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# Carl Wilhelm Sem-Jacobsen

## Aerospace Neurophysiology and Deep Brain Stimulation Pioneer

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## Abstract

The Norwegian physician Carl Wilhelm Sem-Jacobsen (1912–1991) was a pioneer in deep brain stimulation and aerospace neurophysiology, but for several reasons, his story has remained untold. During WW2, he collaborated with a renowned military underground resistance group against the Nazi occupants and then had to flee to neutral Sweden. He returned to participate in the liberation of Northern Norway as a Captain in the US Special Forces also working with the OSS (Office of Strategic Services—precursor for CIA) and received a citation from General Eisenhower for his contributions. Sem-Jacobsen then spent several years in the US training in psychiatry and clinical neurophysiology at the Mayo Clinic. He constructed his own medical technical devices, was among the first to develop deep brain stimulation, and made the smallest EEG and EKG recording systems yet produced, also used by the American astronauts walking on the Moon. But he was more an inventor than a researcher, and few of his observations were published in peer-reviewed medical journals. He built his own neurophysiologic institute for neurosurgery, deep brain recordings, and deep brain stimulation in Oslo's main psychiatric hospital, but was sponsored by US military forces and NASA. He knew CIA Director William E. Colby personally, and rumors soon flourished that Sem-Jacobsen conducted secret mind control experiments for American authorities and the CIA. These accusations were investigated, and long after his death, he was officially absolved by a Hearing Committee appointed by the Norwegian Government. Nevertheless, all his personal files were burnt by his family who was still harassed by investigative journalists. Sem-Jacobsen also documented some of his work on film, but the whereabouts of these films have remained unknown. I searched for them for several years and recently discovered numerous films and photographs in an old barn in rural Norway. These films and photographs document in-action neurophysiology recordings in divers, pilots, and astronauts, and they show how Sem-Jacobsen in collaboration with experienced neurosurgeons in Oslo conducted the very first trials with deep brain stimulation in patients with Parkinson disease. He apparently even tried subthalamic stimulation as early as in the 1950s.

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Carl Wilhelm Sem-Jacobsen (1912–1991; Figure 1A) graduated in Medicine from University of Oslo, Norway, in 1941. During the next years, he worked as a general practitioner in different small Norwegian communities but also joined underground resistance against the Nazi WW2 occupants. He was associated with the famous "Linge Company," the Norwegian Independent Company 1. This was a British Special Operations Executive (SOE) group. Early during WW2, many other members of this company trained in the United Kingdom to perform commando raids against Nazi targets in Norway. Because of his collaboration with the Linge Company, Sem-Jacobsen toward the end of the war had to flee to neutral Sweden to avoid being caught by the Nazis. He worked for a short period as a physician at Kjesäter refugee camp, the Swedish transit center for Norwegians fleeing Nazi persecution. There he met American officers, was recruited as a Captain in the US Special Forces, and participated in the liberation of Northern Norway. At the same time, he was working for the Office of Strategic Services (OSS—precursor for CIA). After WW2, he was nominated for the OSS Certificate of Commendation for "work in connection with the projects undertaken by the Westfield Norwegian Section" and received a citation from General Eisenhower, but the exact nature of his OSS mission is not known.[1]

After WW2, Sem-Jacobsen started training in psychiatry in Norway and then went to Rochester State Hospital and the Mayo Clinic on a Fulbright program grant to complete his specialization in psychiatry and clinical neurophysiology. In the early 1950s, he participated in trials of depth recordings from brain electrodes in epileptic and psychiatric patients,[2,3] and they did some preliminary studies of deep electrical stimulation in psychiatric patients.[4]

Sem-Jacobsen returned to Norway in 1956. He was appointed consultant at Gaustad, Oslo's main psychiatric hospital, where he built his own neurophysiology institute for research and clinical purposes. This institute was supported financially by Gaustad Hospital and the Norwegian Research Council for Science and the Humanities, but most of the funding came from American sources. The major contributor was The Ford Foundation and their Foundations' Fund for Research in Psychiatry, but Sem-Jacobsen[4] also got valuable support from the US Army, US Air Force, US Navy, and NASA.

