Proceedings

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of the

Historical Diving Society

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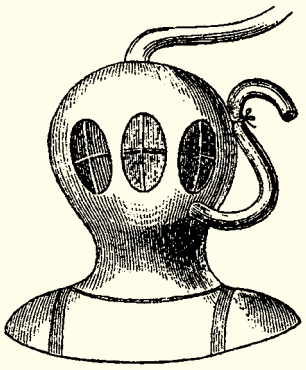


All the images in this article are taken from *Inspiring People*, published by Subsea7 in 2021.

Are there any questions?

Q: Where's the gold? [laughter].

Peter Dick: I was just going to say there is a parallel development which plays into what you said and that is the underwater engineering consultancies which sprang up in the late 1970s. From my own experience with Comex John Brown I moved on to Tokola Underwater Engineers the heaviest workload I have ever had in my life, but it brought civil engineering into diving along parallel lines. Our call-sign offshore on one job was "Mama Bear, Mama Bear this is Honeypot One"

Mike O'Meara: Thank you Peter. I think this calls for a round of applause.

PATRICK VAN HOESERLANDE

The Development of Buoyancy Aids in Diving

Introduction by Mike O'Meara.

Our second speaker is Air Force Major Patrick Van Hoeserlande. Patrick is a diving instructor, a writer-editor of the Flemish diving magazine Hippocampus *and an occasional contributor to* Divers for the Environment.

As an aeronautical engineer, he has a keen interest in how things work and why. He started a professional doctorate at the Cardiff Metropolitan University carrying out research in (military) concept development. He is passionate about the combination of technology and diving and enthusiastic about spreading the word about his field of interest.

Patrick will talk to us on the subject of 'The Development of Buoyancy Aids in Diving'.

Please give Patrick a warm welcome.

Thank you, Patrick.

Thank you Mike for the introduction.

This briefing is for me a very big challenge. It is exceptionally 'out-of-the-box' for me because it is the first time I have an audience more experienced than I. Normally, I am standing in front of an audience as the expert; but not today. I am an engineer, not a historian. A scuba diver, a sports diver, and a certified inshore diver, but not a commercial diver. I am also a diver-journalist and editor for the Flemish magazine *Hippocampus*. One of the last articles I published was on Belgian Military Divers in World War I. I have also written *Scuba Diving, Past and Future* and some articles about Cousteau and the invention of the regulator for which I dived with old equipment, just for the experience.

Secondly, you master the English language much better. Not only have I been living for six years in the United States, explaining the slight Southern accent, but also I tend to mix Flemish, French, and English. Please, if you don't understand me, please raise your hand.

I have a love-hate relationship with history. I love explaining things but hate dates and names. As an engineer, I am looking at how things work, why it works like that and not another way – I don't care who invented it. For my job as a concept developer, I looked for trends: if you consider this, what is the next step? How can we win the next battle? That is why I have studied history because the military had a lot of good ideas a hundred years ago that didn't work well but now, with new technology, maybe they can. That is why in diving too, I am looking for the next step. What is the future of diving?

What I am going to talk about is my story on buoyancy devices.

One of my professors in military history said the history we tell changes, certainly in the military. So, for example, in handling the WWII North African Campaign, you could conclude that General Montgomery was a genius. Later it was discovered that he was not that much of a genius because the Enigma was cracked, and he knew what the Germans would do. So, if somebody is aware of proof that the BCD is older than what I discovered, I'll accept it. This is my story based on the information I found in books, documents, and the internet. It's about tracing and finding the facts – certainly, there must be some BCDs that left no trace, no sign, no drawing, no patent. In which case, I am sorry, I didn't find it. This talk is going to be my story and when you go home, you can say it was 'his story'.

The surprising element – research always has a surprising element. Cousteau went diving to test the double-hose regulator and then, to my surprise, in the pictures of the event there is no BCD. He dived with his family, but none of them had a BCD. He and Gagnan didn't invent the regulator and the BCD. So, I went looking.

If you want to look for something you have to know what you are looking for. I don't have to explain what a BCD is unless there are no divers here. All divers? Good!

Elements of a BCD (Fig. 1)

I started looking at the pictures for the elements of the BCD. You need:

- air under pressure
- an outlet valve
- an inlet valve
- a harness to fix it to the diver, and
- you need some air pockets.

This is my checklist. It is not perfect as you can find some inventions that have not all the elements but may be considered BCDs. But we have a checklist. The final check is that the device must be used successfully, or at least leave some trace that it has been used by divers.

Assyrian breathing bags (Fig. 2)

Assyria was geographically situated very badly so they built a military force to protect themselves and when you have a military force you have to keep them occupied otherwise they will occupy themselves in the country. In ancient times, you send them out to capture cities. They had a force, a kind of combat swimmers, swimming to city walls. I don't know what they did when they arrived because I don't see any weapons on them. You see some bags with an inlet and an outlet valve but they are swimmers, not divers. If you use our checklist, they have an outlet valve, an inlet valve, and an airbag but there is no compressed air. Was it used successfully? Yes, but it is not a BCD.

