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MAX E NOHL AND THE WORLD RECORD DIVE OF 1937

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December 1, 1937 was a momentous day in the history of diving. Not only was a new world record set at 420 feet; it was also the first significant use of a helium-oxygen breathing mixture in an open water environment outside the confines of a dry hyperbaric facility.

The participants

Max Eugene Nohl was 27 years of age at the time of the dive. He was the son of Mr and Mrs Lee F Nohl (a prominent Milwaukee attorney). In 1929, the year Max Nohl graduated from the Milwaukee University School, he made his first dive in a swimming pool with an open helmet made from a pail. During his college years, he attended the Massachusetts Institute of Technology. Upon his graduation in 1933 Nohl returned to Milwaukee. He later purchased a standard hard hat rig from the friend of a diver who had died in an accident while using it. Nohl began to dive regularly and from this experience he was on his way towards the development of a new diving apparatus.

Dr Edgar End, of the Marquette University School of Medicine in Milwaukee, was the person responsible for calculating the helium-oxygen breathing mixtures and the decompression schedule used for the world record dive. Dr End first met Max Nohl in April 1937.

Captain John D Craig (Danger is My Business book and TV series) also played an important role in terms of financially backing and participating in the experiments conducted at the Milwaukee County Emergency Hospital Recompression Chamber in the months prior to the 420 foot (127 m) dive. Captain Craig and Max Nohl had dived together on a shipwreck (the John Dwight) in the summer of 1935 and had kept in contact with each other to work on new equipment designs since that time.

Experimentation

In 1937, the use of a helium-oxygen breathing mixture for an actual dive was seen as a revolutionary step. However, the actual theory was first proposed nearly two decades earlier. Professor and inventor Elihu Thompson first theorised, in 1919, that helium might be used to

replace nitrogen in a diver's breathing mixture, thus avoiding the narcotic effect of air at greater depths. The United States Bureau of Mines and the United States Navy (USN) conducted joint experiments in 1924 with helium-oxygen breathing mixtures. By 1927, the USN was running its own tests at the Experimental Diving Unit in Washington, DC.

In the spring and summer of 1937, Max Nohl, Captain John Craig and Dr Edgar End participated in three experiments conducted by Dr End. The recompression chamber at the Milwaukee County Emergency Hospital was the site of the experiments.

The three experiments were conducted in the same manner. Max Nohl and Captain Craig entered one compartment of the chamber and used rebreather apparatus. Each unit had a spirometer, soda lime canister and a mouth-piece. Max Nohl and Captain Craig would breathe helium-nitrogen-oxygen and helium-oxygen mixtures (premixed) through each apparatus. Dr End was in the other compartment and breathed air during each experiment. He controlled the experiments and observed Nohl and Craig through a small window in the compartment door.

In each experiment the chamber was pressurised to an equivalent of 90 feet (27 m) of water. In experiment 1, Nohl and Craig breathed 21% oxygen, 52.5% nitrogen and 26.5% helium. Dr End breathed air in a separate compartment. The participants remained for one hour at the 90 foot (27 m) level. Because of the reduced nitrogen content, decompression was greatly reduced. Less nitrogen had been absorbed into the divers' bodies. Decompression took only 8 minutes. Because of the reduced nitrogen, it was as if the two divers had been at the 60 foot level. Dr End required a longer decompression due to his breathing air.

In the second experiment Max Nohl and Captain Craig breathed a mixture of 21% oxygen, 26.5% nitrogen and 52.5% helium. Once again the participants remained for one hour at a 90 foot (27 m) equivalent. Dr End wanted to cut the decompression time in half. Decompression was conducted as planned at a uniform rate. Within four minutes Nohl and Craig were back at atmospheric pressure with no side effects.

The third and final experiment employed a mixture of 79% helium and 21% oxygen. After one hour at a 90 foot equivalent, decompression was carried out within two minutes. No ill effects occurred. The only problem noted was the change in pitch of the divers' voices as they breathed helium-oxygen mixtures.

New equipment

The diving equipment used by Max Nohl on his record dive was completely self-contained in terms of its breathing supply. The only connection to the surface was made via a telephone cable and a life line. Both life line and cable could be disconnected at the diver's discretion or cut by the diver if need be in any emergency situation.

