

# WHEN THE RUST SETTLES, CONVERT IT

BY JOHNNA RIZZO AND MATTHEW TWOMBLY



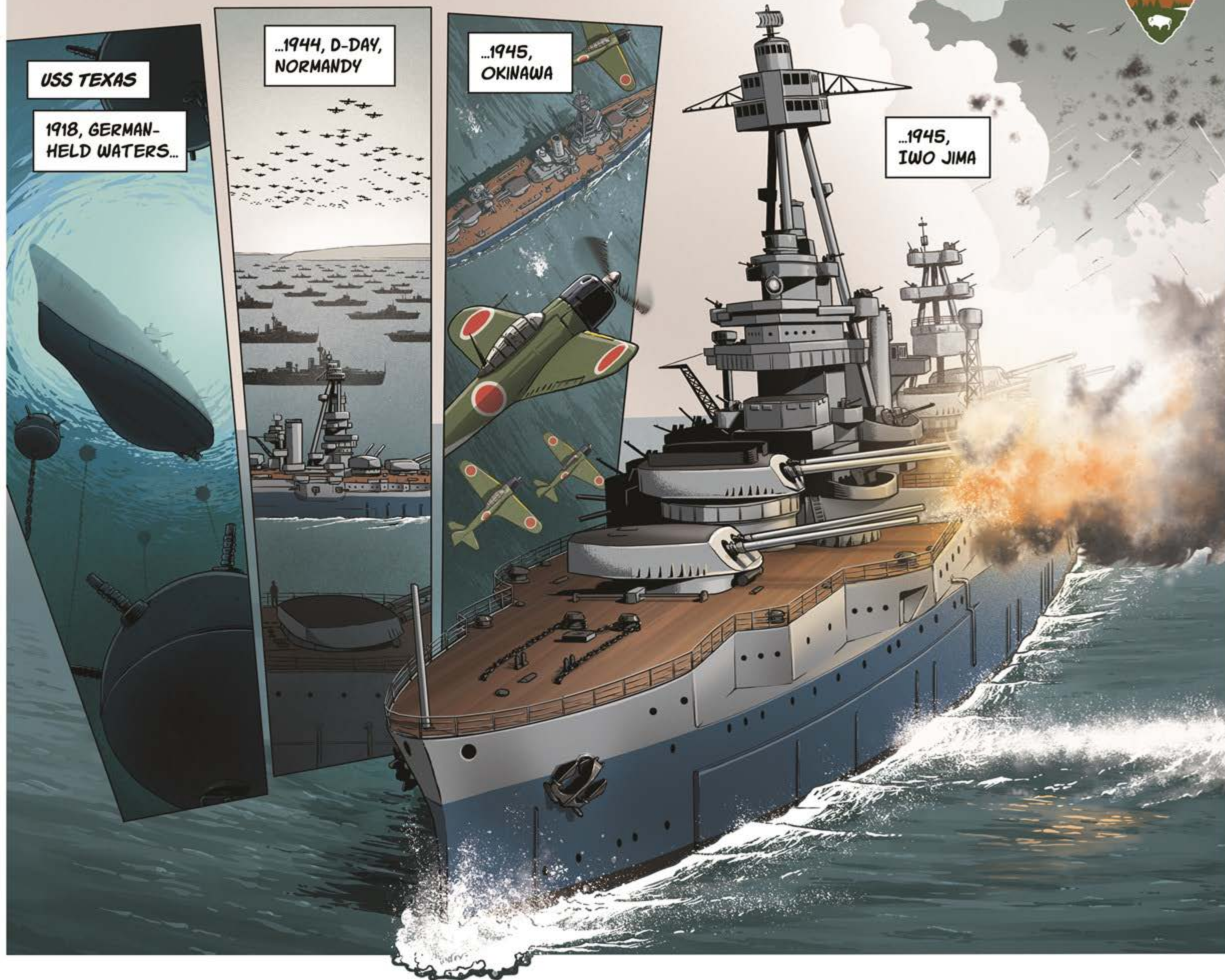
USS TEXAS

1918, GERMAN-HELD WATERS...

