water and landscape
AGUA y TERRITORIO

The crazy waters of Euripus' Strait: philosophy, oceanographic science and hydroelectric potential of a puzzling tidal phenomenon

Las locas aguas del Estrecho de Euripo: filosofía, ciencia oceanográfica y potencial hidroeléctrico de un desconcertante fenómeno de mareas

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ABSTRACT

The water channel of Euripus on the Greek island of Euboia experiences a unique phenomenon, where strong tidal currents abruptly reverse direction. This paper will trace the historiography of tidal research in the Euripus Strait that culminated in the Greek Hydrography Service's surveys in the Strait in the early 1920s. The creation of a thalassographic station on the Strait in 1921, will be also discussed as a milestone in Greek oceanography science. This paper will demonstrate that the establishment of an observation station on the Strait attested to the significance of Euripus in the infant Greek oceanographic community. Finally, this paper will include a short discussion on the potential of the Euripus' tides to generate hydroelectrical energy. Even though some initial propositions to exploit the site's tidal energy potential were first discussed by renowned Greek meteorologist Dimitrios Aiginitis back in the late 1920s- they have not hitherto materialized.

KEYWORDS: Euripus, Tidology, Tidal energy, Oceanography, Greek Hydrography Service.

RESUMEN

El canal de agua de Euripus, en la isla griega de Eubea, experimenta un fenómeno único en el que las fuertes corrientes de marea invierten bruscamente su dirección. Esta ponencia trazará la historiografía de la investigación de las mareas en el estrecho de Euripus, que culminó con los estudios del Servicio Hidrográfico griego en el estrecho a principios de la década de 1920. También se analizará la creación de una estación talasográfica en el Estrecho en 1921, como un hito en la ciencia oceanográfica griega. Este trabajo demostrará que la creación de una estación de observación en el Estrecho atestigua la importancia de Euripus en la comunidad oceanográfica griega infantil. Por último, este trabajo incluirá una breve discusión sobre el potencial de las mareas de Euripus para generar energía hidroeléctrica. Aunque algunas propuestas iniciales para explotar el potencial de energía mareomotriz del lugar fueron discutidas por primera vez por el renombrado meteorólogo griego Dimitrios Aiginitis a finales de la década de 1920, hasta ahora no se han materializado.

PALABRAS CLAVE: Euripus, Tipología, Energía mareomotriz, Oceanografía, Servicio Hidrográfico Griego.

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As águas loucas do Estreito de Euripo: filosofia, ciência oceanográfica e potencial hidroelétrico de um intrigante fenómeno de mares

RESUMO

O canal de água de Euripus, na ilha grega de Evia, apresenta um fenómeno único em que fortes correntes de maré invertem abruptamente a sua direção. Esta palestra irá traçar a historiografia da investigação das marés no Estreito de Euripus, que culminou com os levantamentos do Serviço Hidrográfico Grego no início da década de 1920. O estabelecimento de uma estação talassográfica no Estreito em 1921, como um marco na ciência oceanográfica grega, também será discutido. Este documento demonstrará que o estabelecimento de uma estação de observação no estreito testemunha a importância do Euripus na comunidade oceanográfica grega nascente. Por último, este documento incluirá uma breve discussão sobre o potencial das marés do Euripus para a produção de energia hidroelétrica. Embora algumas propostas iniciais para explorar o potencial de energia das marés do local tenham sido discutidas pela primeira vez pelo famoso meteorologista grego Dimitrios Aiginitis no final da década de 1920, até agora não se concretizaram.

PALAVRAS-CHAVE: Euripus, Tidologia, Energia das marés, Oceanografia, Serviço Hidrográfico Grego.

Les eaux folles du Détroit d'Euripus : philosophie, science océanographique et potentiel hydroélectrique d'un phénomène de marée déroutant

RÉSUMÉ

Le canal d'Euripus, sur l'île grecque d'Eubée, est le théâtre d'un phénomène unique : de forts courants de marée s'y inversent brusquement. Cet article retrace l'historiographie de la recherche sur les marées dans le détroit d'Euripus, qui a culminé avec les relevés effectués par le service hydrographique grec dans le détroit au début des années 1920. La création d'une station thalassographique dans le détroit en 1921 sera également discutée en tant qu'étape importante de l'océanographie grecque. Cet article démontrera que l'établissement d'une station d'observation dans le détroit atteste de l'importance d'Euripus dans la communauté océanographique grecque naissante. Enfin, cet article comprendra une brève discussion sur le potentiel des marées d'Euripus à générer de l'énergie hydroélectrique. Même si certaines propositions initiales visant à exploiter le potentiel énergétique des marées du site ont été discutées pour la première fois par le célèbre météorologue grec Dimitrios Aiginitis à la fin des années 1920, elles ne se sont pas concrétisées jusqu'à présent.

MOTS-CLÉS : Euripus, Tidologie, Énergie marémotrice, Océanographie, Service hydrographique Grec.

Le folli acque dello Stretto di Euripo: filosofia, scienza oceanografica e potenziale idroelettrico di uno sconcertante fenomeno di marea

SOMMARIO

Il canale di Euripo, sull'isola greca di Eubea, è caratterizzato da un fenomeno unico nel suo genere: le forti correnti di marea si invertono bruscamente di direzione. Questo articolo ripercorre la storiografia della ricerca sulle maree nello Stretto di Euripo, culminata nei rilevamenti del Servizio Idrografico Greco nello Stretto all'inizio degli anni Venti. La creazione di una stazione talassografica sullo Stretto nel 1921 sarà discussa come una pietra miliare nella scienza oceanografica greca. Il documento dimostrerà che la creazione di una stazione di osservazione sullo Stretto attesta l'importanza dell'Euripus nella comunità oceanografica greca infantile. Infine, questo articolo includerà una breve discussione sul potenziale delle maree dell'Euripo per generare energia idroelettrica. Anche se alcune proposte iniziali per sfruttare il potenziale energetico delle maree del sito sono state discusse per la prima volta dal famoso meteorologo greco Dimitrios Aiginitis alla fine degli anni Venti, finora non si sono concretizzate.

PAROLE CHIAVE: Euripus, Tidologia, Energia di marea, Oceanografia, Servizio Idrografico Greco.

Introduction

Separating the island of Euboea from the mainland region of Boeotia in central Greece, the narrow strait of Euripus has long grabbed the attention and intrigued the imagination of the scientific community, travellers, and local residents (Figure 1). The water channel experiences a unique phenomenon where tidal currents, exceptionally strong for the Eastern Mediterranean region, abruptly reverse direction approximately four and up to fourteen times per day.

