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The Undersea World of the Sound Department: the Construction of Sonic Conventions in Sub-aqua Screen Environments

Abstract

The availability of new underwater cameras and sub-aqua diving gear in the immediate post-war era opened up exciting possibilities for both narrative and documentary filmmakers. While the visual elements of this new world could now be more easily captured on film, the sound elements of the sub-aqua environment remained more elusive. How should, this undersea world sound? This article examines the use of sound in the sub-aqua scenes of both fictional and documentary films in the 1950s and asks questions about the methods used in the sonification of these worlds. Comparing the operation of underwater sound and human hearing with the production and post-production strategies used by filmmakers this article identifies the emergence of a sound convention and its implications for issues of cinematic realism. Central to this convention is the manipulation of sonic frequencies. The sound strategies adopted also raise questions about the malleability of viewer perspective and sound-image relationship in terms of a realist mode of address. Linked to this is the use of sound to enhance audience experience on an affective level. As well as underpinning cinematic realism, these new sound environments offered fresh experiences to audiences seeking new reasons to visit the cinema in an era of widening forms of entertainment.

Keywords

Film sound

Sound Frequency

Sub-aqua sound

Hans Hass

Jacques Cousteau

Diving films

The creation of credible sonic worlds has been the stock-in-trade of sound departments since the emergence of sound film. The growth of the science-fiction film in the 1950s pushed the sound editors and Foley artists to develop sonic environments to match the visual spectacle of these new worlds of the imagination, filling these distant planets and potential futures with the whirls and bleeps of robots, the sonic emissions of space craft and weaponry, or the vocalisations of alien races and species. While the sonic construction of these extra-terrestrial film realms has been well documented, a consideration of another alien world closer to home has received less attention: namely, the world of the sub-aquatic.

The underwater environment remained a place of mystery that made relatively few filmic appearances in pre-World War 2 cinema. Technical restraints played a large part in this absence. Before the development of specialised underwater cine cameras in the 1940s, underwater scenes were shot either through a system of tubes and mirrors,¹ as with the 1916 version of *20,000 Leagues Under the Sea* (Paton, 1916), or with composite shots involving aquariums or large scale glass-sided tanks.² The development of underwater breathing equipment was also being pushed forward during the 1940s, by the twin imperatives of scientific research and wartime military advantage. The scientific work of Hans Hass and Jacques Cousteau during the 1940s was key in progressing both sub-aqua breathing and swimming equipment, as well as the design and commissioning of underwater housing for cinematic cameras. The development of these technologies massively expanded the potential for underwater scenarios to be brought into the orbit of both narrative film and documentary. But if the cameras could now move effectively through the sub-aquatic sphere, what technical demands and questions of representational strategies did this raise in relation to sub-aquatic sound? Did sound technology advance in tandem with cameras? How would this new world be sonified as a space for filmed narratives and sound harnessed for affective impact? Further, what does the sonification of the undersea film world tell us about the interactions of sound and vision and the varying formal strategies that audiences may accept as cinematic realism?

To try and answer these questions, one should first consider the technologies of underwater sound recording. The ability to hear underwater by means of a metal tube penetrating the water surface was described by Leonardo Da Vinci as early as 1490. The modern piezoelectric transducer-based hydrophone has been in existence in some

form since late in World War 1. These hydrophones were first used by shipping convoys as a means of detecting U-boats, but were not used for sound recording until some time later. Interesting recordings made by the US Navy during World War 2³ indicate that useful material could be gathered by hydrophones, but the output was perhaps not of sufficient clarity or of too harsh a tone to be acceptable to commercial filmmakers. Another method of recording underwater involved placing a standard directional microphone in a waterproof housing or material (a common method was the use of a non-lubricated rubber condom – an expense item that often raised a few eyebrows in the accounts department). As this method involved using a material barrier and microphones that were designed to work with the acoustic properties of sound moving through the air rather than water, it was not successful at capturing the full frequency spectrum of sub-aquatic sound; yet it was able to gather material that could be used. Given the problems of recording in the underwater environment, it was largely the Foley artists and sound engineers that were called on to construct sounds that mimicked, or more pertinently, could be thought to mimic, the sonic experience of the ocean bed and the sound produced by underwater actors and action.

