Technologies enable new modes of perception, which transform the imagination and inspire the arts. A vivid example of this process is the transvaluation of the underwater environment in the Western imaginary. For millennia, there were only very rudimentary technologies to observe this realm of our planet that is inhospitable to human physiology for longer than a breath of air.¹ Humans understood it through the little they could glean from the surface via mariners’ sounding lines and what was fished up or washed up on shore. To descend into the depths was to drown, and the undersea world was hence imagined as a horrifying abyss, with occasional glimpses of fabulous riches. One famous example of this fantasy is Clarence’s sea nightmare of “the slimy bottom of the deep” in William Shakespeare’s Richard III: “Methought I saw a thousand fearful wrecks; /Ten thousand men that fishes gnaw’d upon;/Wedges of gold, great anchors, heaps of pearl,/ Inestimable stones, unvalued jewels,/ All scatter’d in the bottom of the sea.”²

During the nineteenth century, however, science and technology started to penetrate the obscurity beneath the water’s surface in the most technologically advanced nations, notably France, Germany, the United Kingdom, and the United States. As Helen Rozwadowski has detailed in Fathoming the Ocean: The Discovery and Exploration of the Deep Sea, the factors catalyzing this penetration were complex.³ They involved developments in biology, geology, engineering, communications, warfare, and the culture of the spectacle. Once human perception, action, and curiosity were immersed in the depths, the underwater imagination blossomed as well. Jules Verne’s Vingt mille lieues sous les mers (1869–1870) is a milestone marking the imaginative transformation of the depths from an obscure abyss to a holistic, diverse environment. Compare, for example, the sea bottom in Richard III to Captain Nemo and Profes-
sor Arronax's promenade through the undersea forest of Crespo in Verne's novel. There, our marine biology professor marvels at plays of light, “flowers, rocks, plantlets, shells and polyps,” magnificent seaweeds, captivating otters, glorious “hedges of zoophytes on which bloomed meandrine corals,” a fearsome sea spider, and a “superb rock wall of imposing height,” among an overwhelming variety of experiences leading him to collapse on his return to the submarine “in a state of complete wonder at this extraordinary excursion over the ocean floor.”

The following article considers one particularly alluring aspect of the underwater world revealed when the general public started to understand the reality of its conditions: the properties of underwater optics. Seeing through water differs dramatically from seeing through air. The nature of underwater optics was evident to working divers from the middle of the nineteenth century. This reality started to reach a more general public, including artistic creators, in the first decades of the twentieth century. Helmet diving, at this time, expanded to communities beyond engineering, and adventurers and naturalists started to write about their perceptions undersea. Another important factor in diffusing underwater optics to a non-technical public was the take-off of underwater photography and film. Underwater photographs date to experiments in Weymouth Bay by the British coastal expert William Thompson in 1856; however, reliable processes were only devised in the 1890s by French marine biologist Louis Boutan off Banyuls-sur-Mer. Boutan explained his techniques in *La Photographie sous-marine et les progrès de la photographie* (1900). The first underwater movie was made by the Scottish-American J.E. Williamson, along with his brother, in 1914. In 1916, Williamson provided the underwater footage for a silent adaptation of Verne's *Vingt mille lieues sous les mers*.

As the properties of seeing through water became known, underwater scenery became the portal to imagining an altered reality, which at the same time belonged to our physical world. Creators across the arts took inspiration from underwater optics to structure fantasy spaces of dream, hallucination, and marvel—hence my article's title, undersea optics as symbolic form. With this title, I evoke the seminal argument made by Erwin Panofsky that formal constructions of visual space express historical configurations of the imagination and cognition. Panofsky’s example to develop this idea is the organization of pictorial space that came to dominate Renaissance art. In this system epitomized by linear perspective, an illusionistic set of conventions created a spatial depiction, which was at once mathematically organized, and yet simultaneously presented as realistic. The system of linear perspective fusing abstraction and realism would be integral to the Western episteme Martin Jay has termed “Cartesian perspectivalism,” which would dominate over subsequent centuries.

While completely physical, the properties of underwater optics, as I will explain, spectacularly defy the reality of terrestrial perception, along with the system of linear perspective. Depth of field is radically diminished and difficult
to gauge, for example, and colors and forms behave differently, as well. The emergence of technologies capable of accessing this reality at the turn of the twentieth century is a fortuitous example of the congruence between the practical discovery of a new planetary environment and the history of the arts and epistemology. As Jay has observed, “the waning years of the nineteenth century ... [saw] an accelerated interrogation of ... Cartesian perspectivalism,” where features like the authoritative, distanced transcendent subject or clarity and distinction as the hallmarks of reality came into question. It may be that such interrogations, notably in the arts, validated divers’ perceptions, enabling them to recognize how different underwater optics were from seeing through air. In fact, some of the early divers who communicated underwater optics to the general public explicitly noted their similarity to artistic modernism. A good example is the rhetoric of the naturalist and explorer William Beebe, inventor of a pioneering submersible for deep-sea observation, the bathysphere, in the 1930s. In 1928, he published perhaps the first extended portrayal of how humans perceived in shallow coastal waters, entitled *Beneath Tropic Seas* (1928). Describing the experience of diving on a coral reef in the waters off of Haiti, Beebe wrote, “[n]o change need be made in the most weird, most ultramodern of ballets, if the architecture and designs of undersea were copied closely; the only criticism being that of gross exaggeration.” Or again, “[i]f one asks for modernist ... designs, no opium dream can compare with a batfish or an angry octopus.”

In allying bizarre aspects of the undersea world with artistic modernism, Beebe was emphasizing a different strand of modernism from the modernisms that attacked the false mystifications of tradition, although these modernisms similarly offered alternatives to realistic illusion. Seeking to move beyond such illusion, movements such as cubism and futurism drew inspiration from the formal properties of artistic media, as well as from the rationalized processes of the machine. Other modernisms, such as Brecht’s epic theater, targeted emotion as an agent of false “bourgeois” ideology; hence Brecht envisaged his theater as the public’s education into reasoned critique. Perception beneath the water, in contrast, would appeal to modernisms that explored an emotional palette of wonder as an antidote to bourgeois aesthetics and society—a form of wonder that was at once otherworldly and completely secular. Surrealism was the most famous of these movements, and a number of surrealists drew on the aquatic world to give this wonder spatial expression. This article hence concludes with how surrealists used conditions beneath the water and notably underwater optics as invitations to a higher state of surreality, including examples by the marine biologist-surrealist Jean Painlevé, the leader of surrealism, André Breton, and the surrealist-inspired film director Jean Vigo.