## Deep Brain Stimulation and Recording

Sem-Jacobsen was originally hired at Gaustad Hospital to improve the methods for frontal lobotomy. Lobotomy was at that time widely practiced around the world and often with non-stereotactical techniques.[5] The procedure was common across Norway, often performed by non-neurosurgeons and with high morbidity and mortality.[6] At Sem-Jacobsen's EEG institute at Gaustad Hospital, neurosurgeons from Rikshospitalet (The

**Figure 1** Photos from Sem-Jacobsen's Recovered Archives


(A) Carl Wilhelm Sem-Jacobsen in his Gaustad Hospital office. The bust shows his father, the aviation pioneer. (B) Neurosurgeon Ragnar Nordlie (left) and Carl Wilhelm Sem-Jacobsen at Gaustad Hospital with one of the first patients with deep brain stimulation for Parkinson disease. (C) NASA astronaut ready for a test flight wearing Vesla EEG electrodes. (D) US Air Force jet fighter pilot before take-off. Electrodes have been glued to his scalp for in-flight EEG monitoring with the Vesla system. All photographs from the newly recovered personal archives of Sem-Jacobsen, published with permission from the Sem-Jacobsen family.

National Hospital—now part of Oslo University Hospital) implanted depth electrodes stereotactically into the brain, and Sem-Jacobsen then performed neurophysiologic recordings and electrical test stimulation before making a lesion. Sem-Jacobsen[4] wrote that "by introducing depth electrodes in the general area where the lesion is to be made, and thus plotting the electrical activity and the responses to electrical stimulation of these electrodes, it is possible to reduce considerably the size of the lesion." Lobotomy has remained controversial.[6] No detailed clinical data from Gaustad are available for effect, adverse effects, or complications, but contemporary neurosurgeons confirm that surgical complications and mortality were significantly reduced by this prelesion brain mapping (Dr. Eivinn Hauglie-Hanssen, personal communication).

Despite working in a mental hospital, Sem-Jacobsen soon started to focus on Parkinson disease. Stereotactic neurosurgery for Parkinson disease with thalamotomy, pallidotomy, and lesions at other targets had been introduced around 1950.[7] Sem-Jacobsen and his collaborators took up this at Gaustad Hospital a few years later. Sem-Jacobsen himself constructed new electrodes that could be used for extensive electrical mapping and stimulation at various brain sites to identify the best target and through which he could inject a toxin (ethyl cellulose in ethanol) to make a small chemical lesion. With this new technique, only 1 neurosurgical operation was needed.[4] The practical procedures have been well documented, but there is a lack of published articles with clinical follow-up data. Sem-Jacobsen and his colleagues presented their observations at various national and international neurology meetings. They reported good clinical long-term results and low complication rates, for example, with only 1 death among 30 operated patients.[8] Mortality rates for lesion surgery in Parkinson disease at that time were usually much higher. Tygstrup and Nørholm[9] at the same time reported on 12 operated patients from Denmark, none of which survived for more than 3 years.

