

100th Birthday Tribute for Per V. Brüel

Svend Gade, Brüel & Kjær, Nærum, Denmark

Per Vilhelm Brüel, one of the founders of the Brüel & Kjær Company celebrates his 100th birthday on March 6, 2015.

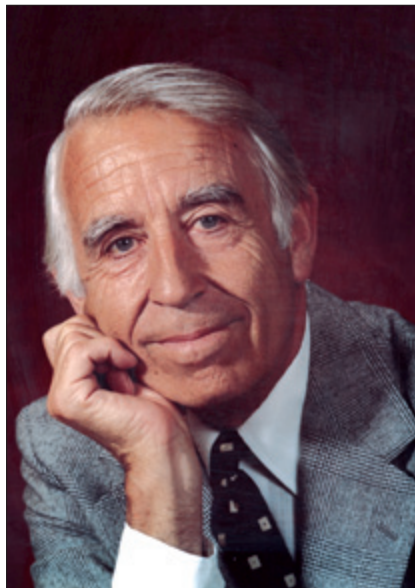
Per Brüel was born during World War I in the New Harbor district (Nyhavn) of Copenhagen (København) Denmark. Both Per and his father Gustaf Brüel were bedridden for a long period of time due to the Spanish flu which raged through large parts of Europe in 1918-19 and killed more than 50 million people, among them 14.000 Danish persons. Both of them were grievously sick.

In the Danish capital Per's father worked as a forester assistant in the Ministry of Agriculture. Soon he was transferred out to the countryside as a forester in various locations in Denmark. The first permanent job was in southern Jutland; in a forest district called Linnet. The family lived in the woods about seven kilometers from the nearest village.

It was a long drive and consequently Per – who was the oldest child of four – didn't go to school during his early childhood. He did not start school until the family moved to the larger city of Åbenrå, which was German territory until 1920, and then just 20 kilometers north of the border. Half of the population was German, so in school he became bilingual in Danish and German. In addition to that, today Brüel is fluent in English, Swedish and a little French and Italian. Missing first as well as second grade, Per Brüel until this day blames the location of his early upbringing for his bad handwriting and spelling.

As were many small boys, Per was born with an interest in technology. The radio was a relatively new development in the 1920s; it was the early years for the Danish National Broadcasting operations. Therefore, Per built his own radio receiver and it became a great sport for him to pick up signals from Germany and to send messages from one farm to another. He spent many hours with his hobby.

As the sixth generation's oldest son, Per was meant to be a forester, but he preferred to work with something related to his interest in radio technology. He didn't argue with his father; that would not have been appropriate in those days, but it was a huge, very huge disappointment in the family when they realized Per's preferences. Per did go against his father's wishes, and that was a kind of opposition no one could accept back then. It was a scandal. The whole family tried to pressure Per, but they didn't succeed. He had made up his mind.



Dr. Per V. Brüel – short and wiry; charismatic; adventuresome; full of ideas; street smart; expert craftsman; clever negotiator; able to express complex subjects verbally and on paper in an understandable way; lover of fine wines, clothes, automobiles, airplanes, and everything Italian; usually charming but with a quick temper.

Per's father could only afford to send one child to college. Therefore, Per was apprenticed to a master mechanic named Jess Christiansen. He was known by Per's father who considered working in a power station repairing conveyer belts and cranes was related to some kind of technology. If everything went according to plans then Per would become an educated mechanic after four years. However, unpredictable things happened as he started working at the local power station. The manager became aware of the potential in his young worker. Observing all the energy and interest he put into his tasks, Christiansen realized that Per Brüel could become a brilliant engineer. It would be a waste of talent to keep him at the station, so Christiansen decided to take matters into his own hands. He went to Per's father, said it was totally ridiculous to deny the boy to become an engineer, and said: "If you don't want to pay for sending him to the university, then I will."

