SEEING THE LIGHT

When the II World War reached Denmark on April 9, 1940, I was 5 years old. We lived in a small harbor town, where I saw the Germans arrive. We soon moved to a deserted countryside area, so I only saw German soldiers on May 5, 1945 (after the British liberation of Denmark), when 2 soldiers passed-by on bikes making their way back to Germany.

My father was poor and at 14 years of age, I was forced to leave the school unfinished. I got a job in Copenhagen as "clerk aspirant pupil", and immediately joined a night gymnasium (school) in my spare time. We had lessons from 6 to 11 pm, mathematical tests on Saturday morning and physics only some Sundays over a two year period. A few days after my 18th year birthday I could finally buy the expensive student cap and go to work at a farm in order to pay my last debt to the gymnasium. One day, a very brave priest (head of the local school board) passed by me in the fields. In spite of my young age, he hired me as the single school teacher in the small village school. Two groups of children (7 to 10 and 11 to 15 years) joined the school every second day including – of course – Saturday. The kids were easy to motivate and I studied extensively to satisfy their curiosity.

One year later, in 1954, I left to hitch hike trough Germany, France and Italy, but I returned on foot from Palermo, although I got a job on a Norwegian boat heading for New York. At the time there were only a few cars in Sicily and I tried my luck at hitchhiking, only to be surprised by a huge black car that invited me to join the ride. Inside was Lucky Luciano, who kindly spoke to me in English for an hour and carried me closer towards Palermo.

Shortly after my return I started studying medicine at the University of Århus in 1954. My interest for our first topic, philosophy, was evoked by an excellent language philosopher, Justus Hartnack, just arrived from Cambridge. Hartnack arranged philosophical exercises, and he was a fantastic tutor with few pupils, so I learned a lot.

My fellow students on the medical study suggested to me that I should prepare them for the philosophy examinations. I protested, because I was afraid to fail the same examination. However, in the end I accepted in order to finance my study. Although nervous we all passed with good results given by Justus Hartnack.

The same group of students later started my carrier as physiology tutor, which I continued throughout the study period and I am extremely grateful to these students that financed my study – I had really no other foundation.

Professor Jens Christian Skou arose in me - with excellent lectures - an unlimited love to medical physiology. I joined Skous' Institute, assisting him with his famous work with sodium-potassium enzymes during the holidays. Skou worked all his life with his sodium-potassium pump for which he received the Nobel Prize many years later.

As I was obliged to serve my military service in the Navy in Copenhagen, I could no longer participate in the work at Århus. First, I joined the Naval Officer School, close to which the Naval Diving School was located. After the officer school I joined the diving school and received a diver´s education. Then I joined the submarine fleet as a medical supervisor for the susbmarine crews. Here we focused on some unexplainable cases of paralysis occurring among our Norwegian frogmen colleagues at the submarine escape-training tank adjacent to the diving school of the Naval Base at Bergen. On our way to Bergen with Danish submarines in order for the crew to practice submarine escape, we discussed the assumption that the accidents were

caused by poison in the water, but to me the clinical pattern suggested decompression sickness, and evidently no poison was ever found.
The training tank has a depth of 20 m, and the equipment and circumstances are highly suitable for exercise in "free escape" and skin diving (diving without air hose or breathing apparatus). From the submarine section at the bottom of the tank each crew member made the ascent while expiring his overshoot of air, otherwise the lungs could burst and air under pressure enter the circulation - most likely killing the person immediately. Frogmen educated tank instructors force each ascending crew member to expire sufficiently, if they should panic and forget to do so.

Paradoxically enough it was among those highly trained tank instructors that the paralysis cases had occurred, and they only breath-hold dived. They used the so-called "bottom drop" in which the diver remains vertical and descends feet first. The diver dons a nose clip and goggles, takes a deep breath, pushes himself downward with his arms from the border of the tank, and descends without further movement of the extremities. After the first 2-3 m, loss of buoyancy with compression of lung gas causes him to drop to the bottom with increasing speed.