It is thus not surprising that the word Euripus itself has been diachronically used to describe people of easily shifting temperaments and situations that are prone to dramatic alterations. References to the Eyripus metaphor, dating back to the seventeenth century, imply that the term was even at one point used to denominate an odd, ineffectual to-and-fro movement that was not expected in the blood, resulting in blood circulation inconsistencies[1]. The tidal idiosyncrasies of Euripus waters' and its especially strong and high currents for Eastern Mediterranean basin standards have featured prominently in the scientific agenda of tidal research since at least the Aristotelian times. In fact, a widely circulated misconception is that Aristotle's mental struggle to solve the bizarre tidal phenomenon became so obsessive that it led him to drown in the very waters of Euripus. Myth and reality are further interwoven when it comes to tales of Euripus, as the site was also near Aulis, where Mycenaean King Agamemnon sacrificed his daughter Iphigeneia to release the curse that held the Greek fleet stagnate so that the Greek forces

Figure 1. The site of the Euripus strait



Source: https://www.antonios-antoniou.gr/evripos (accessed 10/1/2025).

[1] Hall, 1975, 321-350.

set off on their fateful voyage to Troy[2]. Finally, Euripus has been a permanent fixture of journalistic preoccupations and literary tales of the region, as witnessed in an edited volume on literature on the town of Chalcis, tellingly titled' Euripus' incomprehensible tides' and the fact that the most widely circulated newspaper in the region was named 'Euripus'[3].

The crazy waters of Euripus have been at the epicentre of the study of tidal waves, or tidology as it has been termed in Victorian science terms, the science that is exclusively preoccupied with examining and untangling the origins, peculiarities, and features of the tides. Painstaking observations of tidal phases, some more systematic than others, countless measurements of currents' heights and velocity, calculations of the fluctuations on sea level on either side of the strait and other relevant meteorological data have filled endless tables and diagrams, produced extensive sets of data and have been the subject of many diatribes, lively debates and correspondence between scientists[4].

Scholarship has largely focused on the meteorological and geophysical aspects of the phenomenon, with a proper historiographical account of the tidal research undertaken on the site lacking in the literature[5]. The history of Greek oceanography is equally under represented with only a handful of studies dealing with the professionalisation of oceanography and the timeline of its evolution from the late nineteenth century onwards[6]. This article fills this void, further contributing to the scarce literature on the history of Greek oceanographic activities that are practically absent in international scholarship. Moreover, it introduces the discussion on Euripus's scientific significance in the broader context of the newly sovereign Greek state's efforts in the early twentieth century to foreground an era of scientific renaissance amidst a widespread boom in sea science activities in Europe and the USA. As oceanography was blossoming on both sides of the Atlantic, constantly enriching its technological toolkit and expanding its spectrum of activities and advancements, Greece, subdued to almost four centuries of scientific stagnation was lagging seriously behind other European maritime nations in oceanography and marine biology activities. A handful of Greek supporters and promoters of Greek sea science, headed by Admiral Hydrographer Matheos Matheopoulos, pushed forward with the idea that Greece, as the maritime nation par excellence since the Minoan thalassocracy times had to reestablish its maritime prowess and initiate the rigorous scientific study both of seas from surface to bottom.

The literature has frequently highlighted that attempts to establish, re-establish, and strengthen national prestige through science and scientific achievements multifacetedly shaped and drove scientific innovation across Europe in the nineteenth and early twentieth centuries[7]. Historians have discussed the rise and development of oceanographic science from the late nineteenth century onwards, arguing that oceanography projects and schemes were often inextricably tied with nationalistic claims and placed within nationalist and political agendas[8].

Within Greece, Euripus became the site where the newly founded Greek Hydrography Service, founded in 1921 directed its preliminary activities. Shortly after its establishment by royal decree, the Service constructed a thalassographic[9] station near the Euripus site, assigned to perform regular measurements of tidal waves. In the absence of advanced technical know-how, personnel, and equipment, scientifically robust Greek oceanographic investigations and expeditions were not readily feasible, so pilot tidal observations on the Euripus site acted as a stepping stone in Greek oceanography's course. As it will be argued later, the station was an indication that Greece was hesitantly making steps to be on par with the advanced maritime nations in scientifically exploring the maritime realm.

In the centuries-long quest to solve the Euripus' paradox, the twentieth century saw a new challenge: how to exploit the strong potential of the strait's tides and their periodicity and predictability to generate electrical energy that will be cost-effective, reliable, and sustainable. Akin to studies on the tidal energy potential of other sites within the Mediterranean basin, such as the Straits of Messina and Gibraltar, Euripus has been the

[2] Morwood, 2001, 607-608.
[3] Mantas, 2005. The Euripus newspaper was published between 1865 and 1941 on a weekly basis. See more in https://digital.vivlchalkida.gr/archive/item/147.
[4] A lengthy account of all relevant correspondance and discussion on the matter between different scientists is provided in Eginitis, 1929a.
[5] Vlachakis; Tsiblis, 1993. Manassis et al., 2015. Kontoyiannis; Panagiotopoulos; Soukissian, 2015. Skaloumpakas, 2011.
[6] For the history of Greek oceanography see Vlahakis, 1998, 1999.
[7] Crawford, 1992. For the UK, see Edgerton, 1997, 759-776.
[8] Indicatively, for studies on oceanography and marine science and their place within geopolitical and diplomatic agendas, see Robinson, 2018. Höhler, 2002. Hardy, 2017. Hamblin, 2005. Adler, 2017. Oreskes, 2021.
[9] In the Greek sources of the period the term 'thallasography' and 'thalassographic' is generally used instead of 'oceanography' and 'oceanographic'. This is probably due to etymology: 'thalassagraphy' actually refers to the study of the sea, rather than the study of the ocean.

subject of a number of studies examining the manners through which its significant tidal power could be harnessed. However, early groundwork of exploiting the great tidal energy potential of Euripus is missing from the historiography. These go back to the 1920s but thus far have never materialised[10]. This article will finally include a short discussion of the initial propositions to reap the tidal potential of Euripus tidal energy made by renowned Greek meteorologist Dimitrios Eginitis in the late 1920s, thus further contributing to the scarce literature on the history of energy resources within Greece as well as to the growing literature on the history of energy resources internationally[11]. Primary source material for Euripus' role and positioning in the early years of Greek sea science activities is mainly drawn from the journal Nautical Review, the official journal of the Greek Navy, which included reports of the schedule of works of the Greek Hydrography Service by the Navy officers/hydrographers who initiated and fostered the activity in the Greek space[12]. Furthermore, Greek meteorologist Dimitrios Eginiti's thesis from 1929, "On the Problem of Euripus' tide", provides a thorough account of all the attempts to elucidate the puzzling phenomenon and has been invaluable in sketching the contours of the evolution of the ideas and interpretations of the Euripu's riddle.

