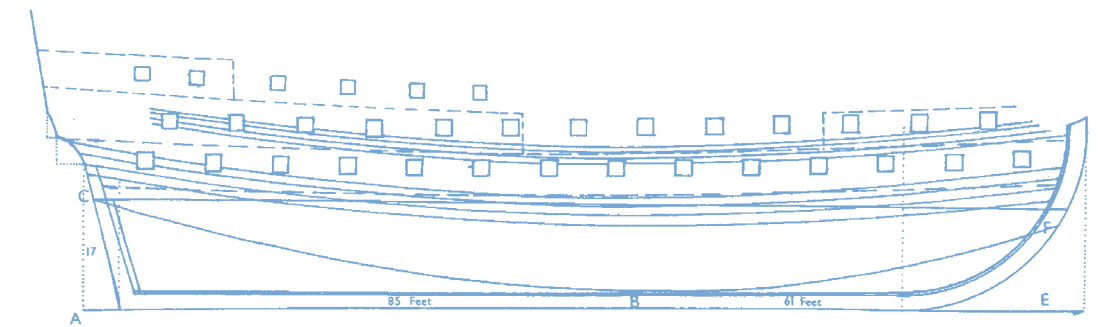


THE VIRTUAL *Dove*

An Interdisciplinary SMP Sails into Uncharted Territory

BY ANNALISE KENNEY '15, BIOLOGY AND RELIGIOUS STUDIES MAJOR

ONE AFTERNOON IN THE FALL OF 2011, REBECCA PRASHER '12 called a meeting with a maritime curator, a physics professor, and an ex-marine engineer. These three men had never before spent time with one another, but one would hardly suspect that, as they excitedly fired ideas in Prasher's direction. Rebecca's goal was a St. Mary's Project (SMP) with roots in several disciplines: an unprecedented analysis of seventeenth-century hull hydrostatics. She asked questions and jotted down notes, ignoring the most important question: *is this project actually possible?*



LEFT: Aboard the *Dove* in June 2012, Prasher (right side) climbs the foremast to loose the sail.

ABOVE: Illustration from a 17th-century text on naval architecture.



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One could say Rebecca's project began when she was eleven, during her first sailing lesson at a summertime sailing camp on the Shenandoah River. "I always wanted to sail tall ships," says Rebecca. "But that's hard to do in Alabama, where my family moved when I was 14." At St. Mary's, Rebecca was finally able to sail. She sailed on the river in recreational sailboats and spent a semester of her sophomore year abroad in the Sea Education Association (SEA) program. Rebecca also volunteered on the *Maryland Dove*, Historic St. Mary's City's replication of the famous seventeenth-century tall ship that delivered the first group of colonists to St. Mary's City in 1634. It was on the *Dove* that Rebecca's SMP was inspired.

At the time a physics major and math minor in her junior year, Rebecca was navigating the *Dove* with Will Gates, maritime curator and *Dove* skipper, at the helm. She had a vague idea of combining her love of ships with physics to create an SMP, so when Gates mentioned that Historic St. Mary's City wished to construct a new replica ship, one that would pass the required stability tests to make the ship passenger-certified, Prasher started brainstorming. She soon realized that designing a stable ship from scratch, with little knowledge of ship design, would be "a stretch." To better incorporate physics into her project, Rebecca turned her focus to measuring and improving the structure and stability of an existent seventeenth century sailing vessel. Because of the community's "inherent interest" in the nearby *Maryland Dove*, Rebecca decided to create and manipulate a model of the *Dove* itself.

Will suggested Rebecca speak with Rick Loheed, assistant director of waterfront activities at the College. An ex-marine engineer, Rick loved the idea of combining physics and naval architecture. Most importantly, he offered up the Rhinoceros3D (Rhino) computer program, which allows the user to create and manipulate a sophisticated 3D model. Rebecca asked Will, Rick, and her SMP physics department mentor Josh Grossman to attend what she has since termed "the Big Meeting."

The Big Meeting was truly the definition of interdisciplinary collaboration. Physics,