While I conclude with well-known examples, the works I use to enter into the translation of underwater optics into the arts are paintings by Walter “Zarh” Pritchard, reputedly the first artist to work *en pleine mer*. Pritchard was born in Madras in 1866, educated in Scotland, and began his career in the Lon-
don theatrical scene in the 1890s, where he designed “costumes, stage accessories, and interior decorations for stage personalities, all on undersea themes,” before going to California and then the South Pacific for his health.9 In 1902, in the warm, clear waters off Tahiti, Pritchard donned a diving helmet, weighted his easel with lead, and drafted paintings inspired by what he saw in the depths. To get a water-resistant picture surface, Pritchard told a reporter, he followed the advice of "Wera Hiko," a chief of "Tongolo" [New Zealand], who said "Boil down flax and soak it," although Pritchard subsequently used calf-skin.10 To the prepared leather, Pritchard applied oils squeezed directly out of tubes onto a palette and used a brush soaked in linseed oil. Pritchard also reported sketching underwater with pastel crayons. He gives a vivid description of the need to work swiftly: “A mistake because a fish comes too near and the whole thing is spoiled.”11 How many of Pritchard’s paintings were in fact done underwater is unclear—many were probably at least finished on land, if not drafted entirely from preliminary underwater sketches.

From these few details about Pritchard’s peripatetic life, it should be clear that it cannot be confined within a national frame. As histories like Rozwadowski’s and Marx’s make clear, a supranational perspective is necessary to grasp the exploration of the underwater frontier, as well as its impact on aesthetics and on society. The opening of this frontier occurred on a planetary stage, where nationalist interests intersected with the rapid circulation of people, discoveries, and innovations across national borders and on the supranational space of the high seas. Such international circulation, of course, characterizes the history of technological modernization, more generally. This internationalism is particularly pronounced for an area of the planet that exceeds the control of the nation state, and where humans contend with natural forces, from the weather to fish, indifferent to national boundaries. Many arenas of ocean activity have, moreover, long been hospitable to international cultures and peripatetic people, from the inception of global ocean travel in the early modern period. Beginning in this era, too, news from the ocean came from around the world, and those who followed it were unfettered by a national field of view. Such ocean internationalism persisted into the era discussed in this article. We will see, thus, André Breton illustrate his paean to corals in his 1937 L’Amour fou with a still from a film made by J.E. Williamson, sponsored by the Field Museum of Natural History in Chicago.

Since I start with paintings that have been forgotten today, I should stress that they were appreciated in the first three decades of the twentieth century by audiences for both their aesthetic qualities and/or their naturalist details. Collectors sought them for their restful, mysterious atmosphere, as well as for offering a window onto a hitherto unknown area of the planet in this period before the advent of underwater color photography. Pritchard’s paintings were purchased by royalty and the wealthy in Europe, the United States, and Japan, including theatrical celebrities like Sarah Bernhardt and Ellen Terry, as well as by the Musée du Luxembourg in Paris, the Boston Fine Arts Museum, and the
Brooklyn Museum, among others. Pritchard’s paintings were, at the same time, praised by scientists of the marine environment. In *Beneath Tropic Seas* (1928), Beebe used one of Pritchard’s underwater scenes as the frontispiece. He wrote, “[o]ne artist, Zarh Pritchard, has brought to canvas, evanescence of hue, tenuousness of tint ... probably because he paints under water.” The avid oceanographer Prince Albert I of Monaco was an admirer of Pritchard and purchased at least four of his paintings for the Musée océanographique. Pritchard’s works were also acquired by the Scripps Institution of Oceanography in La Jolla, the American Museum of Natural History in New York, and the Cleveland Natural History Museum.

For Beebe, Pritchard’s art was particularly distinctive in capturing “the pastel film of aquatic perspective,” which “[n]o aquarium tank could ever show,” along with “the mystery and beauty of this undersea world of color,” not perceptible from the surface, even in a “glass-bottomed boat.” A lush example of Pritchard’s “aquatic perspective” is the painting titled *Parrot fish and poisson d’or amongst the coral in the lagoon of Papara TAHITI* (c. 1910), donated to the Scripps Institution of Oceanography in 1917 by Ellen Scripps and still on display today (Figure 1).

**Figure 1.** Zarh Pritchard, *Parrot fish and poisson d’or amongst the coral in the lagoon of Papara TAHITI*, c. 1910. Oil on animal skin.

*Source: Courtesy of the Scripps Institution of Oceanography, UC San Diego.*
As the title indicates, the image draws our gaze to a delicately patterned fish, which floats right center and slightly below the picture's midpoint, a traditional focal point in landscape painting. The left side of the image is bounded in the foreground by a reef, which delimits our field of view, almost like a wing flat in the theater, and also helps draw our eye towards the center of the scene. From the fish, which is a species of Pacific wrasse, the yellowtail coris, our eyes move up along the reef towards three dimmer yellow butterfly fish, at the top of the painting. The butterfly fish form a group—a visual echo of the coris in the center—poised at a similar downward slope. Undulating purplish, blueish, yellowish stalks of living coral divide the foreground and the background, organized along the diagonal axis of the swimming fish. The coral fronds blur into more massive solid coral heads, sedimentations of once-living organisms.

To today's viewers used to contemporary underwater photography and unfamiliar with optics of the depths, Pritchard's picture appears faded and washed out. Our expectation, however, that an underwater scene would be clear and bright is the result of a long history of photographic technique working to compensate for what happens to light when seen through the medium of water, which is 800 times denser than air. When we see through water, unaided by artificial lighting or corrective lenses, we perceive a pervasive haze and pastel coloring. These conditions occur because water molecules slow down light, absorb it, and scatter it. In water, the refractive index of light—which is to say, the ratio of the speed of light in a substance to the speed of light in a vacuum—is about 1.3, in comparison to the refractive index of light in air, which is close to 1. Further disrupting and refracting light underwater are “minute particles suspended in water,” and also, at shallow depths, the way sunlight is refracted or diffused by the texture of the ocean's surface. As Thomas Burgess observes of Pritchard's work, “[n]o attempt was ever made to sharpen or refine images that were naturally softened” in the aqueous atmosphere. Burgess also cites Pritchard's own counter-intuitive observation that underwater, “not one object looks wet or glitters,” in contrast to the optics of wet surfaces viewed through the medium of air.