Per went from rural Jutland to big city Copenhagen living with his grandparents and things took an advantageous turn for him. His grandfather in particular had a big impact on Brüel. He was an adventurous and wise linguist in Arabic and he wrote,

he read, and he had opinions. Suddenly the world opened up for the young Brüel as he realized the potential to travel and to explore. Many fascinating and knowledgeable people came to that home – people with interests in foreign affairs and academics, and of different political views. To Per it was like stepping into a brand new world, far away from the provincial half-German attitudes of his past. Brüel's grandfather paid for his stay in his house, but to cover other expenses, books for instance, Brüel worked on orders for electronics up in his room. Per stayed there for three years.

Life is filled with coincidences. Brüel meeting Kjær is one of them. When Viggo Kjær (1914-2013) returned home from the Polytechnic High School (today Danish Technical University) for the first summer vacation, his father noticed instantly that he was suffering from tuberculosis. He spent a whole year at a sanitarium before he could return to the University, so that was like starting all over again, but it never crossed his mind to give up and change direction. When it came to the second semester, that was when Viggo and Per met each other. Per always seized any good opportunity. Stretching the limits, he took his chance to connect with Viggo Kjær at a time when Kjær wasn't even back from his sick leave. In the second semester, all students were to perform a number of physical experiments, and everyone should do them with a partner. At that time Per had heard the rumors about a certain student by the name of Viggo Kjær, that he was a genius. However, he was absent, on a one-year leave because of tuberculosis. So at the sign-up list Per wrote that they were partners without Kjær's consent. Although very different personalities as day and night, they have been together ever since. They quickly realized how much faster they could finish their assignments if they each did half of the work.

Brüel was not very tall, with quick moves, and often a wide, white smile on his tanned face. New ideas were constantly popping out of his mind, always in search of input from other people, such as colleagues and business partners. On the contrary, Kjær, the tall almost aristocratic looking scientist didn't jump to quick conclusions but aimed to be as meticulous as possible in his sober reviews of Brüel's ideas.

With more or less the same background, Kjær also came from Jutland, they talked the same language. Per struggled during

his first weeks at the university. His accent wasn't standard Danish because he came from Southern Jutland. Although not far geographically from the Danish capitol in present terms, natural barriers resulted in some vocabulary and pronunciation that were unique to people from that region. So the other students teased him, said he didn't speak Danish, but he soon recovered. He developed some good friends, and they helped each other get through the curriculum. Especially when he met Viggo Kjær, they quickly became friends.

Soon they also decided that they wanted to start something together. The only problem was that they didn't agree on what it should be. Per wanted to do acoustics, greatly inspired by their mentor and professor P.O. Pedersen. Viggo thought they should move into electronics. One thing they did agree on was that they wouldn't start immediately after graduation in 1939. They wanted to get out into the field, pick up more knowledge and get smart on somebody else's money.

As Per Brüel puts it, P.O. Pedersen is the single person to whom Danish acoustics owes so much. He originated the idea of establishing the university's Sound Technology Laboratory. After Brüel's graduation, he was invited to be one of the professor's assistants in the laboratory. As the professor's assistant, Per Brüel was entrusted with writing the first publication about the work performed at the Sound Technical Laboratory. He worked there until the death of professor Pedersen in 1941.

By definition, war is always a time of great distress – uncertainty, anxiety, fear and fury. To Per Brüel and Viggo Kjær, World War II was also a time of great opportunity, although the outbreak of war meant that they had to roll out their business at a dreadfully slow pace. Per Brüel was drafted exactly six months before Hitler's army invaded Poland in September 1939. Because of Viggo Kjær's physical condition with just one lung functioning at full capacity, he was not drafted. He worked at various radio manufacturers until 1944.

After being a dispatch rider on a motorcycle, Brüel managed to be transferred to the Army's radio workshop at the military headquarters in Copenhagen. Using bits and pieces available in Denmark at the time, his task was to develop radios for army vehicles – now he was back to his old hobby – he could hardly believe it. Having plenty of spare time and being able to work evenings at the Army's radio workshop, Brüel started experimenting with what was to become a brand new invention. With the available components, he was able to make the first acoustics analyzer in the world

providing constant percentage bandwidth resolution. Two copies were made and it became the first Brüel & Kjær instrument. When Denmark was occupied in April 1940, all drafted personnel in the Danish Army were demobilized. Brüel feared that he could have been sent to the eastern frontier as a soldier.