Before considering further the development of sound design for sub-aqua scenarios, it is worthwhile to establish some fundamentals about the properties of underwater sound. It is important to ascertain what underwater sound might actually *sound* like if filmmakers were seeking the most naturalistic means of rendition. Sound actually moves approximately four times faster through water than through air, notwithstanding water's greater density and the numerous elements of the underwater environment that can reflect, refract or scatter sound energy (Haines 1974). This greater speed raises issues in relation to the mechanics of human hearing. In order to localise sound, humans and other mammals depend on detecting the arrival time and level differences of sound between two ears. Partly due to the speed of sound underwater, binaural hearing is difficult because the slight time difference in sound reaching the two ears is too short for human audio perception. Therefore, identifying the direction of sound in relation to its source is almost impossible. Hearing is thus not binaural but 'omniphonic', sound being perceived as 'in the ear', rather than as emanating from a particular source or being contoured by the intervening space. It could therefore be argued that unless one is using headphones, the experience of underwater sound has to be translated into what can be delivered in the auditorium (although modern surround systems could perhaps give a better rendition). This was

less important perhaps for the mono reproduction used by most of the films examined in this article, but became more of an issue as stereo and multi-channel sound systems developed. There is also a question in relation to character actions and screen direction. While sounds may be omniphonic in the real undersea environment, in relation to screen action the directionality of normal hearing is often maintained, with actors responding to sounds in relation to the spatial position of their source.

As well as being a problem for standard microphones, the acoustic impedance properties of water are a problem for the human ear. Underwater sound does move faster but also moves through a denser medium and its intensity is thereby diminished. Due to this acoustic impedance mismatch, hearing underwater is less reliant on the eardrum and bones of the outer and middle ear, as it is with air conduction. It operates instead through 'bone conduction', with sound waves being relayed directly to the inner ear via the bones of the skull. The ceramics used in the construction of the piezoelectric transducers, commonly used in hydrophones, has a hard quality similar to human bone, as this stiffness provides a better 'impedance match' in underwater conditions (Maurer 1998). The highest frequency range of human hearing in a healthy ear is around 20Khz, although this varies with age. Recent research has suggested the higher range limit might be extended considerably underwater due to bone conduction (Qin et al 2011). Accordingly, divers often describe underwater sounds as 'clicky' or 'toppy', a description that tallies perhaps to this increased perception of the higher frequencies of a sound event. As the 'underwater musician' Michael Redolfi comments:

Thanks to bone conduction, a radical filtering operates on the sounds that we listen to in the water. The bone equalization brings an emphasis on medium to high frequencies, while basses are completely ignored. The underwater sound world appears very crisp, crystal-like (Redolfi in Maurer 1998:1).

However, the techniques required to create underwater sound 'effects', which are still being passed on in film audio online discussion threads, involve equalising out these higher frequencies and enhancing the mid-frequencies.⁴ Some sound engineers propose taking clean recordings of water splashes and bubbles, and then pitch down and / or filter out the high-end frequencies. Other suggestions include

adding a ‘wobble’ to lower frequency, through various digital processing methods. An old technique apparently used for creating this effect on reel-to-reel tape recorders was to re-spool the sound material so that the magnetic side faces away from the playhead. This had the effect of losing the high-end frequencies, thus providing the required ‘muffled’ sound. In addition, by loosening the dashpot from the capstans ⁵ it was also possible to create some bass ‘flutter’. Interestingly in many of these online discussions these methods – the strategies recommended to achieve the ‘Hollywood’ style of underwater sound – are unambiguously seen as conventions rather than a means of achieving a degree of authenticity.

Why have these conventions emerged? On a technical level I would suggest these conventions correspond to how underwater sounds are heard from *above* the water, as the water surface acts as a significant barrier for sound transmission (Haines 1974). This might also apply to hearing just below the water when swimming, where water might enter the ears and muffle the ‘above the surface’ sound. The same effect is produced if sounds are heard through glass-plated water tanks, as sometimes used on set, or this ‘muffling’ might correspond to the frequency response of standard microphones being used underwater whilst protected by a material barrier. These ‘muffled’ and ‘wobbly’ sounds then become naturalised through convention. We might also ask whether this is the quality of sound an audience might *expect* to hear if they were underwater themselves, rather than watching from the cinema seats. This particular sound quality *suggests* the greater density of water compared to air and how sound might be expected to behave in this denser medium. This compares usefully to Michel Chion’s concept of rendering. As Chion states,

sound that rings true for the spectator and sound that *is* true are two very different things. In order to assess the truth of sound, we refer much more to codes established by cinema itself, by television, and narrative-representational arts in general, than to our hypothetical lived experience (1994:107 original emphasis).

These particular sound characteristics or qualities have become conventions. To trace their emergence and consolidation it is necessary to look at the sound recording and post-production strategies of fiction films that feature underwater scenarios and of documentaries on sub-aquatic scientific discovery. I have focussed on films produced

in the late 1940s and early 1950s, when, as mentioned above, the technology required for underwater filming was beginning to become available to filmmakers.