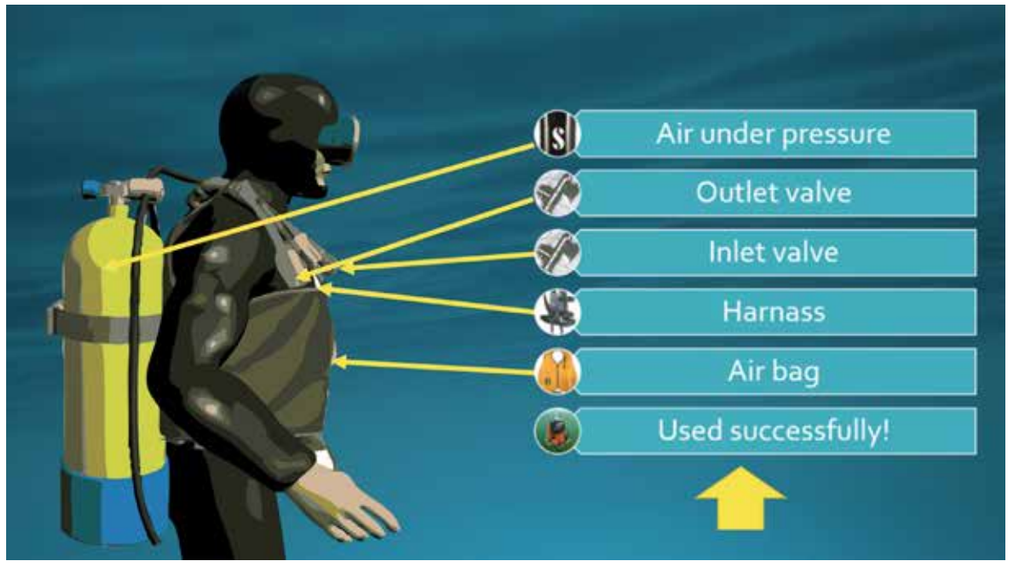
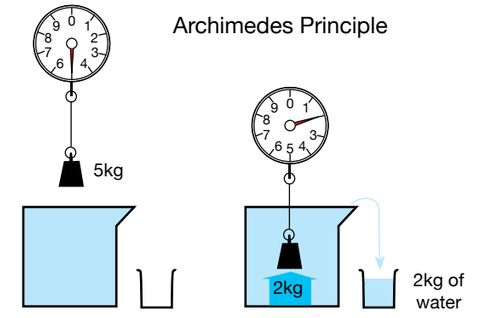


Fig. 1 The essential elements of a BCD.

Fig 2 *(right)*
Assyrian bas relief showing swimmers with breathing bags.

Fig. 3 *(bottom left)*
Alexander the Great's excursion underwater in a glass bell.

Fig. 4 *(bottom right)*
Archimedes and the law that was attributed to him.



Alexander the Great's Glass Barrel (Fig. 3)

332 BC: Alexander the Great went diving in a glass barrel. It is said he dived to more than three hundred metres for days. He apparently saw for more than 3 days, a kind of whale with lightning flashes passing by. Three days in this confined space? Anyhow, there is no need for a BCD; air pocket yes, but for the rest: nothing. Conclusion: No BCD.

Archimedes (Fig. 4)

I have some scientists in here too because you must think about the science. Do you all know Archimedes' Law? People make mistakes because they don't know this Law. We can see that in a few examples of unworkable designs. Everybody knows the story of Archimedes. His king had a crown and he said, "My goldsmith is earning too much money. I think he had cheated me with the crown." He gave it to Archimedes and said, "Can you

decide if this is pure gold or not?" The Greeks knew how to calculate simple volumes like a cube or a cylinder – that was not complicated, so he said, "I can smash the crown into a cube and I can measure it." The king said, "Don't do that" and then we all know the story of how Archimedes took a bath and discovered how to determine it.

He calculated the volume by seeing how much water went over the side of the bath when the crown went in – say two litres – and if a piece of gold with the same weight also displaced two litres, he knew the crown was pure gold. He didn't invent the law, just its application, but as a kind of honour, it is known as 'Archimedes' Law'. Knowing this law is very important for the working of a BCD. In fact, a BCD raises your volume and decreases your specific mass till you are lighter than water and you go up.

Urinatores (Fig. 5)

In the meantime, all activities were concentrated in the military: sabotaging, cutting anchor lines and the like, harbour repairs, ship repair, and treasure hunting. Treasure hunting took place near the coast because navigation was not that good, so they kept near the coast. When a ship was wrecked, it sank near the coast, seven to ten metres deep. Accessible by free diving. Just a story about the urinatores. That is the name of the Roman free divers because of the many dives in cold water they smelled like urine.

No BCD, I hope everybody agrees.

Leonardo da Vinci (Fig. 6)

The first SCUBA? You will hear a lot of 'firsts' because we are looking for the first BCD and we are hoping to discover something. Leonardo da Vinci designed the

Fig. 5 Urinatores, early breath-hold divers.

Fig. 6
Da Vinci's design for a diving suit *(above)* and replica suit *(below)*.

first known SCUBA in the *Codex Atlanticus*. Why did he do that? The Turkish fleet was sailing to the city of Florence and they didn't have enough ships to counter that fleet, so they asked if there were other possibilities. The scientist-inventor said, "I have a design to go unseen underwater and sabotage the fleet by drilling holes in the ships." This is the design (Fig. 6). He especially didn't mention any details because he was afraid that other forces and pirates would use the invention to find a ship at anchor, drill a hole, let it sink in order to easily steal everything that is on it. Leonardo never built it. I saw one being tested on a video and the suit worked but it was surface air supplied. Also, it didn't have air under pressure. So, the diver didn't have a BCD.

But Leonardo didn't stop at one design, he had others. He had military-level dive suits with masks like this one and also a kind of buoyancy device with a suit but it was really for floating. It was more of an airbag as a floating device. Interestingly, he added a pee valve so the diver wouldn't smell! It was never used. Even if it had worked, it was not the first BCD.

Pascal's Law (Fig. 7)

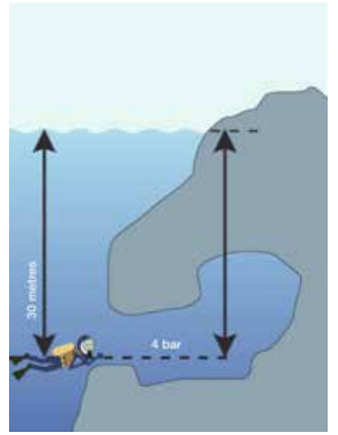
Pascal's Law made people aware of pressure from the 17th century on.

Boyle-Mariotte Law (Fig. 8)

Boyle-Mariotte showed that pressure and volume have a relationship. From then on people could start designing and inventing things that make up a BCD.