Considering Pritchard's paintings with the eye of a marine scientist, J. Malcolm Shick notes that Pritchard was “among the first to recognize the altered submarine spectrum,” characterized by distinctive color loss at different depths. Pritchard's observations are based on physical reality: “as one goes deeper, not only is there less light to be seen, but long red wavelengths disappear first, followed by the progressively shorter orange, yellow, and green. Blue light is left to penetrate deepest.” Although the exact depth of color loss depends on a number of local conditions (how turbid the water is, the strength of the light above the water, and the turbulence of the surface), Pritchard's palette in the painting of the coris indicates typical coloration at thirty feet in the clear waters of Tahiti. In Pritchard's words, “[t]he coloring beneath the ocean is all in the lowest tones, merging from deep indigo and purple into the higher, delicate tints of pale greens, grays, and yellows.”
To say that color is muted is not to say that it is uniform, as Beebe remarked. In the chapter praising Pritchard in Beneath Tropic Seas, “No-Man’s-Land Five Fathoms Down,” Beebe expresses the color subtleties of this new underwater frontier with a vocabulary of enchantment, marking the limits of standard denotative description. To cite Beebe, “[w]e need a whole new vocabulary, new adjectives, adequately to describe the designs and colors of under sea,” which he also calls the “exquisite magic,” the “ineffable, colorful mystery” that is “the theme of this watery world.” The comparison of Pritchard’s coris to the coris as it looks in today’s photography emphasizes Pritchard’s interest in muted underwater coloring, where, in Beebe’s words, “the harshest, most gaudy parrotfish” appears like a Chinese print or an “age-mellowed-tapestry” in this “fairyworld.” Pritchard’s age-mellowed vision of a gaudy fish is only possible, that is to say, from undersea observation. While Pritchard may very well have gathered information about the physical details of the coris from specimens on land, their patterns would have shown brightly when first caught, as would be the case of fish seen behind the glass of an aquarium.

Doubt has been cast upon whether Pritchard did in fact paint his pictures beneath the sea, or whether this was a publicity claim. Pritchard’s knowledge of the haze underwater, however, as well as the specific coloration of differing water depths implies the authenticity of his observation. So, too, does his rendering of underwater depth of field. Pritchard’s paintings really do devise a kind of “aquatic perspective,” to cite Beebe, if we take perspective in the specifically pictorial sense, as the geometry of spatial composition. Pritchard immerses us in his watery world through altering the conventions of linear perspective, a basic paradigm for rendering three-dimensional space in two dimensions since the Renaissance. Pritchard’s turn away from linear perspective is in the spirit of the visual practices of his time. In Suspensions of Perception, Jonathan Crary describes the later nineteenth century in trans-Atlantic modernity as an era when the image’s stability as a coherent window onto a scene started to decompose, along with the integrity of the observing subject. Pritchard’s art emerges from this network of visual practices, though he brings a unique twist on such destabilization through his familiarity with underwater optics.

In jettisoning linear perspective, Pritchard is doing justice to an environment utterly unsuitable to the paradigm’s founding conventions. These conventions, according to Panofsky, include a “ground plane [which] … clearly permits us to read not only the sizes, but also the distances of the individual bodies arrayed on it.” Geometric forms are placed on this ground plane, and they recede proportionally. In such an oft-cited example as Raphael’s School of Athens in the Vatican (1509–1511), for example, diminishing architectural elements, like pillars, tiles, and stairs, aid our ability to measure depth. The culmination of recession in linear perspective is the single vanishing point on the horizon. Orthogonal lines meet at this vanishing point, often endowed with
narrative intensity, as in the Raphael fresco, where the lines lead our eyes back to the spot where Plato and Aristotle converse.

Multiple aspects of the founding conventions of linear perspective are, however, entirely at odds with underwater optics. While linear perspective creates substantial depth of field, the poor visibility underwater radically diminishes the ability to perceive distance. The furthest the eye can see in the clearest of water, distilled water, is only 250 feet. Martin Edge gives some striking figures on this reduced visibility in his practical guide, *The Underwater Photographer*. “Such is the density of water,” writes Edge, “that people compare a picture taken in 0.5 m of water with a picture on land taken 800 m away.” Because visibility is so radically diminished, objects do not come at us from a distant horizon, rather they loom suddenly into view. “How can life be organized in a world without horizons?” asked Philippe Diolé, a writer diving with the French Navy team that pioneered SCUBA in the 1940s, striving to convey a sense of our visual disorientation beneath the water’s surface. The same question might be transposed to the problem of rendering this environment in two dimensions as well.

Linear perspective’s mathematical system of proportional recession is also ill-suited to capturing underwater optics because we are not only near-sighted underwater, but prone to confusion. The denser medium of water magnifies objects. Stereoscopic vision, in addition, does not work well. This is particularly true close up, when the brain experiences a conflict between the tactile knowledge of distance and underwater magnification. But it is also true in distances beyond our reach, because, as Helen Ross explains, stereoscopic perception depends on “the disparity in the images received by the two eyes [which] is a fairly powerful cue to the relative distance of objects, and contributes a great deal to the sensation of three-dimensionality.” In mist, as underwater, “the low contrast of the images makes the disparity difficult to detect, and stereoscopic acuity is much poorer than would be predicted on the grounds of retinal image alone.” Describing perception undersea, Pritchard observes that “[r]ocks and cliffs in the dim light assume an appearance of inconceivable size.” Pritchard also notes how hard it is to orient oneself: even touching bottom underwater was “as if one were temporarily resting ... on a rapidly dissolving fragment of some far planet.”