One of the first commercial fiction films to avail itself of this technology was *The Frogmen* (Bacon 1951).⁶ *The Frogmen* is set during World War 2 and has several sequences of military missions played out underwater. Richard Widmark plays Lt. Cmdr. John Lawrence, a 'by-the-book' commander placed at the head of a US Navy Underwater Demolition Team, the eponymous 'Frogmen'. Lawrence has to fight hard to win respect from his team, who are still grieving for the loss of their much loved, and more personable, former commander. The film follows the team through a number of actions, as they prepare beaches for troop landings and launch attacks on enemy submarine pens.

In the early underwater scenes when the frogmen are engaged in reconnaissance and diversion activities on potential invasion beaches, they are seen free-diving, that is without the aid of breathing apparatus. In these sequences we hear fairly low 'muffled' swirling water sounds and some bubbling to accompany the divers' actions. When the divers submerge to avoid bullets fired from above the surface, there is a noticeable filtration of sound to indicate the shift to the sub-aqua environment. The same muffled effect is added to distant explosions produced by another team of divers further along the coast. Later in the film, during a more prolonged underwater sequence, the divers are equipped with aqualung (Scuba) equipment, with oxygen tanks carried on the back. Distinct sounds of bubbles and the divers' breathing accompany these scenes. The intensity and audio levels of these breathing and bubble sounds are manipulated to reflect the frogmen's actions (such as fighting enemy divers) and the distances from the action as shown on the screen. What we notice about these 'signature' underwater film sounds, is that they create a *first* person audio experience overlaying a *third* person visual perspective. That is to say, the sonic elements are attempting to represent the subjective experience of being underwater equipped with diving equipment, even if the action of being underwater is seen from an objective (the narrator's as opposed to the character's) point of view. In addition, there is no close-synch between the sounds the audience experience and the characters we see in vision, and often the scenes have multiple figures in shot without any noticeable changes in the sound. Another notable sound in this sequence is that of a metal mesh net being snipped through, which is clearly Foley, but with little noticeable filtration to create the impression of being underwater. So while we might

identify the ‘muffling’ of underwater sound events as a general convention, this could be broken when required, and is not always essential in the creation a viable sub-aquatic soundscape.

Another film sharing a World War 2 setting and a diving theme is *The Silent Enemy* (Fairchild 1958). Based on the wartime activities of Lieut. Lionel ‘Buster’ Crabb,⁷ played by Lawrence Harvey. *The Silent Enemy* centres on Crabb’s team of underwater clearance divers as they attempt to combat the activities of the Italian frogmen of the Decima Flottiglia MAS, who plant mines and attack allied shipping from their manned ‘human torpedo’ underwater transports. Crabb’s unit dives using Davis Submerged Escape Apparatus (DSEA), which was developed to aid escape from damaged submarines. The DSEA was oxygen ‘rebreather’ type equipment that recycled the air breathed by the divers in a ‘closed-system’ and did not as a result produce a large amount of bubbles, unlike the ‘open-system’ Scuba. The use of DSEA had implications on film sonification and verisimilitude. The diving sequences were apparently filmed in underwater locations, rather than in tanks on set. I have not found any information on the sound recording methods, but it can be safely assumed that Foley sound was created in post-production. We hear muffled sounds corresponding to the characters’ actions, such as banging metal and a swishing water sound matching more energetic diver movements. One particularly notable sonic element is the sound of breathing mixed at fairly high volume. A scene which shows Crabb removing a mine from beneath a cargo ship is accompanied by this breathing sound. While Crabb’s breathing is clearly subjective sound, the same sound is also used over a third person viewpoint of Crabb, as well as over a subjective point-of-view shot of his hands un-bolting the mine. The ticking from the mine is also heard but is consistent in volume, in spite of the character’s distance from its source, and is run over a number of shots, including one showing Crabb placing his ear on the mine to listen. A quick burst of the close breathing sound is heard once again in a later scene when four divers from the unit are seeking a briefcase of documents from within a sunken aircraft. As in *The Frogmen*, these sounds are not clearly attached to any one of the divers as all four are in shot. This fluid use of sound in relation to image suggests that the sound effects here are more about ‘territorialisation’, setting the sonic framework of the environment or creating a believable sonic field for the audience to enjoy, rather than a more consistent attachment to sonic verisimilitude or a coherent sound / image coordination, as we might more generally expect to

experience in ‘terrestrial’ scenarios. Also, this shifting of viewpoints is at times similar to what Rick Altman (1992: 251) describes as ‘point-of-audition’. One aspect of ‘point-of-audition’ is the shift in sound quality in terms of volume and reverberation levels, which indicate we are experiencing the sound as the character might hear it. However, the level of coherence indicated by Altman’s term is not always in operation in the sequences discussed here.