Borelli apparatus (Fig. 9)

The first closed circuit to appear. Italian design. At least Borelli had a clever design (he even had a design for a submarine). You can see this is a bag with a helmet, an airbag, a viewing window, tubes, and a scrubber with some chemicals. We know, from Boyle-Marriotte, if he is going to dive with this apparatus, his required weight must be tremendous. I don't know how many kilos he



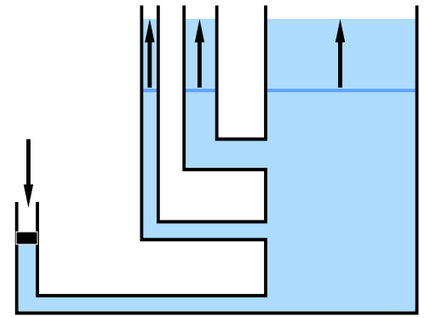
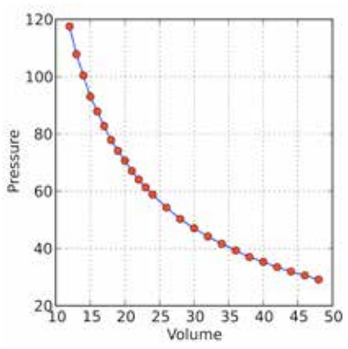


Fig. 7
1663: Pascal's Law: A change in pressure in an enclosed fluid at rest is transmitted undiminshed to all points in the fluid.



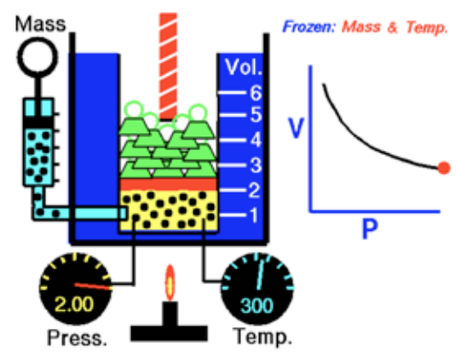


Fig. 8
1662: Boyle-Mariotte Law: The absolute pressure exerted by a given mass of an ideal gas is inversely proportional to the volume it occupies if the temperature and amount of gas remain unchanged within a closed system.

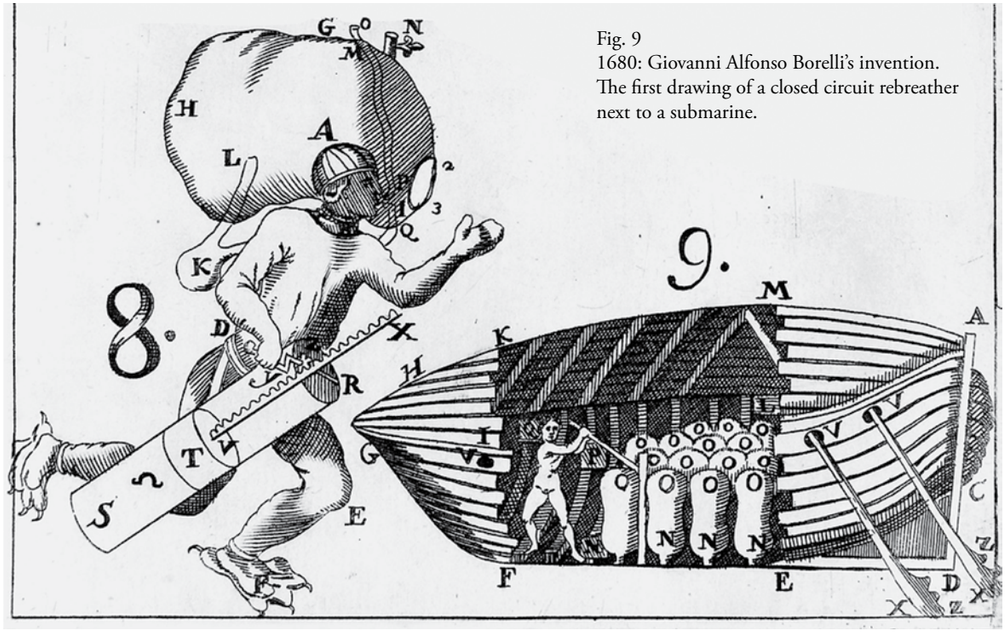


Fig. 9
1680: Giovanni Alfonso Borelli's invention. The first drawing of a closed circuit rebreather next to a submarine.

would need it depends on the volume of the bag of course. But I am not interested in his rebreather, I am interested in the cylinder in the diver's hand. It doesn't have an outlet valve or an inlet valve but it is a BCD. It is a mechanical BCD because with this lever the diver can increase or decrease the volume, and thus control his buoyancy.

So, from the checklist we see it doesn't have compressed air; but it is a BCD with a rigid body. It was likely never used or tested, I hope. This is the first time we see fins on the diver's feet. What was his thinking? In all the older designs, the diver was walking. This guy is a swimmer. He is not walking on the seafloor. The inventor equipped him with a BCD so that he could swim freely. It is the first time we see fins – although we think that Louis Marie de Corlieu invented them in 1923. This is not true, it was Borelli.

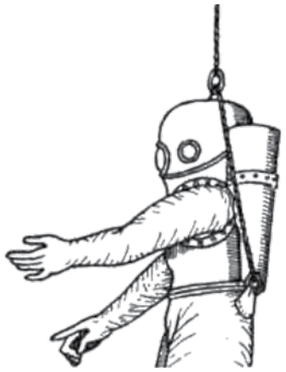
Is this design a BCD? Yes, although the technique is not right, and it was not used successfully. Not the first one.

Halley's diving bell (Fig. 10)

When I first saw the name, I thought I know this guy. Of course, the comet. Was he diving too? But then again, I am air force and I dive too, similar situation.