Another important aspect of the phenomenology of vision beneath the ocean’s surface challenging linear perspective involves the very possibility of perceiving a straight line, due to the technologies divers have to create a layer of air so the human eye can work effectively. As Ross observes, refraction from “the face-mask [makes] ... [s]traight lines appear curved.” Pritchard was using a helmet rather than the later face-mask, but the helmet, too, uses glass and also limits the field of view. Of the limits of this field apropos of the effect of the face-mask, Ross writes that “points on the left of the face-mask are displaced to the left, and those on the right to the right.” It is particularly difficult to adapt to “two opposing distortions.”
Such opposing distortions are even more of a challenge to the abstracted monocular vision of linear perspective than stereoscopic vision on land. Nor, of course, do optics underwater ever achieve anything like linear perspective’s immobility. Underwater, everything is truly an environment *mobilis in mobile*, to cite Verne’s famous phrase from *Vingt mille lieues sous les mers*. Natural phenomena are washed by surge and sway, and the observer too is in motion. The depiction of such undulations is the focus of another Pritchard picture painted around 1910, also donated to the Scripps Institution of Oceanography by Ellen Scripps, which portrays a school of damselfish in the lagoon of Maara, Tahiti.\(^{31}\) In this image, the tentacles of the sea anemones have been swept to the right by the force of the surge. In contrast the damselfish swim in the opposite direction, against it, which is a fact of fish behavior. The realism of these details is one more indication that Pritchard did in fact paint his pictures based on observation while diving, for such behavior would be hard to guess on land, where the fish might just as well be presumed to be swept along by the surge, as would a human swimmer.

In an environment so at odds with linear perspective, Pritchard comes up with alternative techniques of orienting the viewer in his underwater scenes. The basis of his composition is a type of perspective developed during the Renaissance to show hazy objects on the remote horizon. “Aerial perspective” was the term coined by Leonardo da Vinci when he considered the haziness of buildings and mountains in the distance. The cues to orientation at a remote distance, according to da Vinci, should be variations in color and form. The more remote elements of a scene will appear “less defined and bluer,” taking on the hue of the atmosphere, and da Vinci recommended that the artist intensify that blueness as the distance increased.\(^{32}\)

Characterizing perception underwater, Ross observes that “[a]erial perspective is a much more important cue under water than on land—partly because the loss of contrast is more noticeable, and partly because other distance cues are reduced or absent.”\(^{33}\) Pritchard intuitively observes Ross’s observation in his renditions of the underwater environment, which take the techniques of aerial perspective and apply them to the “middle distance,” a phrase from Pritchard’s observation about the unique quality of the underwater experience of distance. Pritchard declares, “Nowhere does substance appear beyond the middle distance. Material forms insensibly vanish into the veils of surrounding color.”\(^{34}\)

We can see Pritchard transposing aerial perspective into the middle distance in *Parrot fish and poisson d’or amongst the coral in the lagoon of Papara TAHITI* if we look, for example, at how he conveys the sense that the butterfly fish are in the background of the scene. Although these fish cannot be more than one or two hundred feet away, most likely less, they take on the Chartreuse color of their atmosphere. Also adhering to conventions of aerial perspective, the color of this portion of the pictures is dimmer than the foreground. In yet a third aspect of aerial perspective, the three butterfly fish...
get progressively blurrier from left to right, inviting our eye to perceive recession as it sweeps across their arc.

Pritchard utilizes aerial perspective yet also evinces his familiarity with conventions of linear perspective in a third painting at Scripps Institution of Oceanography, also donated by Ellen Scripps and painted around 1910 (Figure 2).

**Figure 2.** Zarh Pritchard, untitled [“Moorish Idols”], c. 1910, Oil on animal skin.

This picture shows a pair of Moorish idols, similarly at about thirty feet deep in the waters off Tahiti. While the Moorish idols are cradled amidst the corals close to us at the painting's center, Pritchard depicts the tail end of the long dorsal fin of the fish on the left disappearing into a haze and taking on the color of the background. The vistas of coral, similarly, change in color and clarity as they recede into the background of the scene. At the same time, the
Moorish idols are quite close to the viewer, and the left fish comes towards us foreshortened. At such close viewing, linear perspective operates beneath the surface of the sea, and Pritchard depicts its stripes as receding proportionally.

The aesthetic effect of Pritchard’s distinctive “aquatic perspective,” to use Beebe’s phrase, is one of ineffably pleasing disorientation. Distances have an enigmatic quality, and the imprecise, softened edges of forms shrouded in a haze make the organization of the scene, notably the spatial relations among the corals, somewhat illegible, in a dreamy, mysterious way. Pritchard also utilizes other techniques based on seeing through water to enhance the viewer’s subtle disorientation. In the picture of the Moorish idols, as in the picture of the coris, it is difficult to gauge the scale of the scene. This is partly due to the distortions previously mentioned, coupled with the low light. Yet another reason why we cannot fix size is the fractal nature of the reef formations in the images. Both the coral heads and living branches exist in a range of scales.35

There is no human figure or recognizable architecture in the seascape to serve as a reference point, as in the Raphael School of Athens.

Yet another source of disorientation in Pritchard’s underwater scenes is his treatment of the opposition between horizontal and vertical axes, foundational to linear perspective and to our orientation on land, as well. Underwater, this opposition starts to erode. Floating in this dense medium where it is comparatively easy to move in three dimensions, one discovers perspectives that would be unusual on land, a confusion intensified because phenomena can present themselves from an amplified multiplicity of perspectives as well. Areas of Pritchard’s painting express this confusion. In the picture of the coris, for example, certain forms are clearly oriented. The reef bordering the painting on the left would seem to be a vertical form at the forefront of the picture plane. The blue swath behind the coris also appears as a vertical coral reef in the picture’s foreground. But the swath between these two reefs, comprised of vague forms, can signify either depth or distance. Does, for example, the blue at the very bottom of the picture lead the eye toward the back of the scene, or down to depths outside the picture’s frame?