Some of the underwater sequences in *Silent Enemy* are accompanied by music that could be described as post-Dubussyian impressionism. This music is used to represent the sub-aquatic world, with more emphatic sections matching upsurges in dramatic action. As Mervyn Cooke (2015:105) writes, Debussy’s symphonic poem *La Mer* (1905) was much imitated in film scores, both fictional and documentary, with ocean-going scenes:

Debussy’s novel approach to orchestral textures, specifically the layering of ostinati based on different rhythmic patterns (an idea intensified by his seminal encounter with the Javanese gamelan), seemed perfectly attuned to the need to portray musically the swelling motion of the ocean waters. Furthermore, the same basic approach could be readily adapted to different motions and patterns of both water and light: gentle lapping, sunlight sparkling on the surface, swells and surges, huge waves breaking and so on.

Cooke goes on to say that the use of harp glissandi, often using multiple harps rising and falling simultaneously, also became a standard illustrative device for composers to employ when tackling the sea, both above and below. Most notably introduced in Erich Wolfgang Korngold’s score for the *Sea Hawk* (Curtis 1940), these Debussy inspired harp glissandi reached their apotheosis in Bernard Herrmann’s score for *Beneath the 12 Mile Reef* (Webb 1953), a film for which Herrmann pressed into service an orchestra comprising nine harps to generate a suitably watery effect (Cooke 2015).

This musical model is clearly at work in *The Silent Enemy*, where the music, composed by William Alwyn, also relies on Debussyian impressionism complete with harp glissandi. This is particularly noticeable in the long underwater sequence where British and Italian divers fight over highly secret documents trapped in the fuselage of

a sunken Allied bomber. In this film music accompanies but (apart from very dramatic scenes) does not replace the sound effects entirely. This is in contrast to Disney's *20,000 Leagues Under the Sea* (Fleischer 1954). Here the underwater sequences are accompanied exclusively by music, composed by Paul Smith, of a similar impressionistic variety, with shimmering strings and harp glissandi mimicking the waves, swaying seaweed and the flows of imagined underwater currents. In addition, the low bass sonorities of the orchestra are used to intimate the possible threats lurking within the deep.

While wartime underwater conflicts clearly offer a powerful dramatic theme, a variety of other activities within the underwater environment also provided compelling narrative possibilities. In *Underwater!* (John Sturges 1955) treasure hunters Johnny (Richard Egan) and Dominic Quesada (Gilbert Roland) uncover a wreck they believe might be of an 16th century galleon that sank while allegedly carrying a priceless life-size solid gold and jewel-encrusted statue of a Madonna. Returning to Cuba with a few artefacts, Johnny tries to persuade his long suffering wife Theresa (Jane Russell) that this is not yet another instance in a long line of failed 'get-rich-quick' schemes. Managing to secure a boat and equipment for the venture, Johnny, Theresa, Dominic and his girlfriend Gloria (Lori Nelson) return to the site of the shipwreck. Father Cannon (Robert Keith), a Catholic priest and authority on ecclesiastical art, also comes along on the search. Their explorations are observed by an unsavoury group of shark fisherman who suspect that there might be rich pickings from the divers' endeavours and shadow the heroes, until the inevitable violent confrontation ensues.

Filming on *Underwater!* initially commenced in Hawaii, with some 40 tons of sets, including a sunken galleon shipped from Hollywood. However, bad weather destroyed the sets, and location filming in Hawaii was abandoned. The filming was finally completed in a giant 300,000 gallon water tank constructed in the RKO Radio soundstage. *Underwater!* was RKO's first release in their widescreen Superscope format. So this was clearly a project with some ambition in terms of spectacle and production values.⁸ There is a voice-over narration from Johnny, which is used both to recount the tale but also to explain the diving experience. In this regard the film resembles the documentaries on undersea discovery that were starting to achieve widespread cinema distribution in the early 1950s (discussed below§). To a large extent, the underwater sonics on this film resemble previous films, filtered bubbling

sounds linked to the bubble stream from scuba equipment, with music setting the various moods of tension or excitement and to emphasise action. In an extended scene where the divers are exploring the wreck, the music is absent; we again hear the subjective breathing sounds, fairly extensive Foley effects highlighting interaction with various objects and the clicking of a myriad of sand shrimps. Some new vocal sound sources were introduced. At one point the protagonists utter squeaks to communicate underwater; at another point Johnny removes his mask to speak. This trick, sometimes used by advanced divers, is employed here by Johnny to shout in celebration of the discovery of a chest they believe holds some of the treasure they seek. These examples show that with *Underwater!* attempts were made to extend the variation of the underwater sound palette, referencing the way marine animals emit sounds and by using the human voice, albeit in a truncated form as dictated by the watery environment.

