

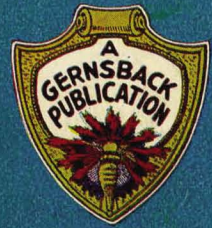
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"Trapped in the Depths"

by **CAPTAIN S. P. MEEK U.S.A.**

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Trapped in the Depths

by Captain
S. P. MEEK
U.S.A.



(Illustration by Paul)

The boat rocked for a moment and Jean was drenched in a downrush of water. Jimmy bounded to his feet and fought his way to the hatch cover.

By the Author of "The Osmotic Theorem"



WOULD you like to take a trip under the surface, Jean? It will take only a few minutes to submerge."

They were standing in the control room. The hatch was open and above was a round patch of sunny blue sky.

Jean Gilmer looked around the room a trifle fearfully. "Are you sure it's safe, Jimmy?" she asked.

"As safe as staying on the surface," replied Jimmy Dale with a laugh. "The *Loon* was especially designed for safety, and one man can handle her. Mac and I can take you thirty feet under and back in five minutes, if you'd like to go."

"I'd love to, Jimmy, but I'm afraid. Are you sure it's safe?"

"We'll leave that to Mac. He's a canny Scot and will err on the side of conservatism rather than recklessness. Oh, Mac! Come forward a minute, will you?"

MacPherson, Dale's engineer, came forward, wiping his hands on a piece of waste.

"Ye'll be calling me, Mr. Dale?" he asked.

"Yes, I was. Miss Gilmer, this is Angus MacPherson, the canniest Scot and the best engineer that ever came out of Edinburgh. Mac, this is my fiancée, Miss Gilmer."

MacPherson wiped his hands again, inspected them carefully and then contented himself with a deep bow. Jean Gilmer laughed and reaching out, took forcible possession of the engineer's hand and shook it warmly.

"Mr. Dale has talked about you so much that I feel just as if I'd known you for years, Mr. MacPherson," she said. "We find that we need some advice and we've decided to ask you for it."

"I'm no Dorothy Dix to be giving advice to the love-lorn," replied the engineer cautiously.

Jean laughed with delight.

"He's cautious enough to suit even me, Jimmy," she said. "It's not that, Mr. MacPherson, it's something you'll be able to express an opinion on. Mr. Dale has offered to take the boat under the water and I'm crazy to go but I'm afraid to. I want to know whether you think it's perfectly safe."

"Well, Miss Gilmer, I don't know that I would say that much. There's an element of risk in all

boats, although I think they're safer than New York streets. However, if it will ease your mind any, I'd say that taking a dive in the *Loon* was about as safe as crossing the Hudson River on a ferry boat."

"I'll take that big a chance," laughed Jean. "All right, Jimmy, let's go down into the 'darkness and the depths.' But tell me first how you do it, won't you, please?"

"Surely. All we have to do is to shut the hatch to keep the water out, fill our diving tanks, set our diving

flippers to send us down and then go full speed ahead. When we have both our diving tanks filled we still have about two hundred pounds of excess buoyancy and we can't sink, although everything but our conning tower will be under water. To dive, we incline two flippers, or fins, that stick out on our sides at the stern end of the boat and start our propeller going. The pressure of the water on our diving flippers will send us right under. When we want to come up we just tilt the flippers the other way and keep going ahead and up we come. When we get to the surface, we blow the water out of our diving tanks with compressed air and the whole upper third of the boat comes up out



CAPTAIN S. P. MEEK, U. S. A.

of the water as it is now."

"We'll have to fill the auxiliary tank today, Mr. Dale," said MacPherson. "Ye'll remember that the air compressor motor has been taken out and lifted on board the *Albatross* for repairs. That gives us an extra three hundred and fifty pounds of lift and we'll be short five men in the crew, so we'll have about thirteen hundred and fifty pounds of excess buoyancy. We'll have to let about half a ton of water into the auxiliary tank to make her handle well."

"Right you are, Mac, I had forgotten about the compressor motor. Are the air tanks both full?"

"They're not full but we have over a thousand pounds pressure in each one, sir."

"That's more than enough to bring her up. Cast loose from the *Albatross*, Mac, and tell them we'll head due east. They are to follow along and pick us up in about ten minutes."

"Very well, sir."