Pritchard recounts he was an avid reader of Verne’s Vingt mille lieues sous les mers as a child. Once we grasp Pritchard’s attention to the specific conditions of underwater optics, we can understand his disappointment with the novel when he started to dive. Shick notes a number of Verne’s scientific mistakes in sequences such as the promenade through the submarine forest of Crespo, where Verne’s narrator Professor Aronnax dons a diving suit and accompanies Captain Nemo. Beguiled by the beauty of the scene, Aronnax describes for his readers, for example, the light thirty feet beneath the surface of the ocean, just the depths at which Pritchard set the paintings we have been considering. In this environment, according to Aronnax, “The sun’s rays struck the surface of the waves at an oblique angle, and the light was decomposed by the refraction as if passing through a prism. It fell on the flowers, rocks, plantlets, shells and polyps, and shaded their edges with all the colours
of the solar spectrum. It was a marvel, a feast for the eyes.”36 Pritchard’s paintings, in contrast, respect that, at thirty feet below the surface, light is not perceived as through a prism and red has dropped off the scale.

The problems with rendering underwater optics in *Vingt mille lieues sous les mers* extend to the novel’s original illustrations. Compare Pritchard’s painting of the damselfish with Edouard Riou and Alphonse de Neuville’s image of Aronnax’s stroll through the submarine forest of Crespo (Figure 3).37

**Figure 3.** Walk through the underwater forest of Crespo, *Vingt mille lieues sous les mers* (Paris: J. Hetzel, 1870), plate by Alphonse de Neuville and Edouard de Riou, engraved by Hildibrand.

*Source:* In the public domain, http://commons.wikimedia.org/wiki/File:Vingtmillelieue00vern_orig_0131_1.jpg.
There is expansive depth of field in the Verne illustration, in comparison to Pritchard’s middle distance. In the novel’s image, the jellyfish, recede proportionally, extending like balloons to the horizon, in contrast to the dimming of the coral reefs in Pritchard’s painting. Verne’s illustrators have made the jellyfish look shiny, with light glinting off their balloons. While Pritchard’s damselfish and sea anemones move reacting to the surge, the jellyfish hang with their tentacles straight down in the illustrations of Verne.

My point in comparing the underwater environments imagined by Verne and his illustrators to those depicted by Pritchard is not to rank one over the other. It is, rather, to underscore how these differing expressions of the underwater environment were shaped by the technological access of the observers. Shick writes that Verne “probably gained his own underwater visions in the Paris aquarium,” and also, it might be added, in the shallows accessible to amateur naturalists of his era. Pritchard’s visions, in contrast, were shaped by the vistas of helmet diving.

Despite my focus on the accuracy of depiction, the images of Verne and his illustrators, like the paintings of Pritchard, are aesthetic works with an emotional mood. And the kind of technological access available for viewing the underwater environment contributed to the mood portrayed. The crystalline, glistening underwater seascapes glimpsed through the aquarium have a whimsical, exhilarating quality that Arronax and Verne’s illustrators emphasized in their depictions undersea. For Pritchard, the reality of optics at depth, so distorting when compared to optics on land, enabled a more enigmatic, if alluring, emotional tone. Contemporaries noted this effect when praising his pictures. Jiro Harada, His Imperial Japanese Majesty’s Commissioner to the Pan Pacific International Exhibition, in a letter to Pritchard written from San Francisco in 1915, thus described Louvre curator Jean Guiffrey’s reaction to the artist’s work as “a remark in French which you told me meant ‘words cannot express.’” In Harada’s assessment, mixing Guiffrey’s observations with his own, Guiffrey was “deeply moved by your paintings, their uniqueness and charm and delight in the mysterious harmony of colors revealing something more than the eye can see.” “[W]onderful,” Harada reports Guiffrey commenting about “the submarine picture of shoals of fishes apparently worshipping the image of Buddha....”

Pritchard himself suggested the experience of underwater perception as one akin to an ecstatic state. “When one leaves the resounding, splashing surface ... to enter the depths below,” he commented, “one is astounded by the sensation that some sudden magic spell has swept away every drop of the water, replacing it with a soft, all-enveloping atmosphere.” “At one moment going over a deep strait in Tahiti in my diving suit,” he tells his interviewer, “I was an atom suspended in the center of a limitless, horizontal-banded sphere of translucent color.” This experience, he says, recalled to him a line from Cardinal Newman’s “The Dream of Gerontius” describing “the experience of the spirit immediately after death.” The Newman line is: “As though I were
a sphere and capable to be accosted thus.”^41 This feeling of being suspended produces what Pritchard describes as “an indescribable feeling of happiness.” Despite the theological reference, for Pritchard, as for Verne’s Arronax, this intense wonder is inspired by the physical conditions of nature rather than by religious belief.

Due to his attentiveness to the reality of underwater optics, Pritchard created lush, muted environments, whose strange organic forms and decorative flatness resonate with *art nouveau*, an artistic movement that featured in his work in theater and design during the 1890s. The disorienting quality of his undersea images, at the same time, diverges from some of the prettier *art nouveau* scenes and intensifies with details of Pritchard’s depiction that come from the inspiration of the artist rather than the observation of the ichthyologist. Note the eye of the coris, with a white pupil and blue iris, spanning the distinction between human and fish.^42 Note, too, the lips, more like human lips than those of a fish, in being so “distinctly offset from the head coloration.”^43 The lips of Pritchard’s coris resemble specifically the lips of a made-up young woman, with their bow form brought out by the red, almost as if the fish were wearing lipstick. The striking red is itself a fantasy element amid Pritchard’s otherwise realistic portrayal of underwater color, for he was aware that at the depth of thirty feet, reds are fading out. Such blurring of species extends the haze of underwater optics to epistemology, as Pritchard’s imagined environment intimates a world where divisions among Enlightenment categories break down.

In the case of the sensitive coris, the divisions are those between animal and human, as well as nature and artifice. Another fundamental identity distinction, between male and female, may also be at issue, depending on what Pritchard knew of the coris’s life cycle. As ichthyologist Philip Hastings observes, corises “are hermaphroditic, spawning first as females and changing sex to male, signaled by a significant change in color.”^44 Despite the feminine red lips, the specimen in Pritchard’s picture has the coloring of “a large male.” Whether the hermaphroditism of the coris was known to ichthyologists, let alone Pritchard, in 1910 is not clear, but naturalists were fascinated by the hermaphroditism of marine organisms from the time of Darwin. Even if we interpret the image based on its visual information alone, the coris has a phallic appendage with his raised front dorsal fin, along with the feminine red bowed lips. Again, we can only wonder if Pritchard knew that corises raise their front dorsal fins in displays of mating and aggression.

