in these studies Freud's first published self-observations, which culminated in the catalogue of self-revelation that he published in *The Interpretation of Dreams*. This serves to remind us that introspection and self-experiment were common scientific paradigms in the late nineteenth century. The significance of this fact for the development of the psychoanalytic method is seldom recognized. The second point I would like to mention is that a strong case could be made for the view that Freud's experience of the effects of cocaine upon sexuality and general arousal must have been an important source for his later libido theory, and perhaps for

the economic point of view in general. Consider for example the following passage from the *Three Essays on the Theory of Sexuality* (Freud, 1905d, pp. 215-216): "It must suffice us to hold firmly to what is essential in this view of the sexual process: the assumption that substances of a peculiar kind arise from the sexual metabolism. For this apparently arbitrary supposition is supported by a fact which has received little attention but deserves the closest consideration. The neuroses, which can be derived only from disturbances of sexual life, show the greatest clinical similarity to the phenomena of intoxication and abstinence that arise from the habitual use of toxic, pleasure-producing substances (alkaloids)".

As you can see, Freud's oft-expressed opinion that the libido theory would someday be grounded upon a chemical substratum can also, apparently, be traced back to the experiences that he reported in the early cocaine studies.

4. Clinical Neurology

During the cocaine period, Freud gradually moved away from histology and anatomy, towards the problems of clinical neurology. This is the next major theme in Freud's neuroscientific writings. With his writings on these problems Freud graduated fully from the controlled laboratory preparation to the living clinical case. It is extremely unusual, especially today, for an individual scientist to be gifted both in the techniques of the anatomical laboratory and of the hospital clinic, but evidently Freud was such a man.

Freud's first three articles in this field were all single-case studies. These are listed in the bibliography as, firstly, 1884a ("A Case of Brain Hemorrhage with Indirect Basal Focal Symptoms"); secondly, 1885c ("A Case of Muscular Atrophy with Widespread Disturbances of Sensibility (Syringomyelia)"); and, thirdly, 1886a ("Acute Multiple Neuritis of the Spinal and Cranial Nerves"). The American neurologist Jelliffe (1937) has described them as "models of good neurological deduction". Freud was an extremely capable neurologist, and he is reputed to have been able to localize the site of a brain lesion so accurately on the basis of the patient's presentation during life that the pathological anatomist had nothing to add to Freud's clinical formulations in the autopsy report. The fame of his diag-

nostic skills brought him a flurry of foreign graduate students. But Freud himself spoke disparagingly of these skills, and he later said of this phase in his clinical life, to Paul Schilder, that focal neurological diagnostics was "a silly game of permutations".

It was after writing these early case-studies that Freud undertook his famous period of study under Charcot, at the Salpêtrière in Paris. During this period (between 1885 and 1886) Freud moved from being under the direct, personal influence of some of the leading figures of the German school of neurology, to being under the direct personal influence of Charcot. This shift had a decisive influence on his thinking. This was not so much a shift away from neurology and towards psychology — as is often suggested — but rather a shift away from the mechanistic anatomical explanations of clinical syndromes which was so characteristic of the neurology of Freud's Austrian teachers, towards the rich clinical descriptions which were characteristic of the French school of neurology under Charcot. The following quotation — from Freud incidentally — graphically illustrates the difference between these two schools of neurology: "Charcot (...) never tired of defending the rights of purely clinical work, which consists in seeing and ordering things, against the encroachments of theoretical medicine. On one occasion there was a small group of us, all students from abroad, who, brought up on German academic physiology, were trying his patience with our doubts about his clinical innovations. 'But that can't be true,' one of us objected, 'it contradicts the Young-Helmholtz theory [of color vision].' He did not reply 'So much the worse for the theory, clinical facts come first' or words to that effect; but he did say something which made a great impression on us: [He said 'Theory is good; but it doesn't prevent things from existing'.]" (Freud 1893*f*, p. 13).

This was one of Freud's favorite anecdotes. It reminds one of the lines spoken by Mephistopheles in Goethe's *Faust*, which Freud also cited (more than once) with approval: "Grey, dear friend, is all theory,/ And green alone Life's eternal tree".

When Freud returned to Vienna, he declared himself to be an enthusiastic disciple of Charcot, and he thenceforth abandoned the grey of anatomical theory in favor of the green of clinical life. What is of fundamental importance here, I think, is the fact that Freud displayed the same new-found respect for careful clinical observation, description and classification in both his neurological and his psychological publications from this pe-

riod, and he displayed the same aversion to reductive physiological and anatomical explanation of the clinical symptoms, regardless of whether the condition in question was functional or organic.