As MacPherson climbed the hatchway ladder to carry out Dale's orders, Jean Gilmer turned to Jimmy, her face flushed.

STORIES dealing with adventures under the sea are none too common and possibly for that reason they are always welcome.

We remember so vividly the submarine disaster off the New England coast several years ago, when a score or so of brave sailors suffered all the agonies of slow suffocation when their submarine was trapped in the depths.

Captain Meek gives us a story of extraordinary adventure far beneath the sea's surface, and shows us how, when confronted with dire necessity, man's fertile brain tries to find a way out. Incidentally we may say that Captain Meek has purposely allowed a fundamental error in the science of the story. We invite our readers to detect this error and send us their opinions on it.

We will be very glad to print the best letters that we receive.

"Oh, Jimmy, I'm so excited!" she cried. "I never thought you'd *really* take me under when I said I'd like to go!"

"Anything to please you," he replied grinning; "I'm glad you didn't want something harder to supply. We'll be under in a few minutes. I expect you'll get quite a kick out of it. I did, the first time I went down."

"That was during the war, wasn't it?"

"Yes. I was in the submarine service then. That was when I really got interested in marine life. When I left the service I kept after dad until he had the *Loon* built for me. It's different from any other submarine in the world."

"In what way?"

"It's the safest submarine ever built. Being designed for laboratory work only, we don't have to bother with torpedo tubes as the war submarines do, and we could build her with a shape designed to resist crushing. We can safely go down to two hundred fathoms, that is, twelve hundred feet. The pressure there would crush most submarines. The *Albatross* is always with us, so we don't have to carry a lot of fuel oil and stuff like that. That makes her handle easily. One man can handle her without any trouble, as I told you. In addition to the usual safety devices, the hull is divided into six compartments by airtight bulkheads, so that if one were to be punctured we could shut it off from the rest of the boat."

"Would the boat sink if one compartment were to fill?"

"It would, but we have a means of overcoming that extra weight. Held to the bottom by electrically controlled catches, which can be operated from the inside of the boat, is a false keel made of lead which weighs six tons. If we were to ship any water in any way, we could drop that keel and get twelve thousand pounds of extra lift. Another peculiarity about this boat is that we are equipped for taking underwater pictures."

"How can you do that?"

"We have enormous floodlights that light up the water around us for quite a distance and we can photograph through the deadlights which are made of rock crystal. We have a complete photographic laboratory on board, dark room and everything."

An Accident

THE clang of the closing hatch interrupted his words and MacPherson climbed down the ladder.

"All clear above, sir," he reported.

"All right," replied Dale. "Fill the tanks."

As MacPherson turned to the valves controlling the tanks, Dale led the way up the ladder into the conning tower.

"Stand here," he directed, "and watch through this glass. You'll get quite a kick out of watching the water come at you and close over you."

"Tanks filling, sir," came MacPherson's voice.

"All right, Mac, I'll be right with you. Now Jean, I'm going down and set the diving flippers and start the motors. Watch the water, and in about forty seconds we'll be under."

He dropped down the ladder and the whirl of electric motors filled the interior of the submarine. Jean gave

a squeal of fright as the water rushed at the conning tower and Dale set the flippers at a sharp angle and drove the *Loon* under. Thirty feet below the surface he set the flippers to hold the boat on a level keel and leaving MacPherson on watch he joined Jean in the conning tower.

"Jimmy, are we under the water?" she demanded.

"We're thirty feet under."

"I can't believe it. Look at that deck out there; it's dry. If we were under water it should be dripping wet."

Dale laughed heartily.

"Where would the water drip to?" he asked. "Don't feel foolish, Jean, that's one thing that strikes almost everyone on their first dive. Come closer to the glass and look up."

Jean gave a cry of surprise as she did so.

"Why, Jimmy, I'm looking at the surface of the water, only it's up!"

"What you are looking at is the surface of the air. You are getting just the view that a fish gets when he looks up."

"It's marvelous. I don't see any fish. Aren't there any around here?"

"There are plenty, but you don't see them out of the deadlights of a moving submarine. They probably think it's a big fish and leave the neighborhood. If you want to see fish, you must go down to the bottom and lie there for a long while, and even then you don't always see them. If you go deep enough and turn on the floodlights, you can usually see some. Are you ready to go up?"

"Any time."

"All right, we'll go up. Stay where you are and I'll go down and set the flippers to bring her up."