The helmet was very sophisticated in terms of its form and design. It was made of polished aluminium and weighed approximately 45 pounds (20.5 kg). No breast plate was to be used. A 360 degree faceplate offered the diver an excellent field of vision in any direction. Into the top of the helmet's interior was fitted a depth gauge, watch, compass, pressure gauges for the back mounted cylinders, and a container for liquid food. The overall appearance of the helmet can be compared to a scaled down lighthouse dome. When using this helmet Nohl wore a leather football helmet. This was to offer protection from bumping his head on the inside of the diving helmet, but also held the earphones in place for communication purposes.

The diving dress was made of rubberised canvas. It was designed to keep the diver dry. The helmet and diving dress were connected together by two metal bands which were drawn tight once the collar of the dress was stretched up over the bottom of the helmet.

The breathing mixture was to be carried in cylinders on the diver's back. A three cylinder unit was available, but only a two cylinder rig was used for the world record dive.

According to Dr End, "In one of the steel cylinders is carried a respirable gas which the diver admits into the suit to equalise increasing water pressure as he descends. The other cylinder contains oxygen which enters the suit at a rate carefully controlled by the diver to satisfy his metabolic requirements."

Inside the diving suit Max Nohl wore an oro-nasal mask which was connected to a rubber device looking like a hot water bottle. This was filled with soda lime to remove carbon dioxide from the diver's exhalations. Valves were arranged so that when Nohl inhaled the breathing mixture would come from what was inside the suit and helmet. When Nohl exhaled the carbon dioxide was effectively removed by passing through the soda lime, while the exhaled helium would reenter the suit to be used again.

One of the great advantages of this design was that Nohl could completely control the flow of oxygen. Decrease it at greater depths and increase it at lesser depths. Therefore, the partial pressure of oxygen could be approximately that of atmospheric air.

On the day of the dive Max Nohl wore a one-piece zippered suit of thick wool. This was complemented by wool



Assistants help Nohl suit up in preparation for the record dive.

socks and mittens. Over the wool undergarment he wore a thin suit of chamois leather.

Standard diving boots were also worn with the diving outfit. Each boot weighed approximately 18 pounds (8 kg). These could be removed by the diver in case of emergency.

Attached to the outside of the diving suit at chest level was a braking device. Through it passed the descending line. At any time during the dive Nohl could stop or slow his descent.

The cylinders, helmet, and braking device were all chained together to form a harness. At the top of the helmet was a lifting ring to facilitate getting the diver in and out of the water. Once out of the water the diver's weight would be supported by the chain harness.

No weight belt was needed or used with the Craig-Nohl diving dress.

The record dive

During the autumn months of 1937, Max Nohl made a series of dives to test his diving apparatus and Dr End's decompression schedules. Each dive was deeper than the



Max Nohl is lowered over the side of the *Antietam* to begin the dive. Note the braking device on the diver's chest to help retard his descent.

preceding one. By late November, Nohl was confident that he could establish a new world's record.

On Wednesday, December 1st 1937, the US Coast Guard cutter *Antietam* reached its destination by noon. The Lake Michigan dive site was about 25 miles (40 km) north east of Milwaukee and approximately 12 miles (19 km) east of Port Washington, Wisconsin. The commanding officer of the *Antietam*, Lieutenant E C Whitfield, ordered depth measurements to be taken. Both by sounding lead and gauge the depth registered was 420 feet (127 m). This would also be verified later by Nohl's descending line and telephone cable.

Max Nohl began to suit up for the dive and was assisted by Mr Ive Vestrem, an associate, and Mr. Carl Fischer (Chief Engineer of Milwaukee Country Institutions). Dr End watched and was near the diver's telephone. Once ready, a lifting cable was attached to the top of Nohl's helmet and he was swung over the side of the *Antietam* using a lifeboat davit.

Nohl entered the water at 12:50 pm. Within three minutes he had reached a depth of 200 feet (60 m), where he paused to equalise his ears and make adjustments to his breathing mixture.