I used myself as a test subject and performed many "bottom drops" for a 5 hour period. When I came out of the water after the breath-hold dives, I experienced hip and knee pains, pareses and severe chest pain. I was immediately placed in a recompression chamber and taken to a pressure of 6 atmospheres.

At this pressure I experienced immediate relief and the pareses disappeared. Signs and symptoms in this and previous cases were consistent with the diagnosis of decompression sickness, unknown at that time. The dramatic response to recompression cannot be explained on any other basis (1, 2). The diving authorities in the US helped me with the publication - an adventure that started with congress travels around the world and a visit to the Mekka of medical physiology at the state university of New York at Buffalo with Prof. Herman Rahn.

Following the work with decompression sickness, I wrote my dissertation with work from the universities in Århus- , Lund- and Copenhagen (ref.1-6). The dissertation was defended in 1969 at the University of Copenhagen: "Cardio-vascular effects of breath-holding". The well known diving reflex was shown to be a fundamental survival reflex, protecting man both in the water and on land. – In 1969 a dissertation written in English opened many doors.
This changed my life.

At a young age I was selected as president for the *European Undersea Biomedical Society* and to the committee: *Mines, Safety and Health* in the EU. Diving in the North Sea in connection with oil extraction was dangerous at that time. Panic kills! We reduced the accident incidence by harmonizing the safety systems among others.

The largest navigable high altitude lake in the world is called TITICACA. The lake is located in Bolivia and Peru at 3810 m and there is a typical barometric pressure of 480 Torr. People live here just like at sea level, although the oxygen tension in the arterial blood is reduced to almost two-thirds of the value (60 Torr). A relative higher risk of developing decompression sickness is probably present when diving in mountain lakes in contrast to the sea, because the relative pressure changes are larger. During a visit to Lund University in 1964 shortly after the decompression event in Norway, the department was contacted by a group of archeologists from Karolinska. They had decided to dive in Titicaca, but they needed tables, and such tables did not exist. The nearest recompression tank was in Florida at that time, so any case of decompression sickness could cost a life.

The archeologists were on their way to the airport, so I only got 10 min to prepare my advice. I suggested to them to bring sea level dive tables and simply use the *double up principle*. A dive to 20 m of depth should be regarded as 40 m and a dive to 30 m as 60 m. This would compensate for a barometric pressure of ½ an atmosphere (as I assumed at the time) at the surface of lake Titicaca, and the pressure relations were not that bad! The barometric pressure was 480 and not 760/2= 380 Torr. They all came back alive with their archeological land marks.

A text book I placed on the internet: "Medical physiology and pathophysiology," brought me into a fruitful contact with Dr Gustavo Zubieta- Calleja from La Paz in Bolivia. Gustavo Zubieta-Calleja and I have developed new tables for high altitude lake diving (ref. 8) that are now evaluated at the Bolivian Navy diving school in Titicaca.
Since his arrival to Copenhagen 4 years ago we have published many scientific reports (ref. 7-12), and Gustavo has just delivered a medical dissertation to the University of Copenhagen.

Rapid pressure fall – decompression – not only creates decompression sickness in water but also in space. Space decompression sickness is utterly dramatic, since the astronaut exposed to instantaneous vacuum immediately increases his volume by several hundred percent – a Michelin man. During a visit to San Antonio Air Force base in Texas, I gave a lecture on decompression and rapid high pressure treatment. The day after, a young and clever medical doctor – who asked a lot after the lecture – saved the life of an astronaut, who developed massive air bubbles, by re-establishing high pressure in seconds.

Inactivity defined as systematic lack of exercise is a natural explanation of many of the life style disorders of the western world. Hypertension is improved by relaxed exercise. This was shown together with colleagues from "Rigshospitalet" and Gentofte hospital.

Much of my own research in this area took place in Japan during frequent visits through 11 years to Chiba University (Tokyo) with professor Honda, and at the Scientific Society in Warsaw with professor Pokorski. These many scientific visits to Japan, Poland, US and England, I have enjoyed with my beloved wife, Kirsten.

True science is the joy of **Seeing the light**.

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