When Beebe used words to describe the phenomenology of undersea perception in *Beneath Tropic Seas*, he emphasized the pleasure of achieving an altered mental state, which was a kind of relaxation. In one passage, Beebe describes, for example, how he became riveted on “a great font of a sponge. It was not especially striking in size nor of perfect symmetry nor of unusual brilliance—a greyish violet as I remember, but it was *satisfying*—a characteristic indefinite but very real if only we will relax before things about us and let
unimportantness fade away.”45 In this passage, the aesthetics of underwater optics are the portal to an experience that sounds like a drug trip; they enable a kind of profane illumination, to use the phrase of Walter Benjamin: “a materialistic, anthropological inspiration, to which hashish, opium, or whatever else can give an introductory lesson.”46

Benjamin coined the notion of the profane illumination in his essay on surrealism, which he understood as the artistic movement that pushed the search for the secular re-enchantment of a disenchanted world the farthest in his time. And although Benjamin does not mention it, an aquatic current runs throughout the surrealists’ search for profane illumination, starting with André Breton and Philippe Soupault’s experiments in automatic writing. Poisson soluble (1924) and Louis Aragon’s aquarium metaphors to describe the dream world of the Parisian arcades in Le Paysan de Paris (1924).47 Throughout the late 1920s and above all in the 1930s, surrealist writers, photographers, and filmmakers increasingly drew on the aquatic environment to create an imaginary space that was more explicitly a gateway to an altered reality than in the naturalist-oriented works of Pritchard. For some surrealists, underwater fantasies intimated the phenomenology of a higher surreality to come.

As scholars have noted, the most direct crossover between explorations of the underwater environment and surrealism is in the œuvre of Jean Painlevé.48 A biologist by training—and son of the prime minister, Paul Painlevé—Jean Painlevé from his youth had been friends with the surrealist photographers Jacques-André Boiffard and Eli Lotar. He published a prose piece in the first issue of Surréalisme (1924), and his photographs and films of marine organisms, which are at once bizarre and factual, appealed to the surrealists, other avant-garde arts communities, and more general audiences alike. In his photos, films, and writing, Painlevé was inspired by the way in which the denizens of the marine world thwarted Enlightenment categories, which he also allied with bourgeois morality, very much in the spirit of Pritchard’s category-confusing coris. One of Painlevé’s most famous films is L’Hippocampe (1934), which presents an alluring vision of how these creatures confuse conventional ideas of male and female. A species where both male and female animals float with a delicate, conventionally feminine grace, the sea horse reverses the distribution of labor in human sexual reproduction. Painlevé’s film has a long segment showing how the male sea horse carries the fertilized eggs and gives birth. In a prose piece, he offers “this symbol of tenacity [which] joins the most virile efforts with the most maternal care” to “those who would forgo the usual selfishness in order to share their pains as well as joys.”49

As Ann Elias observes in her article, “Sea of Dreams: André Breton and the Great Barrier Reef,” surrealists derived inspiration from the holistic underwater environment, as well as from its most charismatic creatures. Citing Allen Sekula’s view that surrealism was “the last aesthetic movement to claim the sea with any seriousness,” Elias focuses on André Breton’s L’Amour fou (1937), unraveling, notably, the symbolic significance of an underwater photograph
incorporated by Breton. This photograph, whose importance had been overlooked before Elias’s recent article, was not taken by any of the famous surrealist photographers who were Breton’s associates and who illustrated many of his books, *L’Amour fou* included. It was, rather, a still from a film by the inventor of underwater cinema J. E. Williamson, initially published in *The New York Times* (Figure 4), which Breton captioned “The treasure bridge of Australia’s Great Barrier Reef.”

**Figure 4.** Image by J.E. Williamson of a coral reef in the Bahams printed in *The New York Times*, and appearing in *L’Amour fou*.

Breton used this documentary photo of one of the most remote spaces on the planet of his time as a kind of natural dreamscape, illustrating his influential aesthetic of “convulsive beauty,” in the first chapter of *L’Amour fou*. This aesthetic is a version of the flash produced by the encounter of irreconcilable qualities, which is at the heart of surrealist literature and art. Breton observes that he knows he is in the presence of convulsive beauty when he experiences a shiver. The shiver occurs because hallowed categorical oppositions essential to Western thought and culture are fused and superseded, such as the oppositions between life/death, real/imagined, high/low, etc. Of “convulsive beauty,”
Breton writes that it will be “veiled-erotic, fixed-explosive, magic-circumstantial, or it will not be.”51

Throughout surrealism, as in *L’Amour fou*, man-made objects and chance occurrences offer occasions for convulsive beauty. In the first chapter of *L’Amour fou*, Breton finds it in an environment as well: an underwater coral reef. For Breton, the specific boundaries dissolved in the coral reef are between animate and inanimate. To cite Breton’s dense yet suggestive language, “those absolute bouquets formed in the depths by the alcyonaria, the madrepores,” are formations “[w]here the inanimate is so close to the animate that the imagination is free to play infinitely with these apparently mineral forms, reproducing their procedure of recognizing a nest, a cluster drawn from a petrifying fountain.” Echoing Heraclitus, Breton associated running water with a perpetual present; earlier in *L’Amour fou*, Breton wrote: “[t]o glide like water into pure sparkle—for that we would have to have lost the notion of time.” He associated the mineral in contrast—crystal, specifically—with an achieved work of art. In the coral reef, such hardened forms, whether animate or inanimate are washed in water, and thus lose their “omnipotent reality in the dazzling sparkle of the sea.”52 Breton then went on to situate life, “in its constant formation and destruction,” between a kind of rock, identified with its scientific name [aragonite], likened to “hedges of blue titmouses,” and “the treasure bridge of Australia’s Great Barrier Reef.” While the Williamson image was in fact from the Bahamas, Breton’s caption exaggerates its remoteness, which, as Elias observes, reinforces the image’s mystique.