He built the first modern diving bell where you could sit inside and relax, but I am not interested in the diving bell, I am interested in this idea. Look, the diver has a little diving bell on his head with an umbilical connection to the big bell. A stupid design? Well, if the diver keeps within a certain range, it works. If he goes higher than the diving bell, he gets water in the bell. If he goes too low, he gets out of air, so he has to stay between certain levels. Air comes in by barrel and tube, and it worked. Complicated, but these bells were used. Halley had this diving bell in 1691 and he stayed four hours in the diving bell just to demonstrate it. We see

Fig. 10 1691: Halley's diving bell.



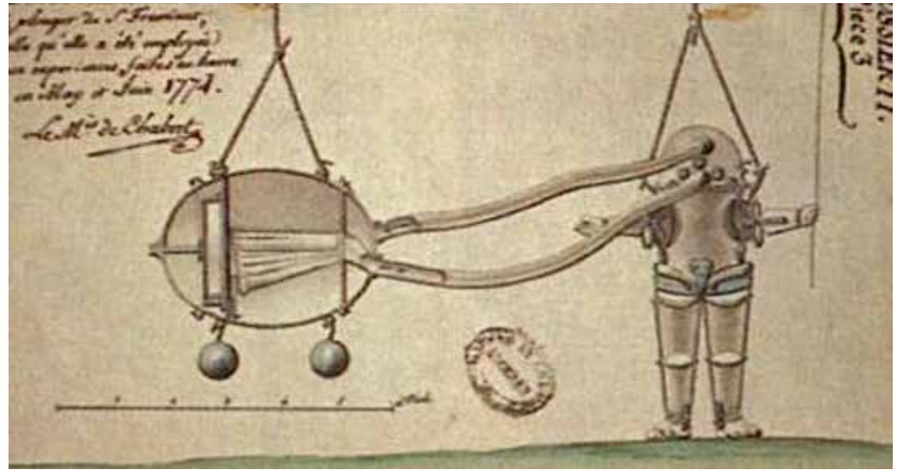


Fig. 11
1771: Fréminet's Machine Hydrostatergatique with copper helmet and air tank.

that many inventors tested their invention or patent if they couldn't find anybody else willing to do it. The diver with his nice little diving bell is connected through a hose, but no fins, and no BCD.

Fréminet's Machine Hydrostatergatique (Fig. 11)

Fréminet was a French doctor. Is this a kind of SCUBA? A copper helmet, a copper harness and again a kind of rebreather system. Interesting to know, this was a mechanical device that pumped the air around. How it worked, I do not know. It reached fifteen metres for several minutes. It was a poor invention because Fréminet died from lack of oxygen. I think the invention was fine but his calculation was off. I am not interested in the SCUBA equipment, I am interested in what he is wearing here. My checklist doesn't check off; he has a harness but he didn't have any airbags. The device was used successfully. But a BCD? No.

Where does the word SCUBA come from? I thought it was an old word, but it was only invented in 1952 by Dr Christian Lambertsen.

Hall's diving suit (Fig. 12)

This suit is made from fixed metal rings coated with leather and leather boots. It is a kind of leather diving bell for one person. There are these lines that if you pull on them, the 'skirt' goes up so the diver can get out. How the diver controls the suit, I don't know because there are only figures provided; no details.

What interests me is this here on the front of the chest. This looks like a valve. A kind of outlet valve? There are hoses to get air under pressure connected to pumps.

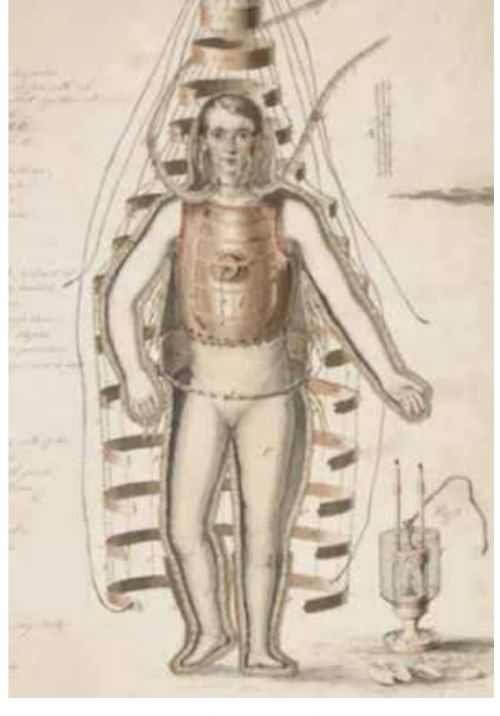


Fig. 12 1810: Chauncey Hall's diving suit.

Or did they use bellows to get air in? Although the air pump was already invented, bellows were used in diving until 1913 or '14. It's not something that they gave up quickly. Again that is not that surprising because, when something works, you keep on improving it. After all, changing it completely entails risks. I don't know if Hall's design was used because I haven't found any trace.

Is it a BCD? It has a harness, but the lack of fins means the diver is not a free swimmer. Conclusion: No BCD.

James' patent (Fig. 13)

By the mid-1800s, the speed of invention is increasing. In technology trends, we see that too. It takes a while to get going and then the speed goes up rapidly.

We are in 1825 now with an English inventor of a modern SCUBA system with compressed air in copper rings. It needs about 150 kilos pressure of air for a seven-minute dive. Although it was patented, it was probably never built. But again, I am interested in the BCD elements. It has a helmet and a fixed-volume system. This means no BCD.

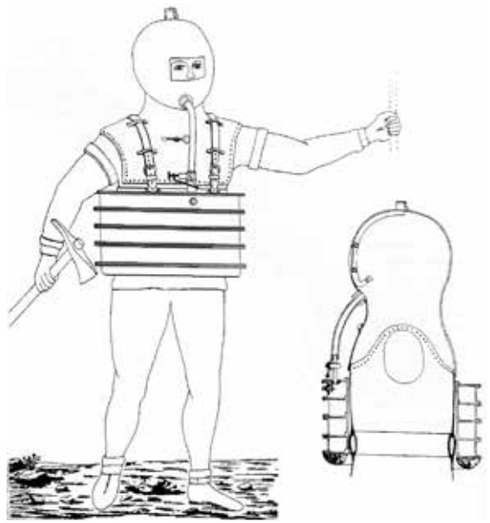


Fig. 13 1825: William James' iron belt.