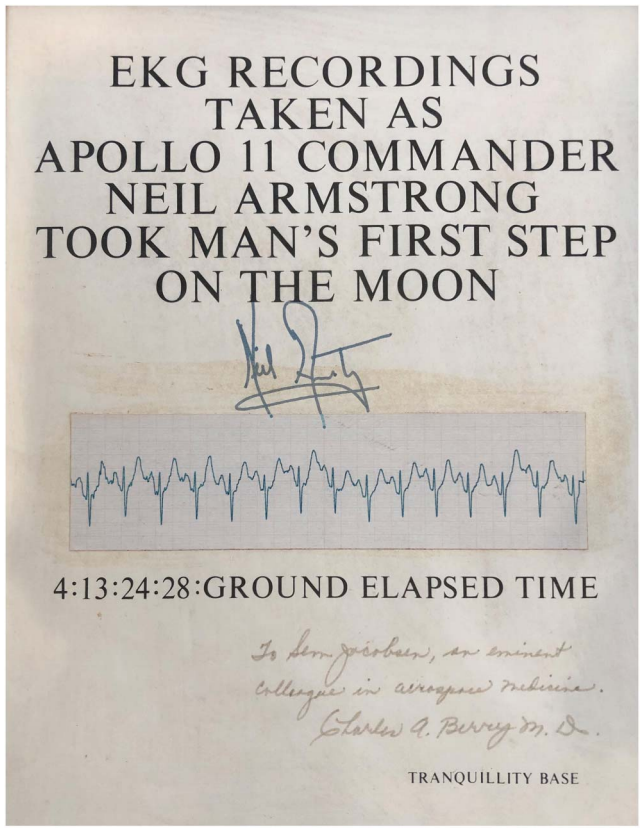
After the neurosurgical implantation of electrodes, Sem-Jacobsen's patients were recorded and stimulated over several weeks before a chemical lesion was made and the electrodes removed (Figure 1B). Results from deep brain stimulation in 10 of these patients were published in the proceedings of the 1962 Scandinavian Neurology Meeting. In this meeting, they also presented a film documenting the treatment, but this film has later been unavailable. Although their aim never was to use permanent stimulation as a treatment, their diagrams document that chronic deep brain stimulation was effective on bradykinesia as well as tremor and rigidity.[10] In a historical review, Hariz et al.[11] have identified this as the first detailed account of deep brain stimulation in Parkinson disease.

## Divers, Pilots, and Astronauts

While doing studies with depth electrodes in the brain, Carl Wilhelm Sem-Jacobsen also developed tools for other neurophysiologic recordings. He was the son of a famous Norwegian flight pioneer and was always fascinated by aviation (Figure 1A). Supported by the US Air Force and NASA and in collaboration with Danish engineer Edmund Kaiser, he developed a minute 4-channel EEG recorder and EKG recorder that could be used for in-flight recordings.[12] The system was named Vesla (Norwegian for "Little girl") after the nickname for Sem-Jacobsen's wife. Electrodes were glued to the scalp and to the chest, and the system was used for monitoring air fighter pilots as well as the astronauts of the Apollo Moon landing program (Figure 1, C and D). With airborne EEG recordings and simultaneous films, he documented that a number of active jet fighter pilots had brief periods of unconsciousness during stressful maneuvers, revealing a possible reason for pilot errors that could explain a number of aircraft accidents.[12] Sem-Jacobsen[13] later developed the system also to include a Vesla aircraft seat pad for the EKG monitoring of pilots. Neil Armstrong wore equipment for EEG and EKG monitoring developed by Sem-Jacobsen when taking his first steps on the Moon (Figure 2).

The Vesla system was also used for testing US Navy divers (unpublished). Later, Sem-Jacobsen[14] took up neurophysiologic monitoring in nonmilitary divers with special focus on deep sea divers working for North Sea oil drilling companies and their working environment.

**Figure 2** EKG from the Moon




Neil Armstrong's first EKG from the Moon donated to Sem-Jacobsen as an acknowledgment from NASA. Published with permission from the Sem-Jacobsen family.