As Jean watched, the surface came nearer and presently the conning tower emerged and Dale joined her again.

"Mac is blowing out the tanks," he reported. "I'll crack the hatch so that we can get some fresh air."

He seized a heavy mallet and struck the latch a sharp blow. It gave, and the hatch cover sprang open a few inches. He raised it by hand about half-way, and then a heavy spring came into play and swung it wide open. Dale climbed the ladder to the deck, but as his head and shoulders rose above the hatchway he gave a hoarse shout. Simultaneously the submarine shivered under a shock. There was a grating noise and the stern of the boat inclined downward so that Jean was thrown to one side of the conning tower. The boat rocked for a moment and Jean was drenched in a downrush of water. She looked up and saw the sea pouring in through the open hatch. Jimmy struck the floor beside her but he bounded to his feet and fought his way up against the rush of the water and grasped the hatch cover. Anything but the toughest steel would have shivered under the impact of the blow, but the cover held and Jimmy hammered the latch into place and dropped rapidly down the ladder.

"The tanks, Mac, quick!" he gasped, "blow them out!"

He glanced at the depth indicator and his face blanched. They were already sixty feet under the sur-

face and were sinking rapidly.

"I'll handle the air, Mac," he cried. "Start the motors and set the flippers for maximum lift."

The engineer hurried away, but came back in a moment with a white face.

"The motors are both watersoaked, sir," he reported. "They are short-circuited and they won't budge."

Dale glanced at the depth gage again.

"Three hundred and still sinking fast," he muttered. "There's only one thing to do, Mac. Drop the emergency keel!"

The engineer hesitated.

"If we do that, we will be out of control, Mr. Dale," he said.

"I know that, but we've got to spend weight. Man, we are at four hundred and still sinking. Drop the keel!"

"Very well, sir."

MacPherson pulled four switches on the control board and the downward motion ceased with a jerk. For an instant the depth indicator seemed to be standing still but the forward motion of the dial was slowly resumed and the boat sank with extreme slowness.

"Empty the trimming tanks, Mac!" cried Dale.

Trapped in the Depths

THE engineer turned other valves and the increase in the sound of the air hissing through pipes told that the small trimming tanks, forward and aft, were being emptied. Dale glanced again at the indicator and as he did so there was a slight shock and the needle stopped moving.

"We're on the bottom," he exclaimed, "six hundred and forty feet down. It's a good thing that the *Loon* is designed for such pressures."

"What happened to us, sir?" asked the engineer.

"We came up right under the *Albatross'* bow and she rammed us before she could change her course. Didn't you see her in the periscope?"

"Didn't you, sir? I didn't look. I thought you had made sure that all was clear before you told me to turn in the air."

"I thought *you* had looked. I guess neither of us did. Keep the air on, Mac, while I go see where Jean is."

Jean was still in the conning tower, white-faced but calm.

"What happened, Jimmy?" she asked in a small voice.

"The *Albatross* rammed us. We were in diving trim and she rode our stern under and forced us down until the water came in through the conning tower hatch. Are you hurt?"

"No, I'm not hurt, but I'm pretty wet. I was almost drowned by that water."

"Come below," said Jimmy, "and I'll see what I can dig up for you to wrap around you. We'll be up in a few minutes—I hope."

Something in the tone in which he spoke the last words alarmed Jean.

"What do you mean, Jimmy?" she cried, grasping him by the arm. "Are we still under water?"

"We're six hundred and forty feet down and resting on the bottom," he replied grimly. "Our motor is short-circuited by sea water. Mac is blowing out the tanks

now and I hope we have buoyancy enough to rise. If we haven't—"

He left the sentence unfinished. Jean Gilmer's face blanched at his words, but she bit her lip and tried to remain calm.

"If we haven't—" she echoed. "Oh Jimmy, do you mean that we may drown?"

"No danger of our drowning," he replied, "the blow wasn't hard enough to start our plates, but it may mean that we stay here longer than we wish. Don't worry about it yet, it will be several minutes before we can get all the tanks empty and we may be all right. We have dropped our emergency keel."

Below he found the white-faced MacPherson engaged in coupling the emergency air tank to the lines.

"What news, Mac?" he asked.