I agree with the paediatric neurologist Pasquale Accardo (1982), who wrote the following words, not about Freud's psychological writings, but about his neurological research following his period of study under Charcot: "what can only be called a "conversion" from mechanistic physiology to clinical medicine occurred during Freud's travelling fellowship to the Salpêtrière (1885 to 1886), when he fell under the influence of the great neurologist, Charcot (...) Charcot breathed life into his previously sterile clinical expertise" (Accardo, 1982, p. 452).

This underlying shift in Freud's neuroscientific allegiances must surely have been decisive for the breakthrough into psychoanalysis. By shifting his attention to the subjects of hysteria and neurasthenia from 1886 onwards, Freud was not shifting his attention away from neurology. Hysteria and neurasthenia were very much problems of neurology in the late nineteenth century. And as you can see if you glance through the pages of the bibliography, Freud continued to publish literally hundreds of works on a wide range of neuroscientific topics together with his early writings on hysteria and other neuroses. There was nothing unusual about that; because the neuroses were generally conceptualized as nothing other than functional disturbances of the nervous system — by Freud as well as by everybody else. What distinguished these neurotic disorders from other nervous diseases was the fact that no anatomical lesion could be found at autopsy. This is why Freud's shift to the French (clinical-descriptive) school of neurology, and away from the German (anatomical-explanatory) school, paved the way for the breakthrough into psychoanalysis. For how is one going to elucidate the anatomical mechanism of a disorder in which no anatomical disease process can be demonstrated by the pathologist? Here the French school had a decisive advantage. Whereas Freud's German teachers could only construct speculative anatomical models, or reject the topic out of hand as being unsuitable for scientific study, the French neurologists could treat the neuroses as — to quote Freud — "just another topic in neuropathology" (Freud, 1893*f*, p. 20). They could study the neuroses in precisely the same way as they had studied every other nervous disorder, namely, by systematically describing and defining its clinical manifestations, in order to arrive at a deeper understanding of its essential nature. This was clearly

the only empirical way to proceed with the neuroses at that time. And from there it was only a small step from looking at the patient (as Charcot did) to listening to her (as Freud did); which, in turn, led to the fundamental clinical observations that laid the foundations of psychoanalysis.

But I am running ahead of myself now. Freud only gradually developed his newly-acquired skills as a truly clinical researcher when he returned to Vienna, and continued to publish in neurological journals. In considering his publications from this period, I am going to ignore (for present purposes) the papers on hysteria and related topics. I would like, instead, to trace the progression of his papers on organic neurological diseases, in order to demonstrate my point that this was far from being an exhausted field of interest for Freud; and also to show that the actual shift to psychology came quite a few years later.

So, let us return first of all to the clinical topics that Freud was concerning himself with just before and after his sojourn in Paris. I have already mentioned the case study listed as 1885*c*. In this paper, Freud became the second neurologist ever to describe a case of syringomyelia, which is now considered to be a relatively common condition. I have also mentioned already the article listed as 1886*a*, which — incidentally — established Freud as the first Viennese physician to make the diagnosis of acute multiple neuritis. This is an excruciatingly painful condition, and it is interesting to read Freud's detached clinical account of his patient's nightmarish descent into death; it is a very far cry from the sympathetic studies of the subjective experiences of his hysterical patients, which he would publish just a few years later, after his return from Paris.

Before we can get to that point, however, we first have to plough through a few pages of the bibliography, that are a testament to the fact that throughout this period Freud was publishing an enormous number of reviews of the contemporary neuroscientific literature. Most of these reviews have only recently been discovered — by Gerhard Fichtner. These short works demonstrate a remarkable mastery of the world neuroscientific literature — German, English, French and Italian — on every conceivable topic. It is fascinating to read Freud's critical appraisals of the works of some of his contemporaries — like Dejerine, Sachs, Bechterew and Babinski — who subsequently went on to become major figures in the history of neurology.

Now the full impact of Charcot's influence began to emerge, in a

paper — listed as 1888*a* and entitled "On Hemianopia in Earliest Childhood" — a work which is remembered today as the first report of this visual symptom in the young child, the existence of which is now absolutely taken for granted.