Produced two years earlier, *Beneath the 12 Mile Reef* (Webb 1953), tells the story of various conflicts arising from communities of Florida sponge fishers fighting over fishing ground. In this film the divers use old-fashioned diving suits with air pumped in from the boat above. Less sonically active than *Underwater!*, *Beneath the 12 Mile Reef* also uses the familiar filtered (minus top and low frequencies) bubble and swirling water sound effects during the diving scenes. These are often mixed fairly low under the music, often following the now familiar combination of tension inducing low bass sonorities and harp glissandi. In these scenes, however, there are no perceptible shifts in the loudness of the bubbling sounds caused by the diver's breathing, even if the shots change in size – Whether wide, medium or close, the shots have the same accompanying sound levels. As these scenes do not include the subjective breathing sounds heard in the films mentioned previously, it is safe to say that this film establishes a more consistent third person viewer / listener. There is another notable scene where, as part of a religious ceremony, youths dive for a crucifix thrown off the harbour wall by the local priest. Here a large number of boys free-diving are accompanied by some minimal water swirling sounds. This third person viewing perspective is accompanied by sounds which might be considered a third person audition effect, but it is perhaps better to consider them as a minimal territorialising effect, with little relation to the movement or number of swimming youths.

These fiction films deploy effects to ‘materialise’ or ‘terretorialise’ the undersea world and create an affective sound experience of sub-aqua exploration. It is instructive to compare them to documentaries on underwater subjects produced in the same period, which also achieved wide theatrical distribution as well as critical and popular acclaim?

The two principal directors of these documentaries, Hans Hass and Jacques Cousteau, were also important pioneers of both underwater scientific exploration as well as the development of a range of diving equipment and specialised photographic and cinematographic apparatus to aid their researches. Hans Hass had previously produced a small number of diving films, both short and feature length, before *Adventures in the Red Sea* (*Abenteuer im Roten Meer*, 1951), but it was this film that, being widely released, brought Hass international attention outside his native Austria and in neighbouring Germany. Hass’ films are a mix of scientific research, adventure in exotic locations and some rather forced, humorous set-ups. The entertainment element is often built around Hass’ assistant and later wife Lotte Baierl (credited here as Lotte Bayerl). Described by reviewer Bob Crowther in the *New York Times* as a ‘beautiful and buoyant young blonde’ (1952:1), it is Bayerl who provides both a popular element of glamour to the films and the centre of some of the film’s more dramatic sequences, when she has to be rescued in her less than ‘buoyant’ moments; scenarios usually involving Lotte being menaced by sharks as her oxygen runs out. Hass (1958) is quite clear in his writings that his films are an important means of documenting and communicating his scientific work but also important sources for funding the voyages in the first place. In this respect, their entertainment value for a wider cinema audience is also important. The films are structured around actual footage gathered in their work and scripted scenarios, some clearly constructed as entertaining interludes and some reconstructions of dramatic events that occurred in their explorations.

Following the success of *Adventures in the Red Sea*, in his next film *Under the Caribbean* (*Unternehmen Xarifa*, 1954) Hass continued to enhance this ‘entertainment’ element. *Under the Caribbean* is shot in colour⁹ and, at the behest of the distributor and part-funders of the expedition, without voice-over commentary, as in Hass’ previous films, and as was common with documentaries of the period. The film was structured around scripted scenarios which Hass wrote himself. The dialogues occur both above the sea and, more surprisingly, underneath. To set-up the

latter conceit, Hass is heard informing the new members of the crew that they will hear themselves speak clearly underwater. Dialogue occurs even when the divers are breathing through their mouthpieces, although there is a slight but noticeable ‘muffled’ quality to these dubbed exchanges. When compared to the quality of the ‘above the surface’ dialogue, the ‘muffling’ is clearly intended to indicate to the audience the change of sound quality when speaking underwater. These underwater conversations are either the only sound element or, sometimes, occur with the accompanying music composed by Arthur Benjamin.

The various scripted scenarios tend to be fairly wooden and usually centre on a somewhat infantilised Lotte getting into various scrapes. These include trying to hypnotise fish or searching for some legendary buried treasure the whereabouts of which comes to her in a dream. The latter scenario sees Lotte heading off to look for the treasure in underwater caves, only to be trapped by hammerhead sharks as her air supply dwindles until, of course, she is rescued by Hans.