Condert's diving apparatus (Fig. 14)

Condert, an American engineer, based his design on William's, and the Deane brothers' diving suit with the helmet. He made dives with his apparatus. Some people claim he is the real SCUBA inventor. He died due to a broken air tube, although that is debated. Some say he tripped and fell because of the weight. With an open helmet, all the air went out and he drowned. Anyhow, is it a BCD? No. Although he had air under pressure, a harness, and an airbag, he had to take a weight to stay down and go up. So, no BCD.

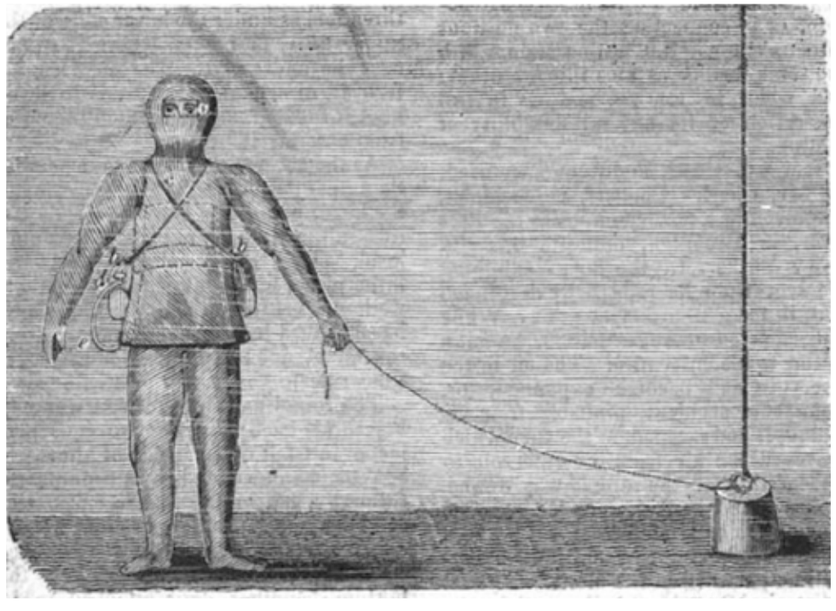


Fig. 14
1828: Condert's diving apparatus.

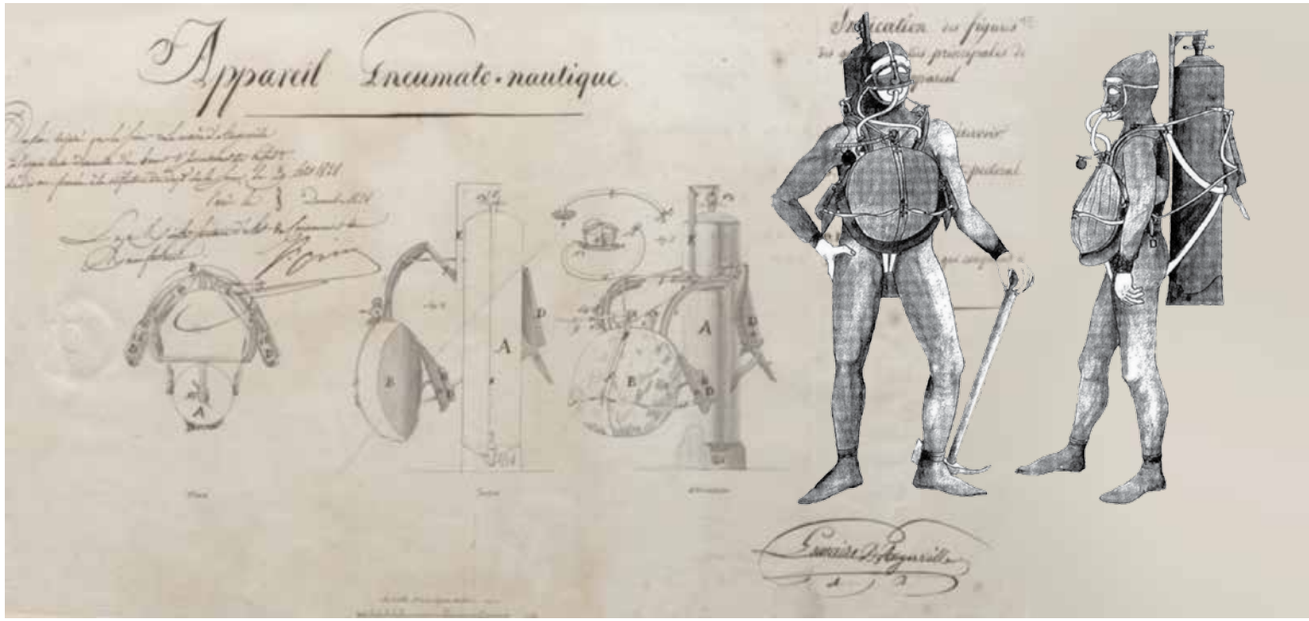


Fig. 15 1828: Lemaire d'Augerville's Appareil Pneumato-nautique with the first real BCD. Drawing © Daniel David.

Lemaire d'Augerville's Appareil Pneumato-nautique (Fig. 15)

Another French invention. In 1824 (some say 1828), his system had a compressed air source (20 bars in an airbag) and constant airflow which the diver could regulate. In the patent, he claimed he could dive to thirty metres for an hour. Not important for my search. But the design had an adjustable jacket combined with a special air cylinder for use in an emergency, as a lifesaver but also as a BCD. So, in an emergency, the diver could open the air valve with the lever, put a finger in the exhaust valve to block it, and then he could ascend. At least it gave the diver something by which he could regulate his buoyancy.

This invention included air under pressure, an outlet valve, an inlet valve, a harness, and an airbag, and was used successfully. This is the first BCD, according to me. Maybe somebody will disagree, but it worked; he successfully dived with it.