"None so good, sir. We have emptied both the main air tanks and we haven't got all the water out of the diving tanks, sir, not to mention the trimming tanks and the auxiliary tank. I am coupling on the emergency air tank now, sir."

Dale looked at the pressure gage on the side of the air tanks.

"Why, those tanks aren't empty," he exclaimed. "They still show nearly three hundred pounds per square inch."

"At six hundred and forty feet, the water pressure is about two hundred and eighty, Mr. Dale. An equilibrium must be reached, for the needles won't fall any further."

A rapid mental calculation assured Dale of the correctness of MacPherson's figures and he bent his energies to helping connect the emergency tank. When it was connected and the valve opened, he watched the needle. From its initial reading of two thousand pounds, it fell rapidly to twelve hundred and then a hiss of air made MacPherson close the valve rapidly.

"The trimming tanks are dry, sir," he said. "We'll turn her into the auxiliary tank."

The connection was soon made and again the needle fell. It moved rapidly down for a moment and then the motion slowed and at two hundred and eighty pounds, it stopped moving. Dale and MacPherson glanced at the depth indicator and then at one another.

"Is there anything else we can do, Mac?"

"I can't think of anything, Mr. Dale. Our compressor motor is on the *Albatross*, our driving motors which we might rig to the compressor are shorted and we can't use our Diesel engines under water, even if we had a motor to crank them with. It looks like the jig is up."

A slight grating sound came through the hull and the two glanced at one another.

"The tide is taking us along the bottom," said the engineer. "I hope it doesn't take us any deeper."

"If the tide can move us like that, Mac, we can't be many pounds overweight. We might try the hand pump."

"Against twenty atmospheres* of pressure? I'm afraid it wouldn't be much use, Mr. Dale."

"That's true, Mac, but it's the only thing I can think of."

* 280 pounds per square inch.

The two men went to the hand pump but the result was as the engineer had prophesied. The strength of two men was as nothing in trying to pump water against a pressure of two hundred and eighty pounds to the square inch. The pump brake was as immovable as a rock. They desisted after a time and Dale walked forward to the cabin where Jean sat, wrapped up in a blanket she had taken from a couch.

"Is your nerve good?" he asked abruptly.

The girl paled at the words but controlled herself with an effort.

"Is the news bad?" she asked.

"As bad as can be. We have used up all of our air and we are still on the bottom. Our motors are gone and we have no way to compress more air. It looks rather hopeless."

"What will happen to us, Jimmy? Shall we suffocate?"

"Possibly, but I rather doubt it. We have an air-purifying apparatus on board which should keep the air usable for three of us for nearly a month. What I am most afraid of is battery gas."

"What's that?"

A Faint Hope

WELL, you see, for underwater running when we can't use our Diesel engines, we depend on electric motors which are run from storage batteries. We have shipped a lot of sea water, and if any of it gets mixed up with the battery acid, the combination will form battery gas, or hydrochloric acid gas which is an irrespirable gas and very poisonous. It would kill us all off in a very few minutes. Aside from that, we are safe for a long time. We have plenty of food and water."

"Won't the *Albatross* send down divers and rescue us?"

"No diver could work at such a depth. His ribs would be crushed right in. They may try lowering grappling irons but they probably wouldn't find us even if the tide had left us alone. Do you hear that grating sound? Well, that's the tide moving us along the bottom. We may be half a mile from the place where we sunk. In fact, I would just as soon the *Albatross* didn't get a line on us."

"Why?"

"Because, if they raised one end of the boat, the sea-water would run down into the battery compartment and flood it and then it would be all off. I am hoping that something don't up-end us. Our batteries are a good three feet above water on both ends, but if we tilted—Of course the air-purifying apparatus will take care of some battery gas but if it's used up in absorbing it, we shall smother."

"Why should we smother, Jimmy? Excuse all the foolish questions that I am asking, but I don't know much about that sort of thing."

"Glad to have you ask. It takes my mind off things. You know that we breathe in oxygen and breathe out a gas called carbon dioxide?"

"Yes."

"Carbon dioxide is not in itself very poisonous, but when it becomes concentrated, as would happen with

three people using up oxygen and making carbon dioxide all the time, it may become quite a menace. In order to keep the air pure, it is kept circulating through the boat and on each trip it is forced through tanks of soda lime which absorbs the carbon dioxide. The lost oxygen is replaced from tanks which feed a small steady stream of oxygen into the air. But for this system, the air would become dead here in a few hours."