A slight mishap occurred during this part of the dive. One of the surface crew did not hold onto the telephone cable. The cable continued to feed out on its own weight from the cable already in the water. This was noticed and corrected, but the cable in the water had formed into a large loop. As Nohl resumed his descent he passed through the loop and became entangled. He worked his way to 240 feet (72 m), but this took 26 minutes. Nohl could have cut his telephone cable and continued his descent, but it was thought wiser to return him to the surface and start the dive over again.²⁰

At 1:25 pm. Max Nohl re-entered the water after being untangled and reached the bottom without incident within 9 minutes. At the 400 foot (120 m) level he had paused momentarily. Ive Vestrem asked Nohl to come up, but Nohl replied that he had better go as far down as he could. He also said that the temperature was just above freezing and that he could see his white diving suit mittens in front of his helmet.

Moments later (1:34 pm.) Max Nohl reported, "I've hit bottom." The crew on the *Antietam* started to shout and cheer. The cutter's whistle was blown. Nohl spent nine minutes on the bottom, walking and crawling. He was hoping to find a small stone or a rock to bring up, but could not find any due to the clay and mud-like bottom conditions. Nohl was in constant communication with Mr Vestrem and Dr End. Visibility on the bottom was reported by Nohl to be only 5 to 6 inches at best.

At 1:43 pm. the ascent to the surface began. Nohl was raised towards the surface at a slow rate. On the way up he vented excess helium-oxygen from his suit to avoid a blow up. Large bubbles were noticed on the surface as Nohl carried out this procedure. He reached the 200 foot (60 m) level at 1:55 pm. and ten minutes later was at the 30 foot (9 m) level. Nohl's breathing mixture up to this stage of the dive had been 80% helium and 20% oxygen. Once having reached the 30 foot (9 m) level, Nohl vented all helium-oxygen out of the suit and replaced it with pure oxygen. This was also done at the 20 foot (6 m) and 10 foot (3 m) levels as well.

Nohl remained at the 30 foot (9 m) level for 22 minutes and at the 20 foot (6 m) level for 28 minutes. His longest decompression stop was for 46 minutes at the 10 foot (3 m) level. It took Nohl a total of 118 minutes to reach the surface. Dr End was not in a hurry to return him to the surface quickly and considered the decompression schedule used to have a wide margin of safety.

At 3:41 pm. Nohl reached the surface. His helmet was removed and according to the newspaper accounts Nohl's first words were. "What's that funny smell?" His assistants replied, "That's fresh air."

Conclusion

Max Nohl's dive was a great success. His equipment worked very well as did Dr End's decompression schedule. Nohl showed no sign of mental alteration during or after the dive. Having cold feet were his only complaint. Dr. End examined Nohl once he was out of his diving suit and was unable to find anything physically or mentally wrong with the diver.

Once inside the warm cabin of the *Antietam*, Nohl sat down to eat a ham sandwich and sip coffee. He spoke with reporters and smiled for the cameramen as the Coast Guard cutter headed back to Milwaukee.

Max Eugene Nohl had set a new world's record. He had reached a depth that no other diver had ever attained in a flexible diving suit. Most importantly, Nohl and Dr End had clearly demonstrated the practical use and enormous benefits to be gained from helium-oxygen as a breathing mixture for deep diving. The door to the future was now open.

Max Nohl had intended to modify his diving suit following the December 1937 dive. He had also planned to join with Captain John D Craig in an effort to dive the sunken ocean liner "Lusitania", off the coast of Ireland. For reasons unknown the planned dive on the "Lusitania" never took place. This may have been because Max Nohl and Jack Browne, with the help of Milwaukee businessman Norman Kuehn were in the process of founding DESCO (Diving Equipment and Salvage Company) in 1937. In 1960 Max Nohl was killed in an automobile accident which also claimed his wife.

Acknowledgments

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The author

John Kane, who dedicated this paper to the memories of Max E Nohl and Dr Edgar End MD, grew up in Erie, Pennsylvania. He became interested in diving at an early age and received his certification as a scuba diver in

1970. His exploration and study of Lake Erie shipwrecks has continued to the present time. John has a Masters Degree in history, specialising in the history of Japan. He teaches at Campbell University in North Carolina and at Wake Technical Community College in Raleigh, North Carolina. John has an extensive collection of Savoie diving helmets, including a rare flip-up model and a Savoie mixed gas recirculator/CO₂ scrubber. His other interests include the study of Japanese history, the history of diving and undersea exploration and other (art related) collecting activities.

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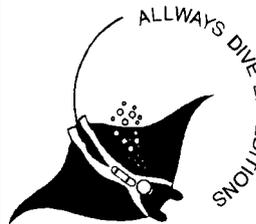
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