Guillaumet's double hose regulator (Fig. 16)

In 1838 – the double-hose regulator, with no clue how it worked. Bags could be inflated or deflated at will. A BCD, but it was too late, it was not the first BCD.

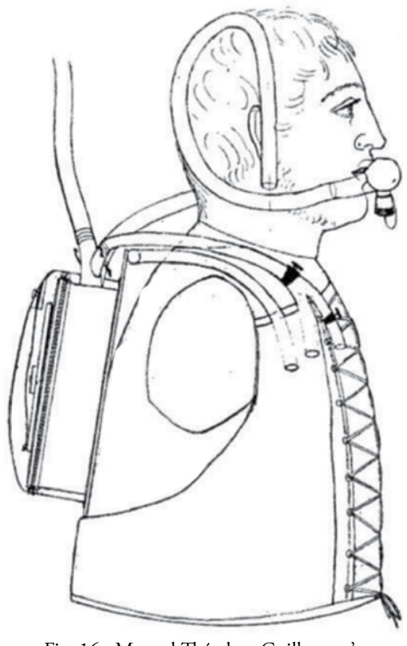


Fig. 16 Manuel Théodore Guillaumet's double hose regulator.

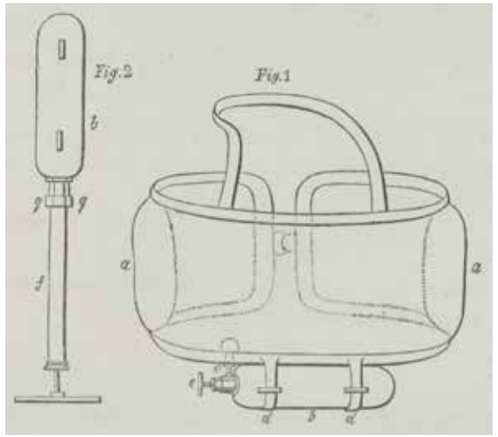


Fig. 17 Hoxton Thornthwaite's inflatable rescue belt

Fig. 18 Frédéric Dumas' inflatable 'bouée collerette'.

Hoxton Thornthwaite's rescue belt (Fig. 17)

In 1839, an inflatable rescue belt. You could inflate the rescue belt to go up. But it was a rescue belt, not a BCD. Partial inflation was not possible, therefore, not a BCD.

And then? Nothing. For 150 years: nothing, no BCDs, nothing at all. What is the reason for this lack of BCDs? Jacques Cousteau should have had a BCD during his first dive because they were invented 150 years before. What happened?

In 1853 Macintosh fabric made good rubber diving suits. The Deane brothers and Siebe attached them to helmets. This combination created one volume of compressed air so the diver could use his suit as a BCD. I know that commercial divers use the buoyancy of their suits to ascend and descend. The suit was the BCD. There was no need for a separate BCD anymore. As a result, all the previous inventions were 'lost.' 150 years of nothing.

Dumas' Bouée Collerette (Fig. 18)

In 1943 Cousteau carried out the first test dive in the Marne. It was not the first dive; it was the first test. They had no BCDs. But with a modern double-hose regulator you want something like a BCD. It is much more comfortable to dive with. Soon after those first dives, you have the Bouée Collerette. In 1951, Frederic Dumas, one of the divers in the team of Cousteau, reinvented the buoyancy device. First, he had a compressed air container on his back but later he connected it to the tank. For him, the 'bouée collerette' was more of a rescue device than a BCD.

We have to make a time jump via the British Fleet Air Arm, where in January 1940 a journalist describes the life jacket worn by pilots as a 'Mae West' (an inflated life jacket would bear some resemblance to the ample bosom of the American film actress Mary Jane 'Mae' West). Because years of experience had been built up with this type of life jacket and with an oversupply after World War II, they soon appeared in the world of diving. At first, they were mainly used to increase the buoyancy at the surface, but soon the use evolved to self-rescue at depth. They were equipped with an emergency cylinder and later connected to the air tank. In 1958, variants were for the first time offered in the U.S. Divers catalogue. The lifejackets, specially designed for divers and equipped with a between-legs strap, could be inflated with a CO_2 ampule or by mouth. At the time, self-rescue for divers was a growing market with, among others, the Res-Q-Pac.

Maurice Fenzy's ABLJ, 'The Fenzy' (Fig. 19)

The first floatation and rescue devices (those things you can blow up when the diver has an emergency) were developed in Europe. Remember Leonardo da Vinci and his floatation device. Later, in 1961 Maurice Fenzy applied for a patent for a device invented by the French GERS [*Groupe d'Etudes et de Recherches Sous-marines*]. This Adjustable Buoyancy Life Jacket (ABLJ) consisted of a ring that, in the first versions, was inflated underwater by mouth. Later versions had their cylinder with compressed air mounted on them. Some had an ampule of carbon dioxide,

Fig. 19 1960s Advertisement for The Fenzy.

a development that was abandoned when valves were introduced that enabled divers to breathe from the inflatable, inner bag. Due to its ease of use and durability, within a few years, divers all over Europe were wearing 'Fenzys'. With the possibility of using air from the dive tank, his invention soon became the first commercially successful and fully-fledged BCD. It rapidly became the first commercially successful buoyancy compensator device. Within a few years, divers throughout Europe, and a few well-travelled Americans, were wearing Fenzys.

That was the first commercial BCD for divers and was very successful. I have dived with the Fenzy too. Even with that bottle, it's a lifesaver. And quickly you use it as a BCD, paying attention that you leave some air in case of an emergency.

And then in the 1960s, British cave divers introduced side-mounted cylinders. In the mid-1990s Lamar Hires designed the first commercial side mount diving system with buoyancy control and this was manufactured by Dive Rite. Dive Rite focused on the newly released 'Transpac' harness. Other cave divers continued to manufacture their own DIY configurations.