"Isn't there anything we can do?"

"Not much. We have a hand pump, but Mac and I couldn't budge it. You might come and give us a hand, if you like, and we'll all three try it, although I doubt whether there's much use."

They walked aft to the engine room and all three threw their weight on the pump brake, MacPherson and Dale straining until the muscles in their backs cracked, but they could not move it.

"If we can manage to lighten her a few pounds, we shall be all right," said the engineer. "I just got through measuring up the water we shipped, and if my calculations are correct, we lack only about ninety pounds of being in equilibrium."

"It might as well be nine thousand," replied Dale.

"I don't think so, Mr. Dale. I believe we can lighten her ninety pounds."

"How?" chorused Dale and Jean.

"The oxygen tanks."

Dale executed a highland fling and pounded the engineer on the back.

"You've done it, you old pirate!" he chortled. "Jean, didn't I tell you that he was the canniest Scot that ever came out of Edinborough?"

"Not so fast, Mr. Dale," exclaimed the engineer. "Remember, I guarantee nothing. Our oxygen tanks are only charged up to six hundred pounds pressure and they are pretty small. They may not do the trick and if we use the oxygen up for that, we won't have it to breathe."

Dale stopped his dance and looked solemn.

"That's right, Mac," he said. "I hadn't thought of that angle of it. Let me go over your figures."

"You'd better start at the beginning, Mr. Dale. I may have measured the water wrong."

Aided by the engineer, Dale carefully measured the depth of water in the submarine and calculated its weight. To this he added the known weight of the ship, less the emergency keel, the equipment, his own weight, MacPherson's and Jean's, and the weight of water remaining in the diving and auxiliary tanks as shown by the gages. From the total he subtracted the known displacement of the boat. The remaining figure was ninety-six pounds.

"That is within eight pounds of my figures," said MacPherson when Dale announced his result. "Shall we try it?"

"I don't know," replied Dale. "Let's leave it up to Miss Gilmer. Jean, what do you say? Shall we pour our oxygen into the tanks and try to rise or shall we not? If we succeed, it means safety. If we fail, it means a quicker death."

"Whatever you think, Jimmy. Personally, I would as soon die quickly trying to escape, as to linger on, knowing there was no hope."

"We'll try it, Mac!" decided Dale. "Shut off the oxygen and we'll turn the tanks into the air line. If we can raise her six feet we're saved."

"I don't follow that reasoning, Mr. Dale."

"There is still two hundred and eighty pounds of air in the tanks. Every foot we raise her reduces the external pressure nearly half a pound per square inch. Once we get up a little, the tanks will blow out more water and raise us still more and so it will go."

"I hadn't thought of that, but it's true. Well, here goes!"

The Monster of the Depths

MACPHERSON shut off the oxygen tanks which were pouring their life-giving contents into the atmosphere and by dint of an hour of hard labor they were connected to the air lines. Their valves were opened and with pounding hearts the three watched the depth indicator. The pressure on the oxygen tanks fell to two hundred and eighty pounds but the depth indicator did not move.

"We've failed!" exclaimed Dale bitterly. "This is the end!"

"Hark!" replied MacPherson, "The grating has stopped!"

The grating sound that the submarine had made dragging along the bottom ceased. Dale ran up to the conning tower and turned on his floodlights. The submarine was floating a few feet from the bottom. He gave a shout of joy which died even as he uttered it. The boat was over a dip in the ocean bed and had not risen an inch. Instead, it was slowly sinking.

"We are almost in a state of equilibrium," he reported when he returned. "Even ten pounds might make the difference between life and death to us. Think, everybody!"

Another assault on the hand pump proved the futility of hope of escape through that avenue, and a dull apathy of hopelessness settled over the ship. The depth indicator registered six hundred and fifty-five feet when a slight jar told them that they had again touched bottom. Hardly had they touched than a sudden lurch of the craft nearly threw them to the floor.

"Now what?" exclaimed MacPherson.

As he spoke the forward end of the submarine lifted and there was a rush of sea-water toward the after battery compartment.

"Quick, Mac, the bulkheads!" cried Dale as he half slid and half scrambled down the floor of the submarine. MacPherson was by his side and they slammed and latched the door of the watertight bulkhead which separated the after battery compartment and the engine room from the rest of the craft, just as a slight smell of hydrochloric acid gas began to permeate the atmosphere. Jean was taken with a sudden fit of coughing.