There are fewer added underwater sounds in this film. This is partly due to Hass’ decision to use ‘closed-circuit’ re-breathers rather than the ‘open-circuit’ aqua-lung system, developed and used by Cousteau, where air is exhaled into the water. The re-breathers create fewer bubbles and were used by Hass for this reason, considering them less disturbing for the fish. Therefore diving with this type of equipment did not warrant in the films the added Foley sound of bubbles which accompanies other diving apparatus.

The title of Jacques Cousteau’s first feature length film, *The Silent World* (*Le monde du silence* 1956), co-directed with a youthful Louis Malle, would seem to suggest that the world below the surface hosts little audio activity. However, the opening scene immediately belies this impression, as we hear a loud burst of bubbles and fizz created by the diving team plunging downwards clutching underwater flares. The notion of the silence of the sea is also partially contradicted in Cousteau’s book, co-written with Frédéric Dumas, which is also called *The Silent World* (1953). The book charts many of the adventures shown in the film and discusses aspects of the film’s production.

The sea is a most silent world. I say this deliberately on long accumulated evidence and aware that wide publicity has recently been given to the noises of the sea. Hydrophones have recorded clamours that

have been sold as gramophone curiosities, but the recordings have been grossly amplified. It is not the reality of the sea as we have known it with naked ears. There are noises under water, very interesting ones that the sea transmits exceptionally well, but a diver does not hear boiler factories (Cousteau and Dumas 1953:199).

Cousteau goes on to say that apart from the mammals ‘it is a silent jungle, in which the diver’s sounds are keenly heard – the soft roar of exhalations, the lisp of incoming air, the hoots of a comrade’ (Cousteau and Dumas 1953:199). This understanding of sound seems to be confined to the anthropocentric experience and activities of the divers - the sounds of animals are not included. Although, as Cousteau suggests, the technology at the time might not have been sufficiently sophisticated to bring a wider variety of sub-aquatic sounds into play as part of the film’s sonic architecture. However, the authors do admit to detecting unexplained creaking sounds and some audible sounds emitted by some shrimps and the ‘monotonous’ croaking fish, although there is evidently a certain lack of curiosity on the part of the filmmakers. This lack of interest is also evident from the voice-over commentary: on hearing dolphin echolocation and communication sounds via a sub-aqua chamber in the ship’s hull, Cousteau rather dismissively describes them as having a ‘squeaky’ voice. He is similarly surprised at the fact that when a whale, accidentally hit by the research ship *Calypso*, is heard on the vessel’s echo sounder, ‘the giant squeaks like a mouse!’¹⁰ Cousteau’s flippancy may well be a consequence of the poor quality of hydrophone technology available at the time to capture a wider-range of frequencies and therefore a richer sonic experience. Yet, this approach fits with a certain machismo element presented in the film, where there are scenes of the team dynamiting coral reefs in order to survey resident species and of the crew ‘massacring’ captured sharks. These have remained controversial incidents in the assessment of Cousteau’s early career.

Cousteau’s voice-over, interspersed with some occasional, rather stiff dialogue between the crewmembers, functions as the film’s structuring element. Louis Malle later commented on the struggles he had with Cousteau, who was keen to make what might be now described as a docu-drama, rather than to adopt the purer documentary approach the young and ardent Malle preferred. As Malle recalls saying to Cousteau: ‘what you are trying to do, this is not documentary, this is show

business. It is not what it should be, it is becoming like Walt Disney' (Malle 1993:8). Accordingly, the sounds of the undersea world are similar to that of the fictional feature films discussed above: breathing and bubbles (a mix of first and third person positions) and some incidental sounds of actions (for example, the sounding and cleaning of a bell of a wrecked ship - this scene is also accompanied by an ethereal female voiceover reading out the ship's name and port of registration, as inscribed on the bell). We also get the noise of the latest diving aid developed by Cousteau: an electric underwater scooter, which appears to be an added Foley effect. Also, as with the fiction films discussed earlier, music is a key element of the soundscape of the film's underwater scenes. Although it does not eschew the clichés of harp glissandi completely, Yves Buadrier's music creates a remarkably varied and dynamic musical backing.¹¹ Buadrier was a colleague of Oliver Messiaen in the *La jeune France* group and was therefore clearly well aware of modernist experiments in French music composition. While not shying away from dissonance, he also worked with more accessible music forms, and the music significantly enhances both the dramatic and more clearly structured 'entertainment' scenes (e.g. divers waltzing with a giant grouper fish) as well as the film's general mood. Like Messiaen he makes good use of the *ondes martenot* (an early electronic instrument related to the Theremin) the 'otherworldly' tones of which work well here to create an atmosphere of the uncanny and potential threat emanating from the sub-aquatic world. Buadrier's varied and inventive score supports many of the film's most memorable scenes. In a striking example, images of a large and highly acrobatic pod of dolphins are accompanied with a surprising brass fanfare, in part regal, in part circus, and with drum rolls loosely synched with the leaping animals.