## Experiments on Mind Control?

When Sem-Jacobsen built his EEG institute at Gaustad Hospital, he soon started the collaboration with neurosurgeons to implant his self-constructed depth electrodes before chemical lesion. Each patient could have at least 8 electrodes, each with many channels and points for recording or stimulation. He could thus do extensive mapping at different sites in the brain. In the beginning, these recordings were made in psychiatric patients before lobotomy,[15] but he later worked primarily with patients with Parkinson disease.[4] The special nature of these recordings and the electrical stimulation trials were considered frightening and mysterious both by employees at Gaustad Hospital and by others. Besides as a neurophysiologist, Sem-Jacobsen was more interested in constructing medical technical devices and performing prelesion recordings. Other clinicians did the long-term follow-up of the patients, and most of his publications are dealing with technical and experimental procedures. Because of the special funding of Sem-Jacobsen's institute by American military forces, rumors soon started to spread that he was performing secret mind control experiments. Since he during WW2 met and personally knew CIA Director William E. Colby, words were out that he was working for the CIA. Skepticism may also have been related to his involvement in lobotomy, a procedure that was abandoned few years later. The conspiracy theories were nourished by investigative journalists claiming that Norwegian authorities were also part of the plot and were supporting Sem-Jacobsen's secret mind control experiments for CIA and the US military forces. These assumptions were peaking in the year 2000 with the presentation of a conspiracy documentary on National Norwegian Television—TV2.[16]

Because of the serious allegations, the Norwegian Government in 2001 appointed a special multidisciplinary hearing committee to investigate whether unethical medical experiments had been performed on human beings in Norway during the period 1945–1975. The committee was especially asked to evaluate experiments with deep brain electrodes. The conclusions of this hearing committee were published in 2003.[1] They state that all procedures in Sem-Jacobsen's neurophysiology institute at Gaustad Hospital were performed on strict indication for medical treatment. Furthermore, they found no evidence that Sem-Jacobsen received any financial or other support from the CIA. The hearing committee comments that registration and electrical stimulation may have been somewhat more extensive than necessary both concerning time and location in the brain, but they conclude that "this has not been to the patient's disfavor since the data also could be used to improve treatment in each patient. The relation between treatment and research must thus be considered as within ethical limits for medical research. The commission don't see that the extensive financial support received by Sem-Jacobsen from American sources will change this view."[1]

## The Films

The hearing committee investigating Sem-Jacobsen did a meticulous work interviewing numerous people including health professionals, patients and caregivers, politicians, and American military and CIA superiors. They reached a definite conclusion, although some possibly relevant information was unavailable. They did not get access to secret archives from Pentagon and CIA. Furthermore, they were unable to locate Sem-Jacobsen's personal archive documenting his observations. The reason for this has later become evident: The Sem-Jacobsen family felt haunted by the journalists even many years after Carl Wilhelm Sem-Jacobsen's death in 1991, and they decided to burn all his personal files (Bjørn Erik Sem-Jacobsen, personal communication). Sem-Jacobsen also documented the different procedures on film like the aforementioned Parkinson deep brain stimulation film shown in 1962. These films later disappeared. The hearing committee searched for the films but were unable to find them.

I have tried to locate Sem-Jacobsen's films for many years. Finally, I managed to get in touch with his family. They have long felt that Sem-Jacobsen's work has been undeservedly disregarded, and they therefore decided to help me to recover available information. With their help, I was eventually able to locate numerous of Sem-Jacobsen's films and photographs in an old barn in rural Norway. These films and photographs show how Sem-Jacobsen and his collaborators performed in-action neurophysiology recordings in divers, pilots, and astronauts. One film gives detailed documentation on how he in collaboration with experienced neurosurgeons conducted the first trials with deep brain stimulation in patients with Parkinson disease (Figure 1B). Modern subthalamic deep brain stimulation for Parkinson disease was introduced in 1995 by the Grenoble group.[17] It appears from the old films that Sem-Jacobsen already in the 1950s tried deep brain stimulation in this area. Sem-Jacobsen shows that parkinsonian symptoms are relieved by electrical stimulation close to the red nucleus. Based on our current knowledge, it seems plausible that the subthalamic nucleus was the actual site of his stimulations.

The Sem-Jacobsen family has now donated the old films to the National Medical Museum, which is part of the Norwegian Museum for Science and the Technologies in Oslo. The films are currently being digitized and will then be available for further studies of the achievements of this neurophysiologic pioneer.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## Appendix Author

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