This was Freud's first publication in the new field of paediatric neurology, which is yet another branch of neurological science in which he was an acknowledged pioneer. This is the next phase in his scientific development. Freud conducted his clinical research in this field while he was Director of the Neurological Department of the Institute for Children's Diseases in Vienna, during the last decade of the century. During this period Freud published a series of major works on the subject of cerebral palsy — that is, of movement disorders caused by brain damage near the beginning of life. These were truly monumental works which brought Freud international fame as the world's leading authority on the subject. Incidentally, I think it was not sufficiently appreciated later, when all sorts of criticisms were made about Freud having constructed a developmental theory on the basis of observations made on the adult, just how much direct experience of working with sick children Freud actually had — although it is of course true that these were not psychoanalytical observations. Nevertheless, an investigation of the mental status of the child was a routine part of the clinical work-up in Freud's paediatric neurology department.

Let me begin by giving you the basic bibliographical details of Freud's writings on cerebral palsy. There are three large monographs: the first one, published in 1891, together with Freud's life-long friend Oscar Rie (who appears in the dream of "Irma's injection" as "my friend Otto"), deals with the unilateral paralyses of children from every conceivable point of view. It is listed as 1891*a*. It is 220 pages long, includes a bibliography of 180 titles, and it details Freud's personal observations of 35 cases. The second monograph, listed as 1893*b*, was a supplement to the first one, and it dealt with the bilateral paralyses of children. It reports Freud's personal observations of a further 53 clinical cases. The third monograph (listed as 1897*a*) covers the combined ground of the previous two monographs, in other words it covers all the movement disorders of childhood. It is an absolutely exhaustive and comprehensive treatise, a full 327 pages long; the bibliography alone spans 15 pages.

These three monographs were interspersed by a long series of shorter writings on cerebral palsy, most of which were merely summaries

of the big works, or reviews of the writings of others. I won't mention these works individually, excepting a short paper on childhood enuresis; listed as 1893g. This paper graphically illustrates just how far Freud was from a psychological understanding at that time — it expounds an entirely neurological conception of enuresis.

I am mindful of what might appear to be the uncritical praise I am lavishing on Freud's neurological works; so let me read to you a lengthy quotation from a recent article which appeared in the *Am. J. Dis. Child.*, which was not written by an analyst, to give you some idea of Freud's reputation in the field of paediatric neurology: "The student of the movement disorders of children (...) cannot fail to be impressed by the sheer magnitude, as well as the clinical acumen, of Freud's investigations into the cerebral palsies of childhood. The developmental perspective that he pioneered has only recently been fully appreciated (...) [He produced] some of the most masterly and exhaustive treatises to date on the cerebral paralysees of children. In addition to the typically Germanic erudition with which he reviewed the world literature, Freud reported many perceptive clinical observations. For example, he was the first to describe homonymous hemianopia in [infantile] hemiplegia. He noted the ease with which hemiplegia could be diagnosed simply by placing the child on a flat surface, and he described the occurrence of simultaneous or mirror movements — the involuntary participation of a paralysed limb in the intentional movements of the uninvolved side. He originated a typology of classic postures — constrained postures and unintentionally assumed resting poses representing structures of least resistance. Freud proposed a considerably expanded definition of cerebral palsy when he hypothesized the existence of numerous attenuated and benign forms, paradoxical cases of "cerebral palsy without paralysis". Freud's contribution to the classification of cerebral palsy was revolutionary. A neuropathologist by training, he was nevertheless forced to conclude that the optimal nosology was purely clinical, as the neuropathologic findings bore little or no consistent relationship to the clinical picture. When neuroanatomic localization proved an unobtainable goal, Freud had to search elsewhere for an explanation of the observed symptoms. His solution to this problem was developmental: (...) almost all observed clinical idiosyncrasies "can be traced back to the fact that the disease affects an incompletely developed brain and a growing organism" (Freud 1897a, p. 109). Thus, chorea and athetosis, ataxia and spasticity,

were seen as ontogenetic stages in normal infants, transient infantile movement patterns that would later be suppressed by the evolution of higher centers. Freud's classification imposed a degree of order on half a century of chaos, and his correlations between clinical observation and neuropathology expressed concepts that are still in the vanguard of critical thinking about cerebral palsy today" (Accardo, 1982, pp. 452-453, emphasis added).