Ten years later Scubapro introduced the 'Stabilizing Jacket', better known as the 'Stab Jacket'. With its classic look and increased stability thanks to a patented design of a 360-degree flow of air in the jacket, this trim vest caused a revolution. That it was a revolution can be seen in the use of the word 'stab jacket' as a synonym for a BCD. It was very hard to make but was very popular worldwide. In Belgium, there were Fenzys and Scubapro Stab Jackets but still, the BCDs were not commonly used.

Of course, inflators were also getting better and better – not only did they become more powerful, but they also integrated inlet and outlet buttons and had a 'quick disconnect'. In 1978 Scubapro applied for a patent for the Air II which integrated a second stage.

Between 1971 and 1985, to circumvent the Stab Jacket patent, other manufacturers created vests that were split under the arm (Fig. 20). Another method was to replace the front part with a strap (later detachable). The BCD began to resemble the current models. The backpack is integrated with soft padding for comfort.

An interesting design is the Watergill AT-Pac (Fig. 21). In 1972, Watergill Manufacturing launched the 'Watergill AT Pac'. This model contained several

Fig. 20
1971-86: The split BCD bypassed the Stab Jacket patent.

Fig. 21
1972: Watergill's AT-Pac.

Fig. 22 Wings.

Fig. 23 Dacor Nautilus.

introductions, such as the 'cummerbund' or waistband, wings, and the integration of the regulators in a 'shell system', whereby everything is neatly stored in a hard shell. It was also the first integration of lead into the BCD. The diver could discharge the lead pellets in case of emergency. With so many novelties in one model, the design was considered dangerous and it was advisable to undergo special training before diving with it. The model was not a success, but the ideas did find their way, via later models, to the diving community.

The wing became very popular in the 1970s and 80s. (Fig. 22) With bigger volumes, you had better stability than with a stab jacket and it was simple to operate.

In 1976, the Dacor Nautilus came on the market (Fig. 23). It was a rigid body BCD with regulator-maintained inflatable volume using the pressurised air in the tank. The diver did not have to manually adjust the piston, as the volume was kept constant by an automatic valve and compressed air. There was a conceptual flaw with this design. The promise of a continuous adjustment was not fulfilled because it did not consider the buoyancy variations of the wet suit and because of the air consumption. It worked, but not like they promised it would. It was a good idea but a poor design. As a result, this innovative design slipped into oblivion.

In 1979 rigid back plates were introduced (Fig. 24). Cave diver Greg Flanagan made the first back plate drawing taking inspiration from the Scubapro Stab Jacket. He made it from an aluminium road sign. The idea was 'designed' by Lamar Hires in the mid-1990s and distributed by the company Dive Rite as the first commercial side-mounted system.

The jackets kept getting better and better with adjustable shoulder straps replacing the jacket style. Comfort was improved with cummerbunds instead of webbing, airbags, quick releases on the shoulders, soft packs, and varied sizes and colours. Different weight integration systems were used (Fig. 25). Some had metal pellets you could drop. The problem with the dropping system is that it releases them all or not at all. You could

Fig. 24a Cave diver Greg Flanagan?

Fig. 24b Dive Rite's backplates (*above and right).*

Fig. 24
Rigid backplates were introduced by Dive Rite in 1979 based on Greg Flanagan's earlier prototype.

Fig. 25 Various weight release systems.

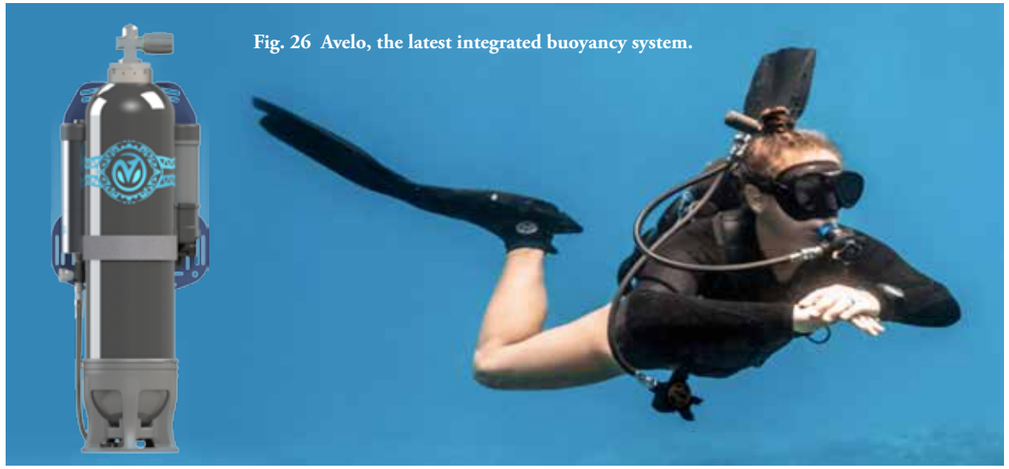


Fig. 26 Avelo, the latest integrated buoyancy system.

open the pouch but the pellets wouldn't go out. That is not a good thing. Weight belts use gravity to release the weight. There are some bad designs too, even nowadays.

There is a new system, the Avelo (2022) (Fig. 26). It has a rigid body (like Borelli's) with an electric pump and a BCD integrated within the tank. The company says it works. However, they did not claim it was based on Borelli's idea! If it works, it would be great. It has to work with dry suits too because if it only works with a shortie, it's of no real use to us. I have seen some videos and the concept seems to work. I would love to dive with it, but it is only available in the States for now.

The Future

In recent years, the BCD design has not changed much although I have seen some patents that use electronic systems to control the buoyancy. The problem is, how do you know when the diver wants to go up or down? It's an airbag system, there are no new approaches that I could find.

It is a challenge to find something new for a BCD. What can be improved? Comfort, yes; design, models, sizes, streamlining, etc. all yes. Perhaps the application of new technologies will change this? Maybe replace the BCD with some sort of propeller? I do not know. Or will old forgotten ideas be made possible again?

Questions? No dates, no names, please!