It is divided into three sub-sections, each dealing with three different aspects outlined above. In the first section, I will trace the historiography of tidal research on the Strait from the embryonic attempts to explain the phenomenon until the 1800s and the explosion of more rigorous studies, facilitated by the widespread rise of tidology research, such as the one by British hydrographer Mansell's in the late nineteenth century[13]. The following section will take a closer look at Greek-produced tidal research in the area, headed by Professor of Meteorology Dimitrios Eginitis in the late 1920s and 1930s and undertaken by the Greek Hydrography Service who established and ran the thalassographic station in Chalcis. The concluding section will access briefly the hydraulic energy potential of the Euripus currents amidst the current urgent demand for RES (renewable energy sources), and Eginitis' futile calls to scientists, industrialist and governmental stakeholders to take notice of the region's substantial tidal energy promise.

From Aristotle to Mansell: Euripus, a perennial riddle

Let us first see how Euripus' tidal occurrences were summarized in a public lecture held at Athens' foremost intellectual and literary salon, Parnassus, in 1939[14]. The talk was delivered by Admiral Georgios Horsch, Director of the Athens Royal Observatory, who became personally preoccupied with Euripus caprices following the lead of another noteworthy scientist, meteorologist Dimitrios Eginitis, who managed to highlight and untangle the core principles of the phenomenon.

> "The island of Euboea is about 160 km long and is located along the length of Central Greece and is separated from it by the Gulf of Evia, divided into two parts, the North and South Evian Gulf by a narrowing in front of the city of Chalkis. The Strait of Euripus, which at its narrowest point is 40 metres wide, 40 metres long and 8,5 metres deep. The strait has two broad basins, to the northward the so-called northern port of Chalkis and to the south the southern port of Chalkis. This position of the strait, above which there is an iron swing bridge, which opens for the passage of ships, causes the phenomenon of a strong localised current, which appears in two distinct forms. On the 22nd or 23rd day of each lunar month, we have a regular and strong current, changing from every six hours or so, after a few minutes of inactivity, and therefore four times during the day, at a speed of at most 5-8½ miles per day, whereupon, at the time of the Full Moon or New Moon, it receives its maximum intensity. On the other hand, on 4 or 5 days a month, and precisely on the first and second days of the month. Therefore at the time of the Full Moon or New Moon it receives the greatest intensity. Moreover, on the 4th or 5th day of the month, and exactly on the first day and last quarter of the Moon, there appears the so-called irregular current, which has a low velocity - up to 2½ miles - and

[10] For the Strait of Messina, see Coiro et al., 2013. For the tides in Gibraltar see Candela; Winant; Ruiz, 1990.

[11] The literature on the history of energy resources is constantly expanding. See indicatively, Kupper, 2017. Smil, 2010; Turnbull, 2021. Hasenöhrl Ute; Meyer, 2020. A notable exception in Greek literature is Aggelopoulou, 2014.

[12] The magazine has been published continuously from 1917 until now, with a short hiatus due to WW2.

[13] Arthur Mansell resided for a prolonged period in Chalcis studying the phenomenon. His observations formed the basis of the diatribe 'On the Tides of Euripus' published in 1882 by his protegee and assistant in the study of Euripus, Admiral Andreas Miaoulis.

[14] By 1939, Dimitrios Eginitis had already published his groundbreaking thesis on Euripus (1929) so it must be assumed that there was some awareness in the scientific circles of the key parameters of Euripus tides.

alternates irregularly in time. As many as 12 and 14 changes are reported in a day and night, and sometimes the waters remain stationary for half an hour or even a full hour"[15].

Horsch's succinct description of Euripus's baffling tides was preceded by a long string of meticulous observations on site that kicked off with Aristotle's assumptions and culminated in the previously mentioned Eginitis' study in the late 1920s. Aristotle, who resided in the area for a prolonged period, is credited with offering the first plausible explanation for the seemingly randomly changing direction of Eyripus' currents by introducing the notion of seiches, to justify the excessively frequent shift of waters' course. A seiche 'is a standing wave oscillating in a body of water'...' caused when strong winds and rapid changes in atmospheric pressure push water from one end of a body of water to the other'[16]. Aristotle's engrossment with Euripus' was tailed by numerous ancient men of intellect, from Strabo, Eratosthenes and Pomponius Mela to Titus Livius, Pliny and Seneca.

Interest in what was occurring on either side of the strait, was further fuelled by the inevitable calamities posed by the currents' speed and fluctuations which made the passage of ships a risky venture. Regular observations, though not very systematic, were probably first undertaken by the Jesuit Babin in the seventeenth century, who lodged in Chalcis for two years and published a series of letters, outlining his findings[17]. Based on his surveys, Venetian P. M. Coronelli published a historical and topographical treaty of Euboea in 1687 featuring his own investigations of Euripus. Babin's influence lingered for a while, as evidenced in the study by Flemish Geographer Olfert Dapper who also attempted to provide a solid explanation for the tidal incident, largely following Babin's line of thought. More scientifically robust was the work done by renowned Swiss naturalist and father of limnology, the study of lakes, Francois Alphonse-Forel, which gave further impetus to then Director of the Athens Observatory J. Schmidt to direct his attention to Euripus, although briefly[18].