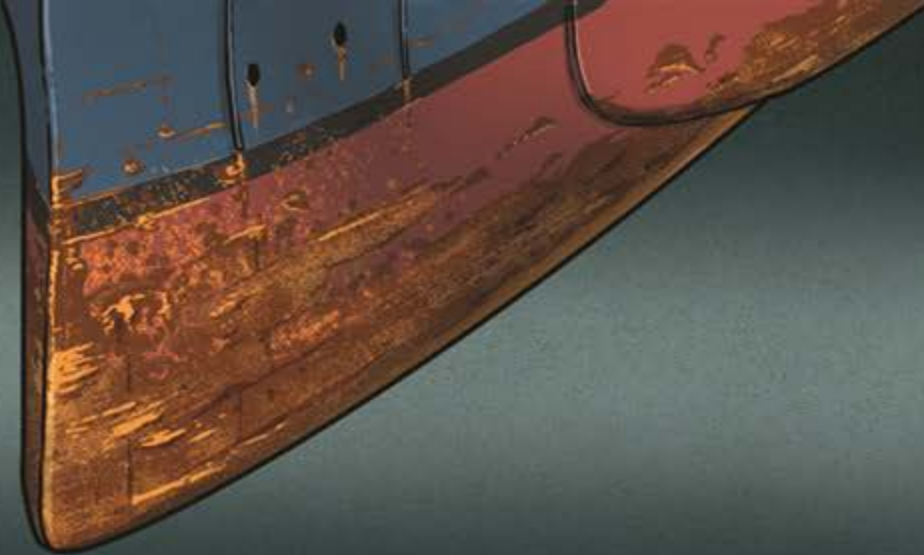
...1944, D-DAY,  
NORMANDY

...1945,  
OKINAWA

...1945,  
IWO JIMA



TODAY, RUST IS THE  
USS TEXAS'S ONLY FOE.





BUT RUST DOESN'T  
THREATEN JUST  
ICONIC STRUCTURES.

CAST IRON, WROUGHT  
IRON, AND STEEL ARE  
THE BASE MATERIALS  
IN EVERYTHING FROM  
BRIDGES TO FARM  
EQUIPMENT.

EXPOSED IRON WILL CORRODE  
IN AS LITTLE AS SIX MONTHS.

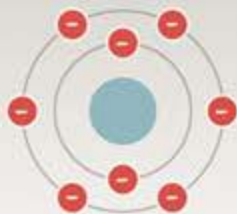
PAINT SHIELDS METAL FROM SALTY  
AIR, OXYGEN, AND MOISTURE—THE  
MAIN ENEMIES OF METAL OBJECTS.

BUT OVER TIME, ALL PAINT CRACKS.  
IT'S IN THESE LITTLE CREVICES  
THAT WATER CREEPS IN.

SALTY AIR



OXYGEN (O<sub>2</sub>)



MOISTURE



PAINT

THE INEVITABLE END  
RESULT IS RUST.



WHEN IRON (FE) IS MADE, IRON ORE IS HEATED TO TAKE THE OXYGEN (O<sub>2</sub>) OUT AND ADD OTHER ELEMENTS LIKE CARBON (C) AND NICKEL IN TO MAKE IT STRONGER. THAT MAKES IRON ALWAYS IN SEARCH OF ITS LOST OXYGEN.

THOUGH IT CAN'T BE PREVENTED, RUST ITSELF CAN BE TRANSFORMED IN A PROCESS CALLED RUST CONVERSION.

SANDBLASTING BREAKS AWAY BITS OF IRON AND CREATES AN UNEVEN SURFACE WITH EVEN MORE NOOKS FOR THE OXYGEN TO GRAB IRON.

RUST CONVERTERS, ON THE OTHER HAND, TURN THE RUST INTO SOMETHING ELSE.

DURING THE RUSTING PROCESS, THE ELECTRONS IN THE ADDED ELEMENTS GET SOAKED UP BY SEAWATER, RAIN, AND HUMIDITY.

OXYGEN IN AIR DONATES ITS ELECTRONS TO THE IRON.

IRON MOVES OUTWARD AND THE OXYGEN MOVES INWARD.

ALL THAT MOVING AROUND FORMS PITS AND THE SURFACE BECOMES FLAKY AND LOOSE.

PITS CAN DISINTEGRATE INTO HOLES THAT CREATE MORE PLACES FOR OXYGEN TO SNEAK IN.