The relationship of normality to pathology just referred to is obviously fundamental to psychoanalysis — one need only think again about the *Three Essays on the Theory of Sexuality* to see how directly Freud carried these ideas over into psychology. Here we can also clearly recognize the shift that I emphasized earlier, away from the anatomical-explanatory tradition of the German neurologists, to the clinical-descriptive approach of the French school of Charcot; as well as the transition from anatomical localizationism, to the dynamic, functional and developmental approach which established the conceptual scaffolding for psychoanalysis. Schott (1981) has discussed these issues in detail, in his important article on Freud's cerebral palsy monograph.

The reason why I am emphasizing these works so much is because I believe that they demonstrate the intimate bond that exists between psychoanalysis and clinical medicine. I think this has important implications for those modern researchers who are attempting to re-integrate psychoanalysis with neurological science, and with mainstream science in general, on the basis of precisely the sort of reductive methods that Freud rejected more than 100 years ago. History has a lot to teach us in this regard, especially in this day and age, when experimental and laboratory techniques are so idealized and the beauty and complexity of the "green tree of life", to which Goethe referred, is being so neglected. I think it is no exaggeration to say that today psychoanalysis stands as one of the last outposts of the great clinical traditions of internal medicine, and it would be to the detriment of science as a whole, if we were to abandon that allegiance.

5. Neuropsychology

We now enter the last phase in the development of Freud's neuroscientific research. From 1891 onwards, we see Freud shifting away from

physical neurology, towards neuropsychology, and then gradually into psychoanalysis. Freud's two major neuropsychological works were, of course, his monograph "On Aphasia" and his "Project for a scientific psychology". I do not want to say too much about these works (not because they are less important than those which I have already discussed — far from it, these are of course amongst Freud's greatest neuroscientific writings) but rather because you will be more familiar with them. I will limit myself to a few scattered remarks.

The monograph on aphasia, which is listed as 1891*b* in the bibliography, is in my view Freud's neurological magnum opus — it is an undisputed work of genius, which continues to be cited to this day in standard neuropsychological and aphasiological textbooks as a classic contribution to the field. Walther Riese (1958), who was the world's foremost neurological historian at that time, called it "a rare and brilliant piece of medical thought" (Riese, 1950, p. 289). I will mention but a few of the innovations that it introduced. The fundamental argument of the work was that language, being a psychological organization, cannot be mapped in a crude one-to-one fashion onto the anatomy of the brain; that there is no direct correlation between the elementary concepts of neurology and those of psychology. Starting from this premise, Freud introduced a new conceptualization of the very nature of aphasic disorder. On the basis of this conceptualization, Freud is sometimes credited with having been the first to advocate the truly psychological study of neurologically impaired patients, and he is thus rightly regarded as one of the founders of modern neuropsychology. In this book, Freud simultaneously formulated the new general theory of the functional anatomy of the human brain that I mentioned earlier, which led to a radical reformulation of the concept of cerebral localization. By carefully reasoned argument, integrating his clinical and anatomical knowledge, he demolished the then-orthodox doctrine of narrow localizationism and exposed the fundamental epistemological flaws of nineteenth century clinico-anatomical correlation. He replaced it with the dynamic, functionalist conception which flourished in the middle decades of the present century, and which went on to inspire some outstanding modern neurologists, such as the famous A.R. Luria. The functionalist model of cognition which Freud developed in this monograph is also highly compatible with the "parallel distributed processing" models which are currently so fashionable. It was also in this book that Freud introduced

the powerful "agnosia" concept, which has had an enormous impact on all subsequent conceptions of higher cortical dysfunction. Here he also adumbrated von Monakow's "diaschisis" concept, he first questioned the clinical validity of the then almost universally accepted condition known as "conduction aphasia" (which is still controversial today), and he introduced many other modern notions too numerous to mention here. The list is almost endless. In nearly every respect, this book represented a turning-point in modern theoretical neuroscience. I wish I had more space to discuss it.

But this book is not only, as I have said, a neurological classic, it also represents Freud's first foray into the field of psychology. The anatomical model that Freud developed in his aphasia monograph, and the reconceptualization of the notion of cerebral localization that went along with it, re-appears in Freud's 1893c "Comparative Study of Organic and Hysterical Motor Paralyses", as well as in Letter 112 of the Fließ correspondence, and in Freud's subsequent writings on the psychological mechanism of hysteria — where it forms the conceptual bedrock of his assertion that hysterical symptoms have nothing to do with the anatomy of the brain, that they arise instead from what he called "lesions of ideas". It is therefore not surprising that an understanding of Freud's aphasia monograph is crucial for an understanding of all his later psychological models. It was perhaps for this very reason that the editors of the original *Gesammelte Schriften* wanted to include it with his collected psychological works. It was Freud himself who prevented this. He seems for some reason to have always wanted to maintain a sharp division between the two periods of his working life. (But Strachey still felt it necessary to append two lengthy extracts from it to his *Standard Edition* translation of Freud's metapsychological essay, "The Unconscious".)