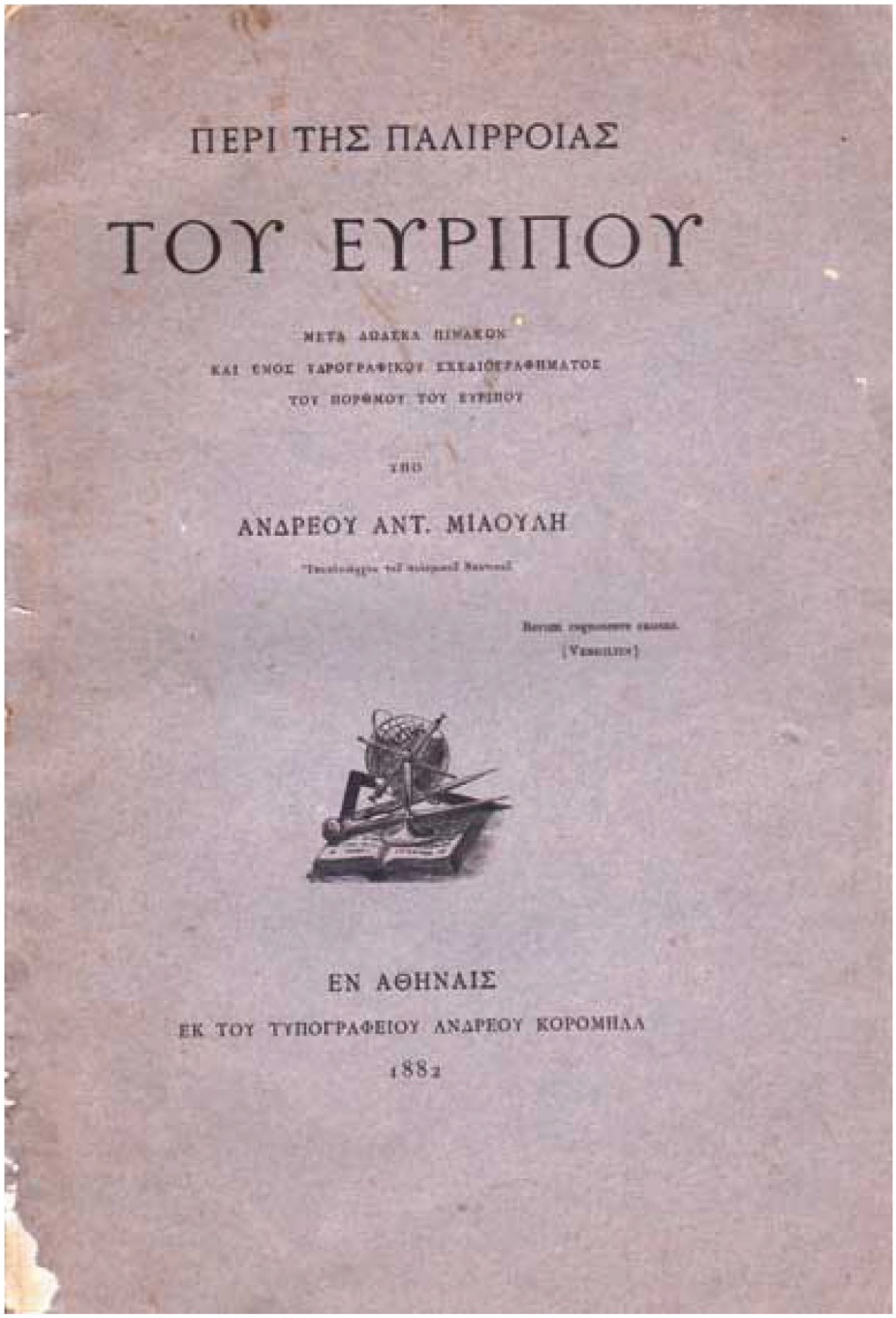
As the nineteenth century progressed, the study of tidal waves was gradually picking up steam. Tidology, the scientific endeavor exclusively dedicated to unveiling and registering the particularities and complexities of tidal formations, was recognized as a distinct subfield of earth and geophysical sciences. Its rise in popularity, especially in Britain, was facilitated by an unprecedented blossoming of earth and natural sciences that enhanced the toolkit of navigational practices, such as oceanography, geodesy, terrestrial magnetism, and meteorology.[19] The trend in advancing geophysical sciences, which started in the eighteenth century, continued well into the nineteenth century, its overarching principle being complete reliance on well-ordered and simultaneous, regionally broad observations that stretched over extended time periods. This type of laborious attention to detail and precision characterized much of the early Victorian scientific practice and has been coined by Susan Faye Cannon as Humboldtian science, after the celebrated German scientist and polymath Alexander Von Humboldt[20].

Michael Reidy has called the study of the tides one of Humboldtian science 'first research frontiers'[21]. Newtonian and Galilean tidal theories were brought back to the fore in the 1820-1840s period and were revamped in Humboldtian spirit mainly by British and scientists, most notably John William Lubbock (1803-1865) and William Whewell (1794-1866). This was also when those engaging seriously in tidal science were given the name tidologists[22]. In 1835, polymath and philosopher of science, William Wheller conducted a large-scale tidal experiment, measuring the times of tides and their heights across many countries, every fifteen minutes for a fortnight[23]. His ultimate goal was to establish a general theory of tidal phenomena, that would cut across topical tidal characteristics and unravel generalized tide patterns[24]. The experiment was made possible by the technical know-how, personnel, and equipment provided by the British Admiralty. With tidology enjoying a moment in both the British scientific and naval community it is no wonder that the next major study of Euripus came from the British Admiralty's ranks.

[15] Horsch, 1939.
[16] Gill, 1982, 84-85. The term *seiches* is described in the National Ocean Service site, https://oceanservice.noaa.gov/facts/seiche.html, (accessed on 27/03/2024).
[17] Babin, 1670.
[18] Eginitis,1929a, 7-11.
[19] Reidy, 2003, 45-71. Cartwright, 1998.
[20] Cannon, 1978, 12.
[21] Reidy, 2008, 55.
[22] Whewell himself coined the term. Cartwright, 1998. The influence of Newtonian theories on the tides is highlighted in Woodworth, 2023, where he argues for two eras of tidology, before and after Newton's contributions, when there was a distinct shift from speculation to careful observation and the application of mathematics.
[23] Ducheyne, 2010, 27-40.
[24] Deacon, 1971.

Rear Admiral Arthur Lukis Mansell was trained in hydrography beside famous British Admiralty hydrographers such as Francis Beaufort and Thomas Spratt. He spent much of his career surveying the Mediterranean coasts, before finally settling in Chalcis in 1866. He acquired a strong interest in the Euripus phenomenon and began making regular observations there, a pursuit he did not abandon well into his late years. In close collaboration with his protégé, young Vice Admiral Andreas Miaoulis, they set off on a series of observations and measurements on the channel between 1871 and 1872. Lacking a tide gauge, they instead placed two tide meters on each side of the bridge that traverses the strait and used a Massey current meter to measure the current's speed. Initially, their findings were disseminated in the form of letters exchanged during 1880 between Mansell and Forel, who retained his interest in Euripus. Two years later, Miaoulis finally published the results of their endeavours in what is still considered a highly accurate study of the Euripus' tides' key features (Figure 2). The study with their reports, exact

Figure. 2. Cover of On the Tides of Euripus, by A. Miaoulis, Athens, 1882



Source: Photo by the author.

figures, and conclusions, named 'Regarding the tides of Euripus', further consisted of ten tables, the first time the Euripus multiple tidal characteristics were pinpointed, collated, and visually represented. The times of the current's change of direction, its velocity, its height variation span, the times of ebb and flow, hourly observations of the sea level on both sides of the straight (north and south Chalcis ports), various meteorological data, a detailed diagram of the strait, and other information made up the emblematic study[25].