"Wet a towel and hold it over your nose!" shouted Dale as he set the example with a handkerchief. "The air purifier will take this much out in a moment."

He scrambled up the slope and closed the door leading to the forward battery compartment just as the submarine began to tilt in the opposite direction.

"What's happening, Jimmy?" asked Jean between coughs.

"A big cephalopod, I fancy," he replied. "We've been attacked by them before. Come up into the conning tower and we'll turn on the lights and see what it is."

He turned on the flood lights and Jean cried out and shrank back against him at the sight which met her gaze. The beast had found the ship and had wrapped four of its fifty-foot tentacles about it and was dragging it along the bottom. Huge eyes glared in through the conning tower deadlights and Jean cried out again in fright. Dale laughed.

"Don't worry about that brute, Jean," he said. "He can't do us a bit of harm and this boat is built so that we can give him a right unpleasant little surprise. Oh, Mac! Rig up the tickler!"

"All right, Mr. Dale," replied the engineer with a chuckle.

"Now watch the fun, Jean," said Dale. "Do you see all those little studs on the outside of the boat? Well, they are electrically insulated from the main hull. Mac is now rigging one terminal of our batteries to the studs and grounding the other terminal on the hull. When he turns on the juice, that fellow will get the surprise of his life."

"I thought the batteries would be ruined by the salt water."

"The after ones may be, but the bank in the forward compartment is all right. They are swung in cradles and will take a forty-five degree tilt without spilling. Terminals come from each compartment to the control board."

"All ready, Mr. Dale!" came MacPherson's voice.

"Tickle him a little."

A sudden tremor shook the boat and the squid released his hold for an instant and backed away. Cautiously he came toward it again.

"Off, Mac!" cried Dale.

The fish made a sudden rush and whipped all eight of the tentacles about the craft. His hard horny beak rang ineffectually on the steel hull and Dale laughed as Jean shuddered again.

"Give him the works, Mac!" he cried.

MacPherson closed a switch and the submarine was jerked through the water by the struggles of the fish. Again the monster released his hold and drew back. The water suddenly grew inky black.

"He has shot his ink at us," explained Dale. "He's good and mad now and he'll grab us in earnest in a minute."

The submarine shivered again as the giant cephalopod attacked, but the electric current was too much and the boat was again released. The inky blackness began to clear. Four more times the beast rushed the submarine, each time more cautiously, and finally gave it up as a bad job. Rather weakly it drew away from the ship.

"Turn off the current, Mac," called Dale. "Our friend has had enough."

"What are all those little bubbles that are rising from the sides of the boat, Jimmy?" asked Jean.

"Hydrogen and chlorine gas," he replied. "Sea-water is an electric conductor, you know, and the current is breaking down the salt into the gases you see."

"Hydrogen gas is what they fill balloons with, isn't it?"

"Yes, it's the lightest gas known. It has more lifting power than helium, the other gas used, but it's rather dangerous because it is highly inflammable."

"If we could just get some of that gas inside the boat, we could rise like a balloon," she said with a smile.

"Good girl!" exclaimed Dale. "Keep up your spirits. There's no use in crying about it and we may win out yet. I'm sorry to have to turn down your suggestion, but there's no hydrogen on board. Let's go down."

An Ingenious Plan

THEY rejoined MacPherson and he laughed as Dale described the struggles of the octopus.

"We have had to tickle several of them, Miss Gilmer," he said. "The whole crew like to have one get hold of us and they all crowd into the conning tower to watch the fun. Our forward batteries are all right, Mr. Dale, but I couldn't get much out of the after compartment."

"All we want them for is light," replied Dale, "and the forward set will do us for as long as we'll want any light. Batteries are rather valueless with wet motors. Mac, is there any chance of drying those motors out?"

"I had thought of rigging a blower on one of them, Mr. Dale, but the air in this boat is saturated with moisture and it wouldn't dry anything. I think that if we had some sulphuric acid, we might be able to dry the air enough to do some good, but there is only about half a pint of concentrated acid on board and dilute would be worthless."

"Sulphuric acid? We might get a little of the hydrogen Jean was wishing we had by mixing it with zinc, if we had some zinc," said Dale quizzically.