It is not well known that Freud also published two shorter works on the subject of aphasia. In view of the importance of this subject for his later psychology, I would like to point them out to you. The first one is identified as 1888b1 — and the second is included in the clump of articles listed under the heading 1893-94a.

Finally, we have "the Project" — another indisputable work of genius — about which even more has been written than about the aphasia book, so I am going to say almost nothing about it. As we all know, this work is legitimately considered a seminal psychoanalytical text. All of the fundamentals of Freud's later topographic, dynamic and economic models

were elaborated in it for the first time. But the "Project" is also very interesting from the neuroscientific point of view. Here I can refer you to Pribram and Gill's (1976) book on the subject — where it is argued that the "Project" represents a sophisticated cognitive neuropsychological theory, even by today's standards. But that was of course written 20 years ago. If you will excuse me advertising my own publications, I would therefore also like to mention that I will be publishing a book next year with the Karnac Books in England and International Universities Press in America, in which I have discussed the "Project" — and the aphasia monograph — in some detail, in relation to modern neuroscientific knowledge. This book will be called *Clinical Studies in Neuro-Psychoanalysis*.

Before ending my survey of Freud's neuroscientific writings, and in order to prevent you from wondering why there are so many pages of Freud's early bibliography that we have not considered, I should mention that Freud continued to publish numerous short articles, medical encyclopedia entries, and many, many reviews, on a wide range of neurological topics, right up until 1900. I will draw your attention to only two of them. One is an article on amnesia which was published in 1893, together with the last aphasia article, which I mentioned a moment ago. This is a previously unknown work, which was only recently discovered. It contains an extremely interesting theory of the forgetting of dreams. In fact the article seems to have more to say about dreams than about amnesia. It seems, therefore, to be Freud's first published work on the subject of dreaming. The theory of the forgetting of dreams that is expounded in this article is almost identical with the "state-dependent" theory of modern times. This is a theory which — ironically — is now being cited as an alternative to the views on forgetting which Freud developed later, in the *Interpretation of Dreams* and the *Psychopathology of Everyday Life*, after giving the subject a little more thought! The second article I would like to mention is a review of an essay on migraine by Möbius, which is quite interesting from the psychoanalytical point of view, and also for the reason that Freud describes his own personal experiences of migraine in it (Freud, 1895j).³

It only remains for me to say that many of the works already included in the old *Standard Edition* deserve also to be included among Freud's neuroscientific works. And I am not only referring to the "Project". If you look at Freud's earliest writings on hysteria and neurasthenia —

which (as I have said) were as much problems of neurology at the end of the nineteenth century as they were of psychiatry — you will see (as I have argued) that these works are methodologically and theoretically continuous with Freud's largely nosological writings on physical neurological topics from the same period. Ironically, because of the sharp division that we have traditionally drawn between Freud's neurological and psychological writings, some of Freud's early so-called psychological writings have not received the attention from neurological historians that they deserve. Here I will mention again Freud's comparative study of organic and hysterical paralysis (that is, item 1893c in the bibliography). This is an unrecognized work of some considerable neurological importance. Almost every point which Freud makes in that article on the differential diagnosis of neurogenic and psychogenic paralysees are now generally-accepted clinical wisdom — and are taken absolutely for granted in neurological diagnosis. When I first read this paper I was really surprised to discover that those ideas originated with Freud — he has certainly not received the credit for them.

Notes

1. This paper was part of the Sarton lectures, in this academic year 1995-1996 (cfr. *Sartonia* vol. 9, 1996). It will be published in a volume on *Freud's pre-analytical Writings*, G. Van de Vijver & F. Geerardyn (eds.), 1998, Rebus Press. For the bibliography of Freud's pre-analytical writings Solms is frequently using in this text, we have to refer to that volume.
2. Incidentally, the method that Freud used here was first pioneered by Paul Flechsig — who later featured in his psychoanalytic writings as the object of Judge Schreber's paranoid delusions.
3. This review will be included in the new, revised *Standard Edition* that we are currently preparing in London.

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