Despite the breadth of information the work provided for further investigations, they did not manage to fully explain the exact causes of Euripus 'whims. Nevertheless, their study was the hitherto most methodical and scientifically driven effort in highlighting the multifaceted idiosyncrasy of the puzzling tidal riddle. It was thus not unexpected that Mansell and Miaoulis' results were taken up swiftly by the celebrated German oceanographer Professor Otto Krummel who published a review of their work, noting that ''most of the problem's aspects have been resolved by Miaoulis and his significant research and from now on, a boost has been offered by him for new accurate observations''[26].

Mansell and Miaoulis' tables initiated a new wave of scholarly interest in the matter as their accuracy was saluted as highly valid and scientifically solid data on the phenomenon was now readily available. Of the scientists following in their footsteps, it is worth mentioning Professor Endros who further expanded on the Aristotelian seiches theory at an announcement at the Academy of Munich in 1914. Greek Professor Ioannis Sarris published a pamphlet on the Euripus tides in 1921 and Austrian Dr. R. V. Sterneck similarly presented his findings at the Proceedings of the Academy of Vienna in 1916, both studies wrapping up Mansell and Miaoulis' conclusions[27].

But Euripus' oddities did not only appeal to the oceanographic or meteorological community. They garnered the attention of a wide array of intellectuals, scholars coming from different disciplines as well as technocrats. Professor of Geography at the University of Bern, Philippson published a thorough topographical, geological and geographical study covering the entire Euboean Gulf, while Greek engineer Dimitrios Kalyvas who was in charge of the works to deepen the Chalcis port in the early 1890s to enable the stress-free vessels' crossings also published his own interpretation 'On the tides of Euripus' in 1892, closely adhering to Miaoulis conclusions[28].

In 1927, the first study on the subject that included an analysis of the measurements on the strait performed by an institutional body appeared in a scientific journal. It was Professor A. Mazis' review at the journal Scientific Echo of the observations made by the young Greek Hydrography Service, established in 1920[29]. What follows is a discussion on how the Euripus topic was placed in the limelight when it came to the schedule of works of the recently established Greek Hydrography Service and subsequently foreshadowed as a milestone of early Greek sea science ventures.

A feat of the infant Greek sea science: The Chalcis thalassographic station

After years of intellectual stagnation due to the four centuries-long subjugation to the Ottoman Turks, the Greek scientific community was eager to embark on a scientific renaissance that would welcome Greek science efforts into the arena of the scientifically and technologically advanced nations[30]. Means, expert personnel, and funding resources to do so were far from adequate as the newly sovereign state was still in restructuring mode on practically all institutional and administrative fronts. Nonetheless, within the ranks of the Greek Royal Navy, there was a clear intention to forward hydrographic and oceanographic activities and begin the scientific exploration of the Greek seas and coasts. The goal was for Greek oceanography to obtain the status of an equal member of the international oceanographic community and the prerequisite and first step to achieve that was to establish a proper Hydrography Service as in the paradigm of the advanced maritime nations[31].

In the summer of 1919, the first-ever International Hydrography Conference was held in London, and Greece was among the participating delegations. The Conference resulted in the foundation of the International Hydrography Office, an international body that would ensure the homogeneity in nautical guidelines

[25] Miaoulis, 1882. Eginitis,1929a, 10-12.
[26] Eginitis, 1929a, 13.
[27] Sarris, 1921. Sterneck,1916. Eginitis, 1929a, 12.
[28] Eginitis, 1929a, 13.
[29] Eginitis, 1929a, 14.
[30] On Greek science in the early new Greek State, see Tampakis, 2014. Karras, 2003. Lappas, 2004. Dimaras, 2004. On the formation of the new Greek State see, Kitromilides, 1994. Gourgouris, 1996.
[31] See Dorovitsa, 2025. Vlahakis, 1999.

and signage and would foster the harmonious and constructive exchange amongst its participating member nations' hydrographical operations and their respective hydrography services. Shortly after Greece's participation in the London event, the Greek Hydrography Service was established by royal decree in 1921 under the aegis of the Ministry of the Marine, with the task of drafting a schedule of works based on the conferences' recommendations[32].

The momentum to instigate the proper scientific exploration of the Greek seas was evident and was further strengthened by Greece's participation in another international scientific gathering of the sister discipline of oceanography a few months later. Similar to the London event, this was a science congress that was taking place for the first time and Greek sea science supporters and promoters were more than eager to attend. Held in Madrid in November 1919, the congress that was long overdue as it was postponed because of the War, gathered some of the leading oceanographers of the time. Amongst them was the pioneer of Greek oceanography, Admiral Mantheos Matheopoulos. Matheopoulos used the occasion to make some bold claims for Greece's maritime superiority in the Mediterranean Sea since ancient times and committed to the rest of the delegates that Greece would seriously engage in oceanographic activities[33].

The Congress launched the research ventures of the Commission Internationale pour l'Exploration Scientifique de la Méditerranée (CIESM) and further mandated that each of the participating nations would establish a National Thalassographic Committee assigned to supervise and coordinate the scientific exploration of its seas. Complying with this ruling, the Greek Thalassographic Committee was established roughly three months after the Congress, in February 1920 by the Greek Hydrography Service. its inaugural bulletin declaring its purpose which was 'the scientific, practical and beneficial exploration of the Greek Seas'[34]. Part of the responsibilities to the CIESM committee was that the national committees would have to proceed with the construction of thalassographic stations in sites of particular oceanographic interest charged with the task of performing oceanographic-related measurements. The decision of where this first thalassographic station on Greek soil would be located was straightforward; The Euripus strait puzzle had for long captivated the interest of the international scientific community making the choice obvious. The Greek Thalassographic Committee worked closely with the Greek Hydrography Service to move forward with the construction plans of the station in Chalcis port and very promptly completed the work at hand. A sophisticated tide gauge, patented after the Thompson tide gauge model was installed and the Chalcis thalassographic station began its tidal observations on the strait in early 1921[35].