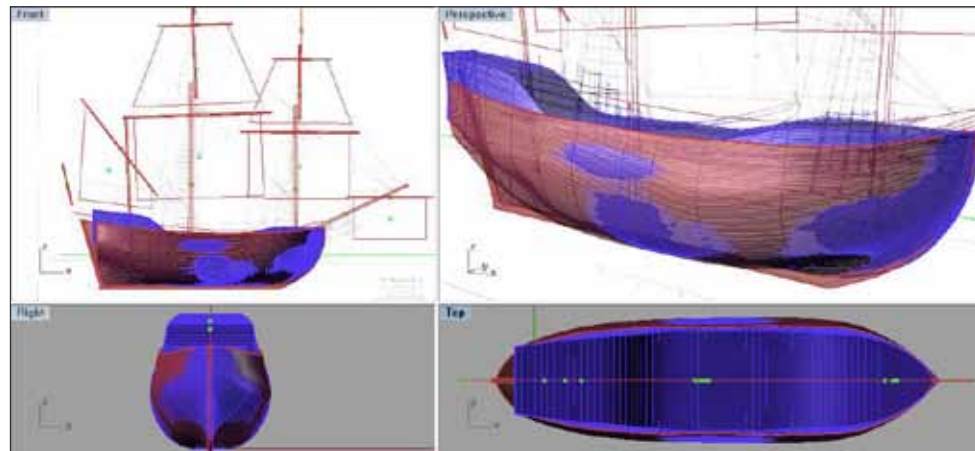
computer science, naval architecture, marine engineering, and history all came together as Rebecca's small panel of experts offered up advice and ideas for her project. But it was Prasher doing the real work. She put ideas together to come up with a method of investigating stability of a virtual model of the *Dove*. "[The meeting] was the essence of cooperation," says Rebecca. "But my biggest problem was keeping the project feasible." She struggled to keep the scope of the project narrow, saying she "always wanted to do more" with the project, but had to stay within her time constraints.

Prasher realized that she had to gain further knowledge of nautical terminology and ship construction before creating a virtual model of a seventeenth-century vessel. Her research led her into still more disciplinary areas. In addition to providing nautical knowledge, Will Gates introduced her to Joe Greeley, the waterfront site supervisor of Historic St. Mary's City, who supplied research material and plenty of knowledge about 17th-century ship construction. Rebecca used a text written in 1670

on naval architecture to determine "rules" to define the shape of the virtual ship. This was difficult, as the text included archaic language and imprecise definitions. To accurately follow 17th-century shipbuilding styles, Rebecca had to fully explore colonial-era language, history, and architectural style.

Basically, Rebecca says, 17th-century ships were made up of a "series of arcs viewed in orthogonal planes." After a lot of research and a few false starts, she began constructing the virtual vessel by incorporating rules gathered from naval architecture texts into a Rhino computer program plug-in called Grasshopper 3D. Rebecca created a virtual hull shape and allowed the program to fill in the rest of the ship's form. She then used another Rhino plug-in called Orca 3D to add the ship's other components, like masts, sails, and ballast, and to find defects in the shape. This part of the project required hours of "visual measurement," as she looked over every aspect of the model to find problem spots. She remembers taking a blacksmithing class in which the instructor repeated the motto, "the master's eye does more than his hand." This advice rang true as she searched for faults in the model. (see figure below)

Rebecca met with her advisers regularly. She became especially close with Rick Loheed, with whom she would discuss naval architecture and computer programming for hours at a time. "My project was really right in his area of expertise," says Prasher. But Loheed's gusto could not compare with Rebecca's gung-



During a semester at sea in 2009, Prasher hauls a line with her watchmates aboard the SS/V Corwith Cramer.

ho attitude towards her own project. "I was the only person I knew who actually enjoyed working on an SMP," she says. Rebecca's dedication to her SMP is comparable to her eagerness to sail earlier in life. "If it's something I care about, I'm going to find a way to do it," she says about her enthusiasm.

With the model complete, the architectural part of the process was through and the physics phase began. Rebecca used computer programs to calculate hydrostatics of the model and to perform stability tests. She determined how vertical center of gravity in the model affected righting moment curve (a measure of torque required to return a boat to the upright position when the boat is heeled). She also tested the effect of ship breadth on stability.

Prasher was able to draw several conclusions from her project, which her multidisciplinary advisers and mentors all agreed was successful. First, she found that her ship model can be considered an accurate representation of a 17th-century sailing ship. She also found that the model was useful in that many

aspects of the virtual ship can be manipulated. It came as a happy surprise to Rebecca that the model remains historically accurate even when certain aspects are manipulated. The model was successfully used to test the stability of a colonial vessel.

Rebecca's project won the Geneva Boone Award, which recognizes an outstanding SMP and supports the author in presenting the project to an audience beyond St. Mary's College. Rebecca is looking into publishing options. Her future, like her project, will likely blend sailing and physics. She plans to attend graduate school for physical oceanography, but first wants to work in an oceanographic laboratory. She looks forward to sailing the Great Lakes next summer, but currently she is in the Pacific Ocean, aboard *S/V Kawai*, having set sail from Hawaii in October. She'll go to Kiribati and the Cook Islands as crew, heading back to Hawaii after five months. Will she be assessing the stability of the ships on which she travels? "Probably," she laughs, "What sailor wouldn't think about their ship's stability?" ♦

RIGHT: Prasher learning to navigate using charts, GPS, radar, and the stars.

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