

## SCIENCE:

PUBLISHED BY N. D. C. HODGES, 874 BROADWAY, NEW YORK.

SUBSCRIPTIONS TO ANY PART OF THE WORLD, \$3.50 A YEAR.

To any contributor, on request in advance, one hundred copies of the issue containing his article will be sent without charge. More copies will be supplied at about cost, also if ordered in advance. Reprints are not supplied, as for obvious reasons we desire to circulate as many copies of SCIENCE as possible. Authors are, however, at perfect liberty to have their articles reprinted elsewhere. For illustrations, drawings in black and white suitable for photo-engraving should be supplied by the contributor. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

# THE CRUISE OF THE CLOVER—FURTHER REMARKS ON THE ABERRATIONS OF AUDIBILITY OF FOG SIGNALS—THE METHODS USED.<sup>1</sup>

BY ARNOLD BURGESS JOHNSON, WASHINGTON, D. C.

It is now about a quarter of a century since Prof. Joseph Henry, the first President of this society, commenced his investigation into the operations of the laws of sound in connection with the fog signals used by the Light House Board, of which board he was then the scientific member.

When I was made Chief Clerk of the Light House Board in 1869 it became my duty, as well as a privilege which I highly prized, to act to a certain extent as his amanuensis and aid in putting the results of his experiments in the form of reports to the Light House Board. In this way I became interested in this work and was, in a very humble way, associated with Professor Henry in its prosecution. Thus I entered with him into a practical discussion of the subject and became, after a fashion, possessed of his views as to the best way to follow up the investigation. I thus came to know something of his tentative plans and of his desire to make very practical use for light house purposes of the outcome of the investigations.

On Nov. 6, 1880, the great Long Island Sound steamer Rhode Island was stranded and finally lost on Bonnet Point in Narragansett Bay. Then, putting it roughly, a million in property was lost and thousands of lives were imperilled. The master and pilot of the steamer claimed that the fog-signal at Beaver Tail Point, about one and seven-eighths miles away, was not sounding at the time of the accident; and hence the casualty. The light keeper who was in charge of the fog-signal at the time, and who was in peril of losing his place, proved conclusively that at the time of the wreck the sound of the fog-signal was heard at Newport, five miles away, at Fort Adams, four and a quarter miles away in one direction, and at Narragansett Pier, four and a half miles away in another direction. The steamer people, who were in danger of forfeiting their licenses, came back with affidavits of many on board that they were anxiously listening for the fog-signal, and that it was not in operation, for they did not hear its sound.

Then the Light House Board took a hand in the matter. It had been shown by Professor Henry that, although a sound could be heard at a certain distance from its

source, it might not be heard in the same direction, and at the same time, at a less distance. Could this be one of those cases? A naval officer in the service of the board, now ranking as a Commodore, was sent to the locality to find out. He had the fog-signal at Beaver Tail started, and cruised round it in a sail boat for some time, taking constant note of the intervals of the sound. He found, and reported to everybody's surprise, that not only did he fail to get the sound of the Beaver Tail fog-signal at Bonnet Point, one and seven-eighths miles away, where the Rhode Island was lost, but he failed to get it at other points even nearer to the fog-signal, while he heard it on the same day at different points farther away, and much farther away in a line with the nearer points where he could not hear it. This settled the question. The light keeper was relieved from the charge of failing to have the fog-signal in operation, and the steamer people were relieved from the charge of failing to act on the warning of the fog-signal, which was blowing, but which, while within earshot, they might not hear.

In 1881 the great propeller Galatea, while on the way from New York to Providence, ran onto Little Gull Island in Long Island Sound, imperilling many lives and much property. There was, and is, on that island, which is but one-eighth of a mile long, a powerful light and a powerful fog-signal. That fog signal has been often heard sixteen miles away. The defense of the steamer people was that the fog was dense and that the fog-signal was not blowing. The light-keeper, in his defense, showed that the fog-signal was blowing, that it was heard and noted at several different points in different directions, say at New London, Mystic, and at several light houses, many miles away, at the very time the Galatea ran on the little islet on which the fog-signal was at work. Again the Light House Board was required to look into the matter. Again careful investigation was made. And again it was shown that the fog-signal might be heard far off, and not close to, and the spots where it was not heard were noted and plotted on the chart; and again the steamer people and the light house people were exonerated from blame.

In 1881 I gathered these facts and submitted them to the Philosophical Society. My paper was printed in the Bulletin of the Society, and it was largely copied in maritime and scientific publications in this and other countries. The light house establishments of England, France and Spain reprinted the paper, each in its own language. And the eminent Emile Allard, head of the French light house establishment and a prominent officer of the French Corps of Engineers, plotted my numerical statement of the intensity of sound as heard from the fog-signals, in graphic form, that is, in lines of various width, and sent his diagrams to me in a letter in which he discussed the subject at length.

The Light House Board meantime was considering the matter from a purely practical standpoint. If, it was reasoned, there is a point within earshot of a fog-signal, where, from any cause, the fog-signal cannot be heard, then some other signal should be placed at that point, from which vessels can take a fresh departure. Acting upon that idea, investigation was made as to the region about each prominent fog-signal which it had been said could not be heard at points where it ought to be heard. In several instances I was sent to such points to make investigation and to report with recommendations. In the summer of 1885 I cruised about Point Judith, R. I., and the southeast end of Block Island, both at the entrance of Long Island Sound, and about the light house and fog-signal on Little Brewster Island, entrance to Boston Harbor. An area of silence was found and plotted about one and a quarter miles south of Point Judith, where the

<sup>1</sup>Read before the Philosophical Society of Washington, Nov. 25, 1893.