Along with “convulsive beauty,” the coral reef image in *L’Amour fou* serves surrealism through its aquatic opticality. In this still, the forms are hard to make out, and we have trouble organizing the perspective of the scene. The “treasure bridge,” is hence a window onto a disorienting world furthering the surrealist agenda of disrupting habitual perception. Elias cites an intriguing comment by Breton in “Surrealism and Painting,” “where Breton brought to mind ‘the Marvels of the sea a hundred feet deep,’” writing that “only the ‘wild eye’ freed from habit can be fully receptive to the magical sensations of the outer limits of the world.”53 Elias observes differences between the original copy of the Williamson photo Breton obtained from *The New York Times* and its blurry reproduction in *L’Amour fou*, remarking that Breton might have been disappointed to see “that magnificent, detailed, vibrant underwater photograph become a dim and imprecise copy.”54 This haze is doubtless a disadvantage, from the perspective of documentary photography. Indeed, documentary photography in underwater conditions would spend the rest of the twentieth century trying to diminish haze and obscurity, as well as to increase depth of field, with lenses, lighting, and type of film. While confusing, the haze of the Williamson reproduction included in *L’Amour fou*, however, in no way conflicts with one principle reason underwater scenes appealed to Breton and his fellow surrealists: the resonance of underwater optics with surrealism’s search
for imaginative expressions going beyond habitual terrestrial experience and intimating a higher surreality.

The physical qualities of underwater optics, indeed, have an extraordinary resonance with a number of visual effects important in surrealist art. These effects as described by Rosalind Krauss fall under the rubric informe. Krauss takes the notion of the informe from the philosopher Georges Bataille to highlight the ability of physical representations to intimate a mental state characterized by “the removal of all those boundaries by which concepts organize reality, dividing it up into little packages of sense.” In the medium of air, surrealist photographers achieved such effects with highly crafted techniques, such as close-ups from unusual angles, lighting, cropping and the way they developed film. But what required an artist’s skill to create in the medium of air is intrinsic to optics at depth. In this environment of extremely low light conditions and murk, for example, close-ups are the norm rather than the exception. As I have explained apropos of Pritchard, the fact that viewer and phenomena, in addition, move in three dimensions results in scenes presenting themselves from all manner of confusing perspectives, which are unthinkable on land.

Throughout the 1930s, there were surrealist artists, notably photographers and filmmakers, who realized the resonance of underwater optics with surrealist techniques, and experimented with immersing vision in water. One example is the series of photos that Rogi André, an alias for the photographer Rosza Klein, took in an aquarium in 1934 of Breton’s mad love in L’Amour fou, the dancer Jacqueline Lamba, who would become his wife. Breton has included one of the most legible in L’Amour fou, where Lamba glides gracefully, her harmonious body easily decipherable, like an enchanting water nymph (in the book, Breton indeed compared her to Undine). Others among André’s images, however, were more in the spirit of the enigmatic “treasure bridge” or the glamorous interspecies creature of Pritchard’s Poisson d’or. While Pritchard humanized the coris, André dehumanized Lamba, accompanying her supple human lower body with an upper body that increasingly mutates into some unrecognizable marine creature, with ambiguous appendages that might be arms or legs, like those of a crab, and a monstrous head, lacking legible humanoid features such as eyes and hair (Figure 5). This effect was achieved through lighting, “lenses specially modified by André Kertesz and ... a mirror.”

Jean Vigo, a filmmaker who melded surrealism with more realistic narrative, gives us in his film L’Atalante (1934) one of the most vivid contrasts of this era between the symbolic significance of terrestrial optics as the expression of quotidian reality and underwater optics as the portal to an altered reality, in his case, the hallucinations of desire. Before making this film, Vigo, who was friends with Painlevé, honed techniques for shooting underwater by directing a short film with Soviet cinematographer Boris Kaufman about French freestyle champion Jean Taris: Taris roi de l’eau (1931). In this short,
sequences shot below the surface in a pool are documentary, showing Taris's swimming technique.

When Vigo and Kaufmann returned to underwater space in the full-length *L’Atalante*, their focus was no longer documentation. The famous underwater sequence occurs, rather, at a dramatic moment in the film’s chronicle of the life of a young barge captain, played by Jean Dasté, and his bride, played by Dita Parlo. Disappointed in quotidian married life, with its conflicts and work, the young wife runs away, leaving her husband distraught. At the peak of sadness, he jumps overboard, but rather than portraying a suicide attempt, the camera follows him in close-up as he swims in the murky underwater haze. The haze becomes a space of fantasy, when, in a superimposition, his wife comes floating towards him, dancing like a graceful jellyfish, a creature admired as the epitome of flexibility, lightness, and luminosity in this era. The vision shifts to a close-up of his wife seen through the medium of air rather than water, restoring the reality of her absence, and back to the captain searching amidst the murk, before dissipating in a cut back to the medium of air, suited to the workaday life of the barge.

The hazy perspective of the underwater sequence solicits emotions from the viewer as well. Thrust into intimate connection with the captain, we are steeped in the longing on his face, and his taut body, tumbling in three dimensions, swimming, searching left and right, up and down, for his lost love. His wife, similarly, glides gracefully unconstrained by gravity, emphasizing her erotic allure. With the landscape Vigo uses to mark the return to the barge, he creates a dramatic emblem of the contrast between the symbolic significance of linear perspective and underwater optics. The return to the workaday world is expressed as a view down the tranquil canal to a vanishing point.

**Figure 5.** *Jacqueline Breton: la nymphe*. Rogi André, 1934.

*Source: Image reproduced courtesy of the Bibliothèque nationale de France.*
where its parallel lines converge. Clarity, orientation, and organization rule. No sign of the captain’s swim disrupts the glassy mirror of the water, where we can see the reflection of the trees, which fringe its banks, and no obstacles impede our view to the horizon. Cartesian perspectivalism has been restored, and yet the fantasy allure of the underwater realm echoes in our mind’s eye.