Now that Brüel was safe and had plenty of spare time, he and Kjær got together regarding the plans for the company. Brüel improved the acoustics analyzer to operate on line power rather than running on batteries. Kjær had developed various vacuum tube voltmeters. All they needed now was to begin production. At the Army's workshop, there was six to seven good people who were just walking around doing almost nothing. So they were happy to work for and being paid by B&K, and that arrangement lasted for the next year or so. This origin explains the somewhat odd color, which has always been a distinctive feature of Brüel & Kjær Instruments – green. The company's signature comes in two colors – a light green and a dark green. Thinking about it, the limited palette reminds one of Army colors, and that is exactly what they are.

Based on a large order for voltmeters in 1942 it was decided to obtain a License to Operate from the Danish authorities. Thus, the official start of the company is dated November 28 that year, but it was not until 1944 that Kjær worked full time and 1948 that Brüel worked full time for the company.

After the death of P.O. Pedersen, Brüel worked for professor Nøkkentved designing the acoustics for the new Danish radio-broadcasting house in Copenhagen until 1943. Hereafter he worked in Sweden first for Höganäs-Billesholm AB in Stockholm to develop new materials for acoustic absorption (1943-1946). Later he was involved with setting up an Acoustics Laboratory at Chalmers University in Göteborg (1944-1947). After he returned home from Sweden Brüel became the director for Danish Decca Navigator A/S and conducted the build-up of the Danish Decca system.

Brüel wrote his doctoral dissertation about the use of the standing wave apparatus in acoustics while he was in Sweden, but he went to Denmark to defend it in late 1944. He was able to cross the border using a false visa he had obtained. Whenever he was travelling to Denmark, he often carried inside his dissertation a bunch of secret notes and letters to contacts on the other side of the Øresund, which is the strait separating Denmark and Sweden that opens into the Baltic Sea. Many of the notes went straight to the Danish nuclear scientist and Nobel award winner Niels Bohr and his associates. Per Brüel's mail service ran

smoothly – up until the day he was going to defend his dissertation. German soldiers on the ferry ripped through the papers and tossed them into the air. They did not find anything in the papers but then turned to Brüel's shoes. They noticed a scratch on one heel, and instantly tore off the heel. That did not bring anything either, so for safety sake they also tore off the other heel. Then they let him go. Next day he defended his doctoral dissertation, a festive event at the Technical University. Brüel was in his father's white tie and tails – and wearing shoes with glued-on heels.

As his most cherished mentor, Brüel naturally asked for Professor P.O. Pedersen's opinion when he and Kjær were ready to establish their company. The professor was anything but enthusiastic. He advised the two young engineers not to bet the future on that idea. It would be against all odds. "Maybe one person can make a living out of acoustics, but certainly not two," he warned. Fortunately, that didn't scare Per Brüel and Viggo Kjær. In 1948, Brüel and Kjær bought their first property, a wooden army barracks in Nærum, 15 kilometers north of Copenhagen, which are the premises where the company's headquarters are still located today.

The major breakthrough for the company came in 1949. A half-page article about the company's level recorder written by Per Brüel was published in *The Journal of the Acoustical Society of America*. The B&K recorder developed by Brüel created a sensation among acoustical professionals when it came out – never before had sound pressure level in decibels been measured as a function of time. Better yet, it included a stylus for recording. It was a revolutionary invention, and naturally, the *Journal* didn't miss it. Leo Beranek, an internationally famous acoustician based in Boston, travelled to Nærum to see this wonderful instrument. The visit was the beginning of a friendship between Per Brüel and Leo Beranek that lasted to this day. No marketing department could wish for a better introduction. With one stroke, the article made B&K well known all over the world, and Brüel carried the article wherever he went.

The article was studied all the way to Tokyo where one of the recognized experts in the field read it with great interest. That was Dr. Kojo Sato, a leading experimental physicist in acoustics at Tokyo University. He also visited Nærum, and the first level recorder was actually sold to Japan. The rest is history; the company grew by nearly 10% every year for the next 30 years and became the world's largest manufacturer and supplier of sound and vibration measurement instruments, systems and solutions.