In marked contrast to Cousteau, Hass was intently curious about underwater sound and the apparent ability of fish to pick-up sonic vibrations. He regarded this ability as having wide-ranging possibilities, especially as an aid to finding and tracking fish for the commercial fishing industry. In both *Adventures in the Red Sea* and *Under the Caribbean* Hass is seen experimenting with underwater speakers and microphones to explore fish communication and whether sharks and other predators could detect the vibrations of wounded fish. In *Adventures in the Red Sea* Hass' team attempt to record the vibrations of wounded fish and then play them back via underwater loudspeakers to attract sharks. While the technological aspects of the experiments proved inconclusive, the sound engineer's (Eduard Wawrowetz) joke of

playing music over the loudspeakers was used by the US editor to construct a scene where a large shoal of fish were seen to 'waltz' to the music of Johann Strauss. While Hass dismissed the scientific accuracy of the dancing fish, it did prove one of the many talking points that helped in the film's success. In *Under the Caribbean* one of the sound recordists is seen and heard monitoring the sound from underwater microphones as they pick up the sound of sperm whales, which he described as reminiscent of the 'creaking of an old door'. Whether actual recording of sperm whales or Foley, this sound, along with the sound of swishing water, is used over the sequence of Hass' and fellow cameraman Jimmy Hodges' close encounter with the sperm whales.¹²

In these documentaries we can see at work the economic pressures of the film industry, pushing their director towards more highly narrativised approaches, as clearly indicated by the preference for scripted dialogue as opposed to voiceover commentary in *Under the Caribbean*. This approach was aimed at attracting a popular audience, but the critics were not always impressed. The *Monthly Film Bulletin's* reviewer of *Under the Caribbean* noted that, 'Mrs Hass appears in a series of stunning expeditionary outfits, and most of the film's information is unfortunately conveyed by means of naively matey dialogue between her and Dr Hass, which at times makes one long for a good old-fashioned impersonal commentary' (1955: 14). Malle's comment to Cousteau quoted above indicates the influence of the Disney Studio's highly successful, and decidedly anthropomorphic, True-Life Adventure series of nature films. With their populist and often 'folksy' voice-overs and with the images tightly edited to music, these films were setting a commercial standard for nature documentaries that Hass and Cousteau, if for different reasons, followed. The inclusion of sections of scripted dialogue between the crew in *The Silent World* is another aspect of this drive towards fictionalised structures, which was deemed a prerequisite for commercial success, in spite of the striking and novel documentary material produced by both Hass and Cousteau.

The films discussed here are also a reminder, if one is needed, of the porous border between documentary and fiction. While this border might be seen as clearly crossed by the scripted aspects of Hass and Cousteau's work, what is also interesting here is the operation of the 'truth effect' of the documentary image, which allows the various and sometimes nonsensical sonic strategies adopted in these films to function within the bounds of the documentary. This is best exemplified by the merry chats

conducted by the diving crew in *Under The Caribbean*. The ‘truth effect’ here can be taken to mean that the status of the image as ‘reality’ over-rides the status of the sound, which clearly is entirely constructed. That the organisation of the sound elements in *Under The Caribbean* is so plainly artifice and not perceived as a detriment to its documentary status shows the extent to which the image dominates in constructing (or orchestrating) a realist / naturalistic mode of address. While these examples indicate a clear hierarchy in the image-sound relationship, they also point to the way in which sound can operate relatively freely to produce a functioning sonic backdrop to images.

Conclusion

Early diving films soon adopted a systematic approach to conveying the sonic environment of the undersea world and this is still how we believe the underwater world should sound. While after the period examined here there have clearly been developments in the design of sound in underwater scenes, online audio post-production discussion sites seem to suggest that the ‘tricks’ that sustain these conventions are still being passed on. One of these conventions concerns the range of specific frequencies to emphasise or suppress through equalisation or other processes. These techniques presents a soundscape that in terms of tonal qualities we accept as ‘authentic’, even though it in fact differs from the way sound and human hearing operate underwater as I have outlined above.. While this acceptance might be due to the fact that the audiences of these films lacked any real sub-aqua experience, these techniques have not been changed over time. Evidently, these conventions still serve their function, at least in fiction films, where they territorialise the sub-aqua environment in ways that are convincing. Subsequent advances in audio technology have expanded the possibilities of underwater recording. This is particularly clear in relation to documentary practice, where the use of digital recorders, surface-to-sub aqua communication systems and specialist hydrophones have led to a much more expanded sonic experience. The sonic emissions from the sea and its inhabitants are now an important focus of scientific exploration and there is much interest in animal ‘vocalisation’ beyond the more long-term interest in cetacean communications. In many instances the ‘frequency’ conventions developed in these early films are coupled with the use of first person audio. This use of audio draws the audience into