The Station's measurements and observations were utilized by Professor Mazis as previously mentioned but were mostly expanded and contextualized by Professor of Meteorology Dimitrios Eginitis. His lengthy study of Euripus provided the most in-depth, concise, and comprehensive treatment of the topic thus far. Eginitis' thesis, first announced at the Academy of Paris in 1928 and subsequently published at the Proceedings of the Academy of Athens in 1929 was also the first essay to offer a synopsis of all the previous efforts to decipher the Euripus' enigma, commencing with Aristotle. The treatise validly combined theorems from Hydrodynamics and Celestial Mechanics and rules of Hydraulics with the on-site and real-time data delivered by the Hydrography Service. His main conclusion was that the Euripus tide is derivative but not stemming from the Aegean Sea as it was assumed until then. Rather, it originates from the Eastern Mediterranean basin, essentially turning the Aegean Sea into a sort of Gulf of the Eastern Mediterranean, through which its tide reaches the Gulf of Euboea. The tide when entering the Gulf's two ends is divided when reaching Euripus with a time lag of approximately 1 hour and 25 min between the north and south port of Chalcis[36].

Eginiti's novelty was that he did not restrict himself to interpreting the principal concern related to Euripus, that of the cause of the irregular currents. Instead, he traced, framed, and adequately clarified a set of questions that both separately and combined constitute the Euripus mystery. These can be summarized as follows: the origin of the tide, the cause of both the regular and the irregular current, the reversion of the times of the tide, the briefness of the daily period of the tide, the fact that flood and ebb last almost the same time, the impact

[32] Works of the London held International Hydrography Conference, *Nautical Review*, 1919, 13, July/August/September.
[33] *Matheopoulos,* 1919, 548-554.
[34] *Bulletin of the Greek Thalassographic Committee*, 1920, 25.
[35] Vlahakis, 1999. Sir William Thomson, Lord of Kelvin, patented the first tide predicted machine in 1872. See more in https://collection.sciencemuseumgroup.org.uk/objects/co53901/william-thomsons-tide-predicting-machine-1872.
[36] Stergiopoulou; Stergiopoulos, 2013, 48.

of the wind on the duration, height, and speed of the current, the sea level difference and continuous fluctuations between the North and South port of Chalcis (Figure 3)[37].

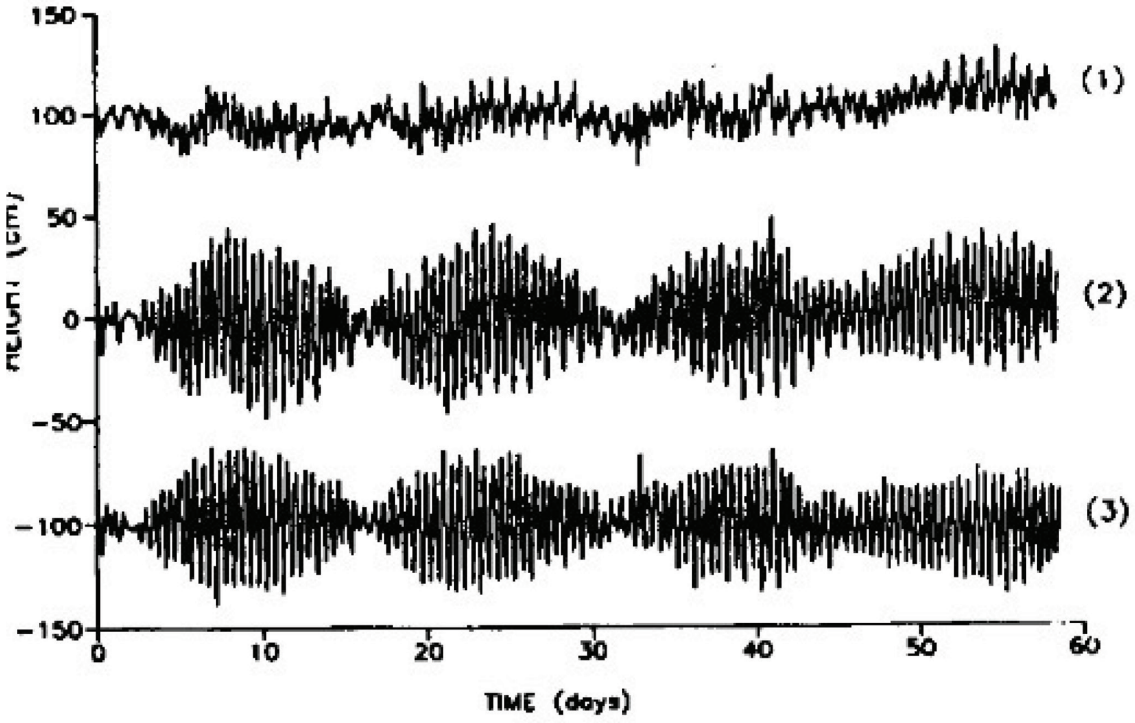
The Chalcis Station, 'a true thalassographic station' as described in Greek Hydrography Service report, was in line with similar projects in the technologically advanced nations and was considered a stepping stone in Greek oceanography's attempts to evolve and prosper (Figure. 4). On its premises, Admiral Alexandros Chrysanthis who was trained in Hydrography alongside Matheos Matheopoulos who was in charge of the observations, employed, for the first time in Greece, free-floating bottles to measure the current's speed and direction[38]. Modelled on the Chalcis Station, several other stations mushroomed in different port cities all over Greece within the next decade[39]. However, the Euripus one remained the prototype one, largely owing to the Euripus tide's significance in the scientific context, both nationally and internationally. Methodical and streamlined observations of its tidal times were not only essential for the safe passage of both Greek and foreign vessels, commercial and naval. They were also long overdue and much anticipated by the international geophysics community which has forged as previously shown, an exciting relationship with the Euripus' paradox.

The significance the Euripus station acquired within the circles of Greek oceanography is best attested by this fact: in the second CIESM conference in Paris in 1922 Greece did not send any representatives as it was decided that the Committee still needed time to fulfil its obligations to the international community. However, Greece did send an announcement to the congress regarding the topic that was most pressing in the Greek oceanographic agenda and where all efforts in these early years were directed: a report on the extended surveys and measurements conducted on the Euripus Strait (Figure 5)[40].

Blue anthrax sidestepped: the overlooked Euripus hydroelectric potential

The looming and impossible-to-ignore threat of climate change has accelerated efforts to abandon fossil fuels

Figure 3. Sea level difference between north and south port of Chalcis



Source: Vlahakis; Tsiblis, 1993, 158.

[37] Eginitis, 1929a.
[38] Vlahakis, 1998, 32-40.
[39] e.g. Chios (1922), Piraeus (1923), Patras (1925), Isthmus (1926). *Nautical Review*, 1922, 422.
[40] *Nautical Review*, 1922, 422.