Naturally, B&K became the flagship of the Danish electronics industry. The company also developed a large market behind the iron curtain during the days of the cold war, because instruments were not developed for military purposes and no instruments were sold to the military anywhere in the world.

Brüel was the marketing and sales person in the company. In the beginning when the market consisted of Denmark and Sweden, he personally delivered the instruments to customers, driving his Danish-made Nimbus motorcycle. Later station wagons and busses well equipped with instruments for demonstrations were used when the market was expanded beyond Scandinavia and finally using airplanes for longer distance business. Flying and being a pilot was another of Per Brüel's many hobbies.

Brüel obtained an "S-certificate" in 1950, which qualified him to fly gliders as pilot in command (PIC). From 1950 to 1957, he logged over 50 hours of flying time over 14 types of gliders. His qualifications included aerobatics, i.e. spins, loops and wingovers. However, he needed powered airplanes for business use. After considerable study and training, he obtained an "A-certificate" in December 1957 to operate single-engine aircraft as PIC under visual flight rules in visual meteorological conditions. That meant he could only fly during the day and only in good weather. Finally, in 1961-62 he obtained his multi-engine aircraft and instrument rating. Thus, Brüel acquired considerable skills in meteorology, avionics,

instrument flight regulations and aircraft systems necessary for flying in all-weather conditions as well as nighttime. From 1957 to 2000, he logged 9476 hours of flying and 7730 landings in over 20 different aircraft. Thus, Brüel was an active pilot for 43 years until the age of 85. The company planes were Brüel's department, so Kjær didn't intervene in that as well as Brüel did not intervene when production needed to buy a new machine. That was Kjær's decision. Brüel often arrived at work from his summerhouse using a company airplane, while Kjær used a bicycle as primary transportation between home and work. When "B&K Airlines" was at its peak, it had a fleet of five airplanes, with a 9-seat Piper Navajo Chieftain and two Beechcraft C90 twin-engine turboprops as the "flagships" and had regular weekly destinations inside Europe. Brüel logged many unusual situations in his flying career, but no serious incidents or accidents; he was a very skilled pilot. It should be mentioned that on September 14, 1962 Brüel became the first Western private flyer, to obtain permission to cross the iron curtain and fly into Sofia, Bulgaria. In October 1966, he became the first Danish private pilot to obtain permission to go to the soviet city of Leningrad (now St. Petersburg). Brüel was elected vice president of the Fédération Aéronautique Internationale from 1967 to 1996.

Dr. Per V. Brüel is recognized as one of the most important pioneers in the field of acoustics. He patented more than 20 ideas

for instruments. He is an honorary member of the acoustical societies in several countries as well as international institutions like INCE (Institute of Noise Control Engineering) and IIAV (International Institute of Acoustics and Vibration). Likewise, he holds honorary doctorate and honorary professorships at seven universities around the world. Brüel has received a large number of rewards and medals, including The Rayleigh Medal from the Institute of Acoustics (IOA) in 1974 for outstanding contributions to acoustics.

Brüel was married twice, first time (1939-1958) to Drude Marstrand and second time (1973-2007) to Birgitte Bonnevie, and fathered three children.

The Brüel & Kjær Company was sold in 1992 after being family owned for 50 years and both Viggo Kjær and Per V. Brüel retired. Today one quarter of a century later the success of the company clearly shows the importance of the work initiated by the two founders 75 years ago. An open-house 100th birthday celebration will take place on March 6, 2015 as well as Per Brüel is celebrated throughout the Brüel & Kjær Company.

Working in acoustics seems to yield a long life. Viggo Kjær reached 99 in 2013. Brüel's other old friends Dah-You Maa in China made it to 97 and Leo Beranek celebrated his 100th birthday on September 15, 2014.

Please send birthday messages and reminiscences of your experiences with Per V. Brüel to sv@mindspring.com. They will be compiled and forwarded to Dr. Brüel. The author can be reached at: svend.gade@bksv.com. 