Mike O'Meara: Thank you Patrick for a history lesson and a refresher on diving physiology which I found fascinating. We have time for questions. Any questions?

Peter Dick: Very interesting. Every time you look at one of these old diagrams you come up with something new, and looking at Borelli we tend to think it would never have worked but, of course, it's a schematic. Scaled-down, there is no reason why it shouldn't have worked. Notice that the buoyancy was held round the neck and that has been proved to work. I think that on the *Vasa* they sealed around the neck. Is that right Lars? Yes. They sealed around the neck. It would work and that idea, the buoyancy, he would have demonstrated the principle of the thing. If you look at the actual buoyancy bags in the submarine he showed, they were flexible. The ideas were all there, they were coming into place, and he was building it exactly the same way as you built up your approach to something you said you knew nothing about. Very, very interesting.

PVH: Thank you. I think the fixed-body BCD is not for a diver who has too many air pockets. For a submarine, fine – that's the principle of the submarine… and that's why I said it would work with a shortie, only every twenty minutes you may have to adjust it a bit. With dry suits, there is too much air so with a change in depth there is a change in volume, you need much more electronics for that than what you have now? But, never say never.

Nigel Phillips: I beg to differ! [In the Borelli design] You could wind the handle round so it would go in. but you would not be able to wind the handle so that it would come out and expand the volume because the pressure on the lid of the cylinder was preventing you from doing so; there is no force inside the cylinder to allow you to expand it. You could wind it in (that would be very easy) but you couldn't wind it out, (that would be very hard) so his BCD would have let him down when he most needed it.

PVH: I am certain that after three metres or so he would only go down, but then again, it is just a principle, he was already suffocated by his helmet.

Peter Wingett: Perhaps it might be the time I recall when I started using a dry suit, you used the dry suit to control your buoyancy and your jacket was there as a safety device. The two need to be separated. The BCD is fine for the scuba diver in warm water that does not have the problems associated with a change of buoyancy due to gas content in the suit, but it loses out when you get these other variables like the volume of the suit and your woollies and everything else that's underneath.

PVH: Well I started to dive a dry suit,….. I put on a jacket as a safety but now I am using my wing as my BCD and my dry suit just to make sure it is comfortable. I don't use my dry suit anymore as a BCD.

PW: If you are making sure your dry suit is comfortable, you are adjusting your volume.

PVH: Yes, of course, but if I have to adjust my BCD too.

Kevin Casey: The offshore industry took a long time to catch on to that and give stab jackets which are an integral part of what we wear, or what we used to wear. In the early days, we would lock out of a bell, we didn't have a stab jacket, we would get cordial bottles, a few litres, use our pneumo to fill them, tie them off on our chest and we'd swim on our backs to try and keep on the level because we couldn't look up at the skirt [of the bell] or down it. That's what we used in the early days and eventually, the Ministry cottoned on to a proper stab jacket.

John Badger: It is more to do with an observation. The Fenzy type of life jacket, being European, we weren't a big manufacturing base so there wasn't a very large number built. The jacket variety, in my opinion, was for the American market where you would have a dive boat with a number of divers on it, particularly in warm water and if you put the whole lot together as one unit so you had the jacket, the cylinder and the weight device you don't have to train the people with any other equipment and also the Americans have such a large manufacturing base because there is such a huge number. I started with a CO_2 jacket and then went to a Fenzy and now I dive with a jacket but I think the manufacturing was there. It's the same with the hard-hat diver, there were 150 years of development, and there was no reason to. Diving was a professional thing, to build harbours, some of it was salvage but basically, it was civil engineering diving so why would you develop anything?

PVH: Then Jacques Cousteau introduced sports diving and the BCD had to be developed again.

JB: And also in the Cousteau days, the people that were doing it, most of them were very good swimmers anyway so the idea of buoyancy didn't matter to them because, if they got into trouble they could just swim to the surface.

PVH: That is what they did then.

Mike O'Meara: I think Patrick deserves a round of applause for a fascinating talk.

NIGEL PHILLIPS

Some Highlights from the Society's Collection

Introduction by Mike O'Meara.

Our last speaker this morning is well-known to us all, Nigel Phillips, He manages the collection in the Diving Museum. In 1982 Nigel founded his own company dealing in rare antiquarian books about science and medicine, in all their aspects and in any language, especially early works from the fifteenth century to about 1850. He is a member of the Antiquarian Booksellers' Association and of the International League of Antiquarian Booksellers.

He is also the Collections Manager of the ever-increasing artefacts, documents, images and films that are in the collection of the Historical Diving Society.

Nigel will talk about some highlights of the Historical Diving Society's collection.

Thank you, Nigel.

I hope that most of you will have visited the Museum to see what's there, but not many of you will have gone to the Bunker which the HDS owns outright and which is also in Alverstoke. It is called the Bunker because it is big and square and made of concrete and looks like a bunker, and that is where the HDS collections are stored which aren't in the Museum. There are some things we can't put in the Museum because the atmosphere is too damp but the Bunker has a good atmosphere so they should be safe there.

Fig. 1a is a view of the main room there, looking south to north. And Fig. 1b is the same room looking north to south. This is the office and most of the things in here are made of paper.

The other rooms are a bit difficult to photograph because there is much less space but Fig. 2 shows one wall which has mostly commercial diving apparatus, just to give you an idea of what the place looks like.

Going back to our main room, these two bookcases here (Fig. 3) contain Navy records and the pale-coloured volumes that you see there are Navy training records from 1927 to the 1990s approximately, including Ships Divers and Clearance Divers with some photographs. These records are unique. They are manuscript, written as ledgers, and the Navy doesn't have them any more but we do. The Navy decided they didn't want them and threw them away but we decided they were much too interesting for that so we took them out of the skip. Most of the records on these shelves came from the Navy in some way or other at some time or other.

Also in this section is a wonderful file which is innocuously entitled *The Story of Human Minesweepers*

The Historical Diving Society

Promoting and Preserving our Diving Heritage

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