the underwater space by giving an imagined audio sensation of being underwater, regardless of the slippages between first and third person visual perspectives. The deployment of these sound design strategies points to the flexibility of the conventions dictating which sound / image interactions may operate successfully within the boundaries of cinematic realism. It is evidence of the increase in the use of sound design to broaden and enhance the sensorial experience of cinema. This enhanced sound added to the panoply of visual effects that emerged in the 1940s and 1950s, at a time when cinema began to fight to maintain its status as the dominant medium for entertainment against an increasing array of enticements and pleasures, specifically television, which competed for audience attention in the post-war years.

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¹ Brothers George and Ernest Williamson, operating as the Williamson Submarine Film Corporation, developed this underwater camera system and were important pioneers in the development of underwater cinematography. Ernest was active for many years and was a consultant on the Disney version of the Jules novel, released in 1954. In the early films they would shoot in shallow water where sunlight could still penetrate sufficiently to illuminate the action.

² The Ester Williams vehicle *Million Dollar Mermaid* (Mervyn Leroy, 1952), has a sequence featuring filming underwater scenes, as we see the ‘behind the scenes’ filming of Williams frolicking in a large glass tank replete with underwater scenery.

³ These can be found at: <http://www.maritime.org/sound/> (Accessed 29 January 2016).

⁴ Discussion threads accessed include:

<https://www.gearsutz.com/board/post-production-forum/153284-making-something-sound-like-its-underwater.html> (Accessed 29 January 2016).

<https://groups.google.com/forum/#!topic/rec.arts.movies.production.sound/AMR0GKk7LuE> (Accessed 29 January 2016).

<http://filmsound.org/QA/underwatersounds.htm> (Accessed 29 January 2016).

⁵ In tape recorders, dashpots were used to regulate tape friction and to dampen vibration and the capstan aided the precise movement of the tape across the record and play heads to eliminate ‘wow’.

⁶ According to a news item in *Variety* of 22nd November 1950, the film was to incorporate footage shot by the U.S. Navy of the invasion of Korea. Publicity emanating from the studio stated the film used innovative equipment, such as a seven-ton undersea bell to encase the cameras and the Aquaflex, a new mobile underwater camera. Apparently only two Aquaflex cameras existed at the time, one of which was owned by the studio and the other by the military.

⁷ Production of the film started roughly a year after Lionel Crabb’s highly publicised death in mysterious circumstances in Portsmouth Harbour. There has been much

speculation over his death, which seems to have some connection with intelligence gathering work for MI6. The most repeated theory suggests he was killed while examining the innovative propeller of the Soviet cruiser *Ordzhonikidze*, moored in Portsmouth after conveying Soviet leader Nickolai Kruschev to the UK on a diplomatic visit.

⁸ A large budget was also lavished on the premiere. According to the RKO press release, the premiere was ‘the most intriguing and successful’ in Hollywood’s history. RKO flew in 156 reviewers to Silver Springs, Florida for a special underwater screening of the film. Apparently this was accomplished by using a screen and some benches were submerged in twenty-feet of water, and a glass bottom boat was converted into a projection booth. The studio also supplied the press with aqua-lung equipment borrowed from the Air Force, as well as flippers, waterproof watches and swimsuits. Jane Russell, resplendent in sub-aqua gear was the main focus for the photographers, and resulted in the memorable headline for the event’s coverage in *Variety* of 12 January 1955: ‘Jane, make with the lungs – sexsational RKO cheesecake dunk’.

⁹ This film was allegedly the first German production in Technicolor (<http://www.wildfilmhistory.org/film/283/283.html?filmid=283> (Accessed 15 October 2015)).

¹⁰ Cousteau’s description here is in stark contrast to the quasi-mystical status attributed to cetacean sonic communications as high quality recordings of them became more widely available in the 1970s. ‘Whale songs’ became an important means of garnering support for whale conservation.

¹¹ Mervyn Cooke (2015) provides a detailed analysis of Baudrier’s score.

¹² The highly experienced Jimmy Hodges sadly died during the production of the film, when he appeared to suffer nitrogen narcosis (raptures of the deep) during one of Hass’ sound experiments and was rendered unable to control his breathing equipment.