"It's not hydrogen that I'm worrying about," replied MacPherson, "it's oxygen. We have precious little of that left."

"We could use both," answered Dale. "Let me think a while and see if I can't figure out a way to supply us with some oxygen. We haven't any chlorate on board."

He sat with his brow wrinkled in thought. Suddenly the two watchers saw an expression, first of inspiration, second of unbelief, and last of joy, race across his face. With a shout he leaped to his feet.

"Eureka!" he shouted. "Eureka and likewise three rousing cheers! Ladies and gentlemen, rise and make your bows to little Jimmy. We are saved!"

"How? What? Why?" they showered questions at him.

"First, Mac, will you please kick me for not thinking of it sooner? Next congratulate yourself and Jean on giving me the idea. Mac, in ten minutes we'll have all the oxygen you can ask for and in a few hours we will be at the surface."

"Mr. Dale, are you serious?"

"I was never more so in my life. Mac, you wanted oxygen, and Jean, you wanted hydrogen. Here they are, thousands of cubic feet of each of them here at our feet."

"Where?"

"The water. H_2O ."

"How do you mean to get it in usable form?"

"Mac, you are unusually dense. Every time we have shot the juice to a squid, you have seen bubbles rising from the sides of the ship and yet you fail to connect

it up with our need. We have water, we have sulphuric acid, the best of all electrolytes—and we have batteries. What more do we need? We will break down the water by electrolysis and get the two gases we need."

"If you try to electrolyze sea-water, won't you get chlorine gas?"

"Of course, but I'm not going to do it. We have a couple of hundred gallons of drinking water on hand and we'll use some of that. Get a granite bucket of fresh water and dump your half pint of sulphuric acid into it while I dig up a couple of electrodes."

He hurried into the laboratory and came out with two sheets of platinum gauze in his hand.

"This is just what we need," he cried exultingly. "I built better than I knew when I had a small laboratory put in here. Connect your batteries in series, Mac, and bring the leads to the bucket."

MacPherson made the connections and brought the leads to Dale, who attached one of the pieces of platinum gauze to each of them and then immersed the two in the bucket of acid and water. A string of bubbles began to come from each of the terminals.

"Which is which, Jimmy?" asked Jean as she bent over the bucket.

"This is the oxygen and this is the hydrogen," he replied with a glance at the control board. You see, when sulphuric acid, H_2SO_4 , is mixed with water, it breaks up into what are known as ions, and from these ions we get hydrogen and oxygen gases.

"I see. And we can breathe that oxygen?"

"Certainly. It is just the same as any other oxygen. We can breathe the hydrogen also; it does us no good but it is just like the nitrogen of the air, it dilutes the oxygen and does us no harm."

"I understand all that, Mr. Dale," interrupted MacPherson, "but what I don't yet see is how this is going to help to raise the boat."

"Mac, you are unusually dense today. Let us consider the matter for a moment. What's the cubic capacity of this boat?"

"Nine thousand eight hundred and sixty-three cubic feet," replied the engineer promptly.

"Correct. Let's call it ten thousand. We have about us ten thousand cubic feet of air, weighing about seven hundred and ninety pounds. Of this weight, about one hundred and seventy-six pounds, or two thousand cubic feet, is oxygen. This oxygen we are continually breathing in and changing in our lungs to carbon dioxide, which is absorbed by our soda lime. This lost oxygen is being replaced from the rapidly diminishing supply in our tanks. We will now shut off the flow from the tanks and depend on the electrolysis of water to supply our needs. Let's see what happens.

"We are replacing this oxygen by a mixture of one part of oxygen to two parts of hydrogen, by volume. Where oxygen weighs about .088 pounds per cubic foot, hydrogen weighs only about .006 pounds per cubic foot. Every time we put into the air from our electrolyzing apparatus one hundred and fifty cubic feet of this mixture, we are replacing one hundred cubic feet of oxygen weighing 8.8 pounds by one hundred cubic feet of hydrogen weighing but 0.6 pounds, a clear gain of eight

and one-fifth pounds. Do you see that?"

"Yes, but what effect is this shortage of oxygen going to have on us?"