In 1934, when Vigo made *L’Atalante*, such an underwater space of dream was all the more beguiling because general audiences had no access to the reality of underwater environments on their own. This inaccessibility would change after the subsequent development of SCUBA technology in the 1940s, which would rapidly spread as a leisure pastime in the later 1950s. Equipped with SCUBA, everyday viewers could enjoy the hallucinatory qualities of underwater optics themselves. Photographers, at the same time, continued their efforts to take underwater the documentary realism of their medium, which they were able to achieve in the 1950s, due to SCUBA along with the development of underwater strobe lighting, faster color film, and lenses adapted to underwater conditions. And yet, even amidst the conquest of the underwater realm for realism, the use of underwater optics to create a fantasy space of altered reality remains an established artistic technique. From *L’Atalante* to James Cameron’s *Titanic* (1997), the camera’s plunge beneath the surface invites us to suspend everyday expectations, and to open our imagination to enchantment, hallucination, and dream.

**Margaret Cohen** is Andrew B. Hammond Professor of French Language, Literature, and Civilization at Stanford University, where she teaches in the Departments of Comparative Literature and English. Her books include *Profane Illumination: Walter Benjamin and the Paris of Surrealist Revolution* (1993), *The Sentimental Education of the Novel* (1999), and *The Novel and the Sea* (2010). This article belongs to a book in progress, which investigates the impact of innovations in science and technology on literary and visual fantasies of the depths, since the opening of the underwater environment as a frontier of modernity in the middle of the nineteenth century.

**Notes**

1. One example was the diving bell, which people had been using since antiquity for salvage and underwater harvesting. Diving bells were, however, very unsatisfactory, dangerous technologies with poor visibility. As Robert Marx explains, “the beginning of the age of helmet diving [c. 1840s]” rendered them “virtually obsolete.” Robert Marx, *The History of Underwater Exploration* (Mineola, NY: Dover Publications, 1990), 46.
2. William Shakespeare, *Richard III*, I, iv, quoted from http://shakespeare.mit.edu/richardii/full.html, created by Jeremy Hylton, 1993–2014. The undersea world retained these contours as late as the early nineteenth century. A good example is the portrayal by Friedrich Schiller in his ballad, “The Diver” (1797). In a first dive to retrieve a golden chalice, successful against all odds, a heroic youth glimpses the monsters of nature: “crowded, in union fearful and black,/ In a horrible mass entwined,/ The rock-fish, the ray with the thorny back,/ And the hammer-fish's misshapen kind,/ And the shark, the hyena dread of the sea.” The youth represents the underwater environment as hostile to human life, a space of “fearful solitude all alone,/ Where the voice of mankind could not reach to mine ear,” and indeed his second dive is fatal. Friedrich Schiller, “The Diver,” cited from anonymous 1902 translation on the website http://germanstories.vcu.edu/schiller/taucher_e.html, created by Robert Godwin-Jones, Virginia Commonwealth University, 1994–2014.


6. Ibid., 150.


8. This technologically-enabled sense of wonder is in continuity with early modern secular wonder, occurring, as Lorraine Daston and Katherine Park among others explain, when observers confronted hitherto unimagined experiences afforded by human activities and nature. At the same time, early modern wonder is a threshold emotion, marking the transition from a theological to a secular worldview. The discourse of wonder catalyzed by the underwater frontier, in contrast, has no residue of theology. Indeed, one component of underwater wonder is that it results from phenomena perceived through human technology. See Lorraine Daston and Katherine Park, *Wonders and the Order of Nature 1150–1750* (New York: Zone Books, 1998).


11. Ibid., 10.


13. Ibid.

14. Shor, “Zarh H. Pritchard, A Biography,” 2. I thank Peter Brueggeman, recently retired as curator of the Scripps Institution of Oceanography’s Special Collections and Archive and coordinator of the UC San Diego Life, Health, Marine & Earth Sciences Collection, for his erudition and generosity in helping me to understand the reality denoted in Pritchard’s paintings, and how Pritchard’s rendition corresponds to what a diver would see in such an environment. I also thank him for photographs of the paintings used in the article. According to Brueggeman, "Ellen
Scripps gave the paintings to SIO. The gift year/date is uncertain. The gift is noted in an art object file here in Scripps Archives by a handwritten reference to SIO director [Malcolm] Vaughan's papers as saying he mentioned the paintings in the Aquarium in 1924.... Paperwork on the paintings in the art object file here in Scripps Archives says it was gifted in 1910 with no attribution.” Email, 22 February 2012.

15. An online image of the same species taken by a contemporary photographer is viewable at http://en.wikipedia.org/wiki/File:Coris_gaimard_real.jpg, credited to laszlo-photo.


21. See Jonathan Crary, *Suspensions of Perception* (Cambridge, MA: MIT Press, 1999). Crary finds this decomposition across a range of practices and media, from the paintings of the Impressionists and Post-Impressionists to fashion plates, stereoscopic views, and early cinema. One particularly intriguing point of contact for Pritchard is Crary’s analysis of how Georges Seurat flattened out illusionistic theatrical space in the chapter “1888: Illuminations of Disenchantment.” Although we lack most details of Pritchard’s career before 1902, we do know he worked as a set designer and interior decorator in the 1890s. There are theatrical elements to the compressed depth in the painting of the coris, such as the coral reefs that work like wing flats to focus attention on the center of the scene.


24. In the words of S. M. Luria and Jo Ann S. Kinney in a *Science* article concerned, among other things, with the reason why divers make errors underwater, “an underwater object is usually viewed by light that is insufficient and drastically changed in wavelength, and the optical image has been modified in size and position.” S. M. Luria and Jo Ann S. Kinney, “Underwater Vision,” *Science* 167 (1970), 1454.


31. See page 5 of Shor’s biography for a copy of this painting.


34. Pritchard, interview in *Asia*, 219.

35. I thank Gert van Tonder for this insight, conversation Stanford Humanities Center, 2012.
42. In his chapter on Pritchard in *Take Me Under the Sea*, Burgess declares, “He descended to a land engulfed in monotones; yet once there, he transposed the bright prisms of the surface world and he often fearlessly redesigned shapes and forms to suit his fancy” (159). This transposition is not consistent, nor is it purely fanciful.
43. Philip Hastings, email to Elizabeth Shor, 12 January 2012. I thank Philip Hastings for his help in understanding the painting, and also Elizabeth Shor for putting us in touch, and sharing Professor Hastings comments with me.
44. Philip Hastings, email to Elizabeth Shor, 12 January 2012.
51. Ibid., 19.
52. Ibid., 11; 6; 13.