Figure 4. The Chalcis Thalassographic Station



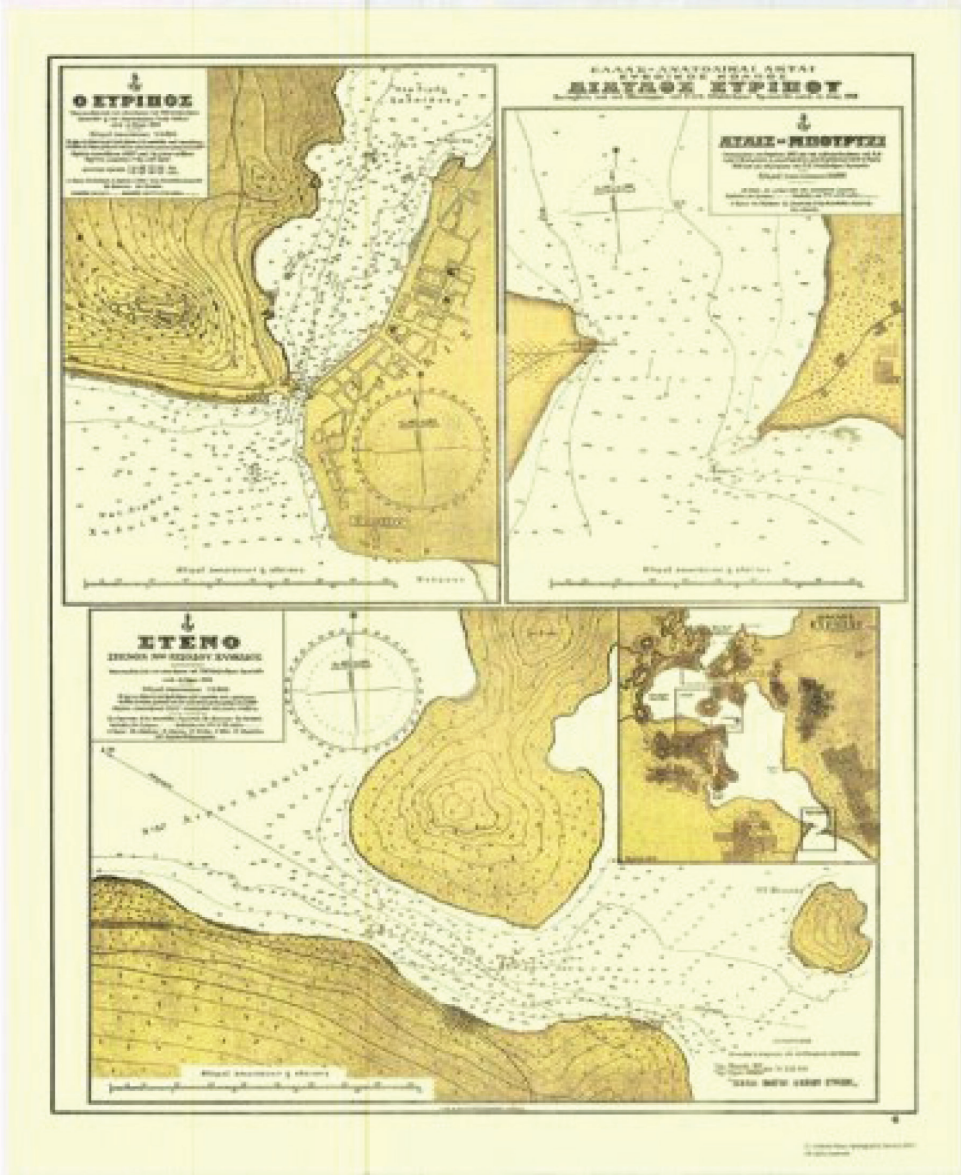
Source: *Nautical Review*, 1922.

and invest seriously in generating energy from RES (renewable energy sources). Amongst all the innovative forms of energy production, solutions harnessing the ocean's vast energy potential are less pronounced compared to solar and wind energy but are steadily gathering speed. Wave energy, offshore wind energy, ocean thermal energy conversion, and tidal energy are some of the schemes that are now being investigated. Pilot tidal energy plants, predominantly in Northern Europe and the USA, that take advantage of the Atlantic Ocean's tides are showing the way to yield energy that is more dependable and sustainable in the long run. Tidal predictability and periodicity as well as the big density and non-compressed nature of tidal waters, make resorting to tides an attractive energy alternative, which, however, has been underexamined in Mediterranean countries. Currents in the basin are indeed weaker than those found in the Atlantic but there exist some non-negligible tidal currents in straits, such as in Gibraltar, Otranto, Sicily, and of course in Euripus[41].

A recent special issue in History and Technology, titled Historicizing Renewables: issues and challenges, edited by Ute Hasenöhrl and Patrick Kupper has stressed that putting renewables into historical perspective is not an easy task. It involves borrowing and expanding established narratives from both the fields of history of science and technology and environmental history[42]. Placing the history of energy transitions within familiar accounts of wider sociotechnical change as well as elucidating the spatial and temporal circumstances that led to their adoption or rejection are key to a better understanding of how energy

[41] Pelc; Fujita, 2002, 471-479.
[42] Hasenöhrl Ute; Kupper, 2021.

Figure 5. The crossing of the Euripus Strait hydrographical chart, c.1922, Greek Hydrography Service



Source: https://www.hnhs.gr.

renewables were deployed and utilized throughout the years. The special issue further aknowledges that the history of green energies suffers from fragmentation as it has thus far been restricted to time and regional-specific studies. What is also easily noticeable is that some energy resources such as hydropower and biomass have been treated distinctively more than others such as solar, wind and ocean harnessed[43].

The history of tidal power schemes is even less marked in relevant studies although considerations of exploiting tidal forces for the production of hydroelectric energy go back to medieval times[44]. The tidal mill at Dover's port in South England is the most commonly cited reference of a project of this kind, while tidal mills found at the riverbanks in coastal Britain and France are also mentioned in the 1600s and 1700s[45]. However, it took almost four centuries for the first tidal energy plant to be put into action. It was the early 1920s and France was recovering from the War, seeking desperately

[43] For hydropower regional-specific schems see Swyngedouw, 2015. Tischler, 2013. On biomass a great study is Kander; Malanima; Warde, 2013. On solar energy see Perlin, 2013 and on wind energy, Heymann, 1995.

[44] A thorough study on international tidal power pants is given in Sonnic, 2021. More recently, see the excellent study on tidal power plants in USA and Russia by Frey, 2021.