"No appreciable effect. It is not lack of oxygen that kills in most cases of suffocation, it is excess of carbon dioxide, a substance which we are constantly removing with our soda lime tanks instead of allowing it to accumulate. We may have to breathe a little faster and even avoid over-exertion but we will live with a good deal less than twenty per cent of oxygen in the air. If we replace just one per cent of it, one hundred cubic feet, we will gain over eight pounds. If we go to what I imagine is about the physiological limit and replace half the oxygen with hydrogen, we will gain eighty-eight pounds, more than enough to start us for the surface, and once started, as I told you before, we are safe."

"How much water will that take?"

"To produce six-tenths of a pound of hydrogen, we will have to electrolyze about 4.95 pounds of water, about two and one-half quarts. This will yield, besides the hydrogen, about four and one-third pounds of oxygen which we will have to get rid of by breathing."

"Will that take long?"

"Quite a while. This is not going to be a fast process, but it will get us there in time."

Success!

MACPHERSON got up and gravely took off his hat to Dale.

"Mr. Dale," he said, "my hat's off to you, sir. I can run an engine or a motor, but when it comes to stuff like this, I'm lost. What am I to do now?"

"Nothing. There's nothing that anyone can do now except wait."

Two hours passed. Jean suddenly sat up on the couch on which she had been reclining.

"Jimmy," she said, "I feel as if my heart was going to burst."

"So do I," he replied. "No wonder," he went on, as he glanced at the barometer, "the pressure is up to 31.5 inches. I'll have to stop the electrolysis. We are pumping gas into the air faster than we can use up oxygen."

He removed the electrode from the water.

"Isn't there some way of getting rid of that oxygen faster than breathing it up, Mr. Dale? I know a fire will take oxygen out of a room, why can't we burn some paper or something?"

"Man, you'd blow us into Kingdom Come," replied Dale. "Hydrogen and oxygen mixed makes one of the most explosive mixtures in the world. There ought to be some way of removing that oxygen safely though. Let me take a look around."

He walked into the laboratory and emerged in a few minutes with a whoop of joy, carrying a large tin can under his arm.

"What is it, Jimmy?" asked Jean.

"Pyrogallic acid," he chortled. "We use it in photographic developing. When this stuff is made into a solution it absorbs oxygen to beat the dickens. I'll make up a solution of it and shake it. The solution will turn brown and the pressure will fall. Watch the barometer!"

He made up a solution of the pyrogallic acid and shook it vigorously. The solution turned brown as he had predicted, and he hastened the reaction by pouring the solution from one bucket to another through the air. As he worked the barometer gradually fell back toward its former reading of thirty inches. He again immersed the electrodes in the sulphuric acid solution and continued pouring the pyrogallic acid from one bucket to another.

"I expect that the acid is about saturated with oxygen," he remarked as he glanced at the barometer. "I'll make up a fresh batch in a moment. Watch the barometer when—"

A whoop of joy from MacPherson interrupted him.

"Damn the barometer!" cried the engineer. "Look at the depth indicator!"

Dale whirled and looked at the instrument. It registered six hundred and forty-five feet and as he watched, the needle moved. It moved as slowly as the minute hand of a clock, but it undeniably moved toward a lower reading. Dale snatched Jean off the couch and whirled her around the boat in a wild dance, MacPherson joining in and enlivening the proceedings with wild war-whoops. Foot by foot the needle's reading rose, and Dale stepped to the light switch and snapped off the lights. For a moment they could see nothing in the sudden darkness, but another war-whoop from MacPherson announced that he could see daylight above. The depth indicator read seventy feet and the upward movement was quite perceptible. Presently the motion stopped.

"What now?" cried the engineer.

"The top of the conning tower must be awash," replied Jimmy. "Let's get on the hand pump."

The two men hurried to the pump and found to their joy that they could move it readily. With long rhythmic strokes they started to drive the water from the interior of the submarine, and the conning tower rose above the waves.

"Get to the periscope, Mac, and tell me if she's clear this time before I crack the hatch!" exclaimed Dale.

"All clear, sir," reported the engineer. "The *Albatross* is about a mile due south."

A quick blow of the mallet opened the hatch and Dale stepped out onto the deck. A quick glance around and he called down the hatchway.

"Say, Mac, pass me up a towel or something white, will you? I want to signal the *Albatross*."

"I'll come up and signal, Mr. Dale," replied the engineer. "You'd better come below. Miss Gilmer has fainted!"