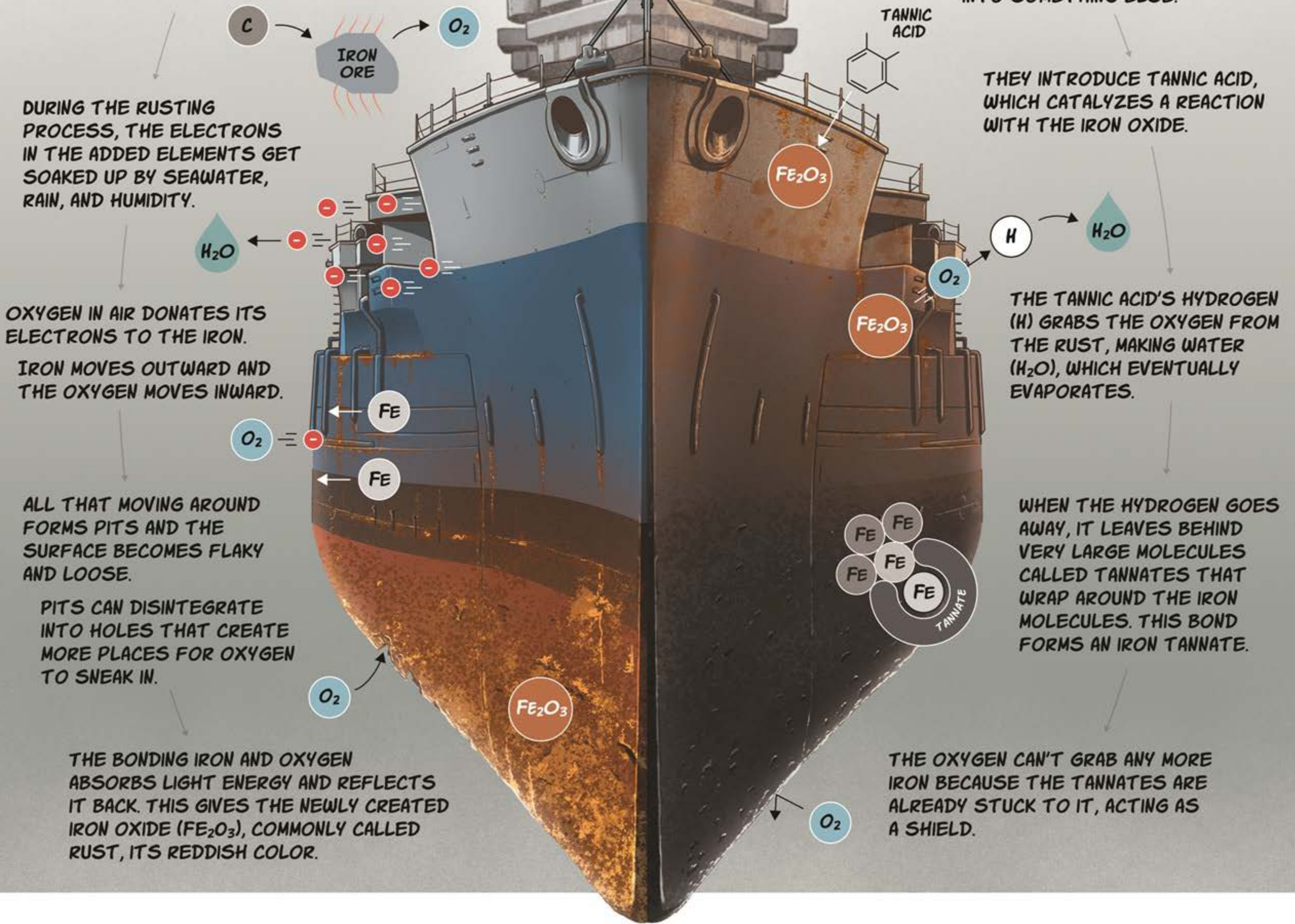
THE BONDING IRON AND OXYGEN ABSORBS LIGHT ENERGY AND REFLECTS IT BACK. THIS GIVES THE NEWLY CREATED IRON OXIDE (FE<sub>2</sub>O<sub>3</sub>), COMMONLY CALLED RUST, ITS REDDISH COLOR.


THEY INTRODUCE TANNIC ACID, WHICH CATALYZES A REACTION WITH THE IRON OXIDE.

THE TANNIC ACID'S HYDROGEN (H) GRABS THE OXYGEN FROM THE RUST, MAKING WATER (H<sub>2</sub>O), WHICH EVENTUALLY EVAPORATES.

WHEN THE HYDROGEN GOES AWAY, IT LEAVES BEHIND VERY LARGE MOLECULES CALLED TANNATES THAT WRAP AROUND THE IRON MOLECULES. THIS BOND FORMS AN IRON TANNATE.

THE OXYGEN CAN'T GRAB ANY MORE IRON BECAUSE THE TANNATES ARE ALREADY STUCK TO IT, ACTING AS A SHIELD.



A large battleship is shown at sea during sunset. The ship is silhouetted against the bright orange and yellow sky. The ship's complex superstructure, including masts, funnels, and gun turrets, is visible. The water in the foreground is dark with some light reflections.

RUST CONVERSION CREATES  
A STABLE SURFACE THAT CAN  
BE PAINTED, SAVING THE IRON  
FOR ANOTHER DAY.



SOURCE: NATIONAL CENTER FOR PRESERVATION TECHNOLOGY AND TRAINING, NATIONAL PARK SERVICE.