[45] Hodgen,1939.

ways to reduce dependence on fossil fuels and enact a novel energy policy. A new term that referred to the tidal energy potential appeared; 'Blue Anthrax'. The country was in desperate need of nationally harnessed energy supply as it could no longer rely on foreign coal. Initially, the French Government targeted its development policies towards hydropower, known as 'white coal'. However, France's northwestern parts lacked in the hydropower front; instead, these were regions with high tidal range. French state engineers stepped in and founded what was called the 'Blue Coal Commission' in 1919 assigned to investigate the exploitation of both tidal and waves as energy resources. The French government subsidized the construction of an experimental tidal power plant in the Aber Wrac'h bay, in Britanny, near Brest in 1925[46].

The project led the way for similar endeavours across the Channel and in the USA, where President Roosevelt commissioned the creation of an ambitious tidal plant project in Passamaquody on the border of USA and Canada, in New Brunswick in 1935. The underdeveloped tidal technology, the high costs, and insecurities on the profitability of such projects in the long term, did not favour the development of such initiatives, which were eventually abandoned. A tidal plant project was reintroduced, much later, in the 1960s, again on the Britanny coast in France, and this time it was highly successful. The La Rance tidal barrage plant, built on the La Rance estuary with a capacity to produce up to 240 MW of electricity via the use of tidal turbines opened its doors in 1966. It is to this day the most well-known commercial tidal power plant and still contributes substantially to France's energy toolkit[47].

With Euripus's tidal current undoubtedly being the most powerful in the Eastern Mediterranean, one would expect that its vast energy potential would have been picked up and forwarded by local and national stakeholders. Unfortunately, apart from initial discussions and some preliminary studies, the issue has never moved beyond the theoretical level. To this end, most recently, the Hellenic Centre of Maritime Research has compiled the profiling of the tidal current, while a team of researchers at the National Technical University of Athens have made experimental and theoretical research into modernizing the Archimedean screw pump into a screw turbine to be deployed on the Strait for extracting tidal and sea current hydraulic energy[48].

But preliminary considerations on capitalizing on Euripus' tidal energy go as far back as Jesuit Babin's remarks. Babin and later Mansell both mention the existence of two mills on either side of the strait in the seventeenth century that were moved by the power of the currents without however making further suggestions on how to make the most of this energy potential[49]. In the late 1920s, Dimitris Eginitis, who partially solved the tidal puzzle, complimented his Euripus study with an article that introduced and promoted the exploitation of the tidal-induced hydroelectric potential of the strait. He referred to the Euripus tide as "a great and non-exhaustive profitable source of power for our country, of major significance and appreciation"[50]. His intervention informed the Greek scientific community of the latest international developments on this front and registered the pros and cons of applying tidal energy, the 'blue anthrax', compared to e.g. energy coming from rivers. The article included a discussion on the French Aber Wrac'h initiative, its background, funding, and technical challenges. Eginitis' commentary on the French project served as a prelude to introduce and convince his readership of Euripus' relative tidal energy assets:

> "The Euripus current, one of the strongest, if not the strongest, also has mechanically fertile ground for industrial exploitation",

he noted before contrasting it with the French project.

> "The large funding needs of the Mahl (the French engineer in charge) plan for the construction of big technical projects, dams, another kind of infrastructures ... for the artificially induced production of strong tidal currents is replaced and provided in Euripus by nature itself and the already existing and forceful current ... so it is mandatory that we seriously study this potential that is financially profitable and useful"[51].

The high velocity and force of the Euripus current compared to similar currents on French and British coasts provided further grounds for advocating for

[46] Marrec, 2022.
[47] Guille, 2009, 133-146. On a more detailed account of ocean wave power in France, see Marrec, 2022.
[48] Stergiopoulou; Stergiopoulos, 2013, 44-51.
[49] Eginitis, 1929b, 7.
[50] Eginitis, 1929b, 10.
[51] Eginitis, 1929b, 9.

Euripus tidal energy exploitation. It was quite self-evident Eginitis maintained:

> "The current's speed usually reaches up to five mph on the coast of France and England. This is considered very profitable in these countries. Euripus current that reaches up to eight mph gives the current the resemblance of a fast-flowing river"[52].

With all the undoubted tidal superiority of Euripus, Eginitis's propositions did not move forward. The reasons are not clear nor has it been possible to unearth further material that would prove that Eginitis' blue anthrax campaign had any apt outcomes. Eginitis and his team did bring the issue to the table by drawing the attention of all relevant stakeholders, engineers, and industrialists who:

> "need to study this from every angle, for the safest practical application and financial benefits and needs of the industry"[53].

But further to this, it seems that no serious plan of action on that front was undertaken. Funding restrictions, absence of specialized technical personnel, and bureaucratic sluggishness are the obvious and perennial culprits in enacting such schemes in Greece at the time. In the end, Euripus' blue anthrax promise has not yet taken shape, despite recent, more focused, and structured efforts. Euripus' mysteries, marvels, and untapped potentialities are bound to continue intriguing and mesmerizing scientists, intellects, technocrats as well as everyday visitors who never cease to flock to the site to revel in the crazy waters.

Conclusions

This article drew the contours of the Euripus Strait tidea unique phenomenon of exceptionally strong, for Eastern Mediterranean basin standards, and seemingly irrational tidal currents that had riddled the scientific world since Aristotelian times. An unprecedented rise in tidology and other sea science activities that had already begun in the last decades of the nineteenth century, not surprisingly, turned Euripus into a locus of intense scientific discourse and scrutiny, with continuous attempts to elucidate the nature, causes and characteristics of its tidal waves.

This article provided a historiographical account of tidal research on the Euripus Strait that showcased the long-lasting appeal the phenomenon has had to the broader scientific community, nationally and internationally, and from physicists and philosophers to meteorologists, hydrographers, and engineers. This appeal and international interest that Euripus received made it the perfect showpiece for the young Greek Hydrography Service that was just commencing its oceanographic activities in the 1920s and was eager to follow in the footsteps of more advanced nations in the sea exploration front. But while oceanographic surveys on the strait were promoted and fostered by the Greek Royal Navy, the hydraulic energy potential of the tidal currents was not equally explored by the Greek Government even though it was recognized since the late 1920s. While there was no doubt for its exploitative potential and similar tidal energy projects were being profitably undertaken elsewhere, e.g. in France, the plans to capitalize on the Euripus' tidal energy have to this day, despite some more recent fastidious studies, remained in the sphere of theory.

[52] Eginitis, 1929b, 10.
[53] Eginitis, 1929b, 10.

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