HAROLD E. EDGERTON

PAPERS

MC 25

Series III

Laboratory Notebooks

Number —

Dated August 4, 1952 to Oct. 19, 1952

Book No.
August 4, 1952

Massachusetts Institute of Technology

COMPUTATION BOOK

NAME	Number
HAROLD E. EDGERTON	

Course UNDERWATER PHOTOGRAPHY.

Used from AUGUST 4 1952, to Oct. 19 1952.

Notebook # Aug. 4, 1952 - Oct. 19, 1952

Filming and Separation Record

____ unmounted photograph(s)

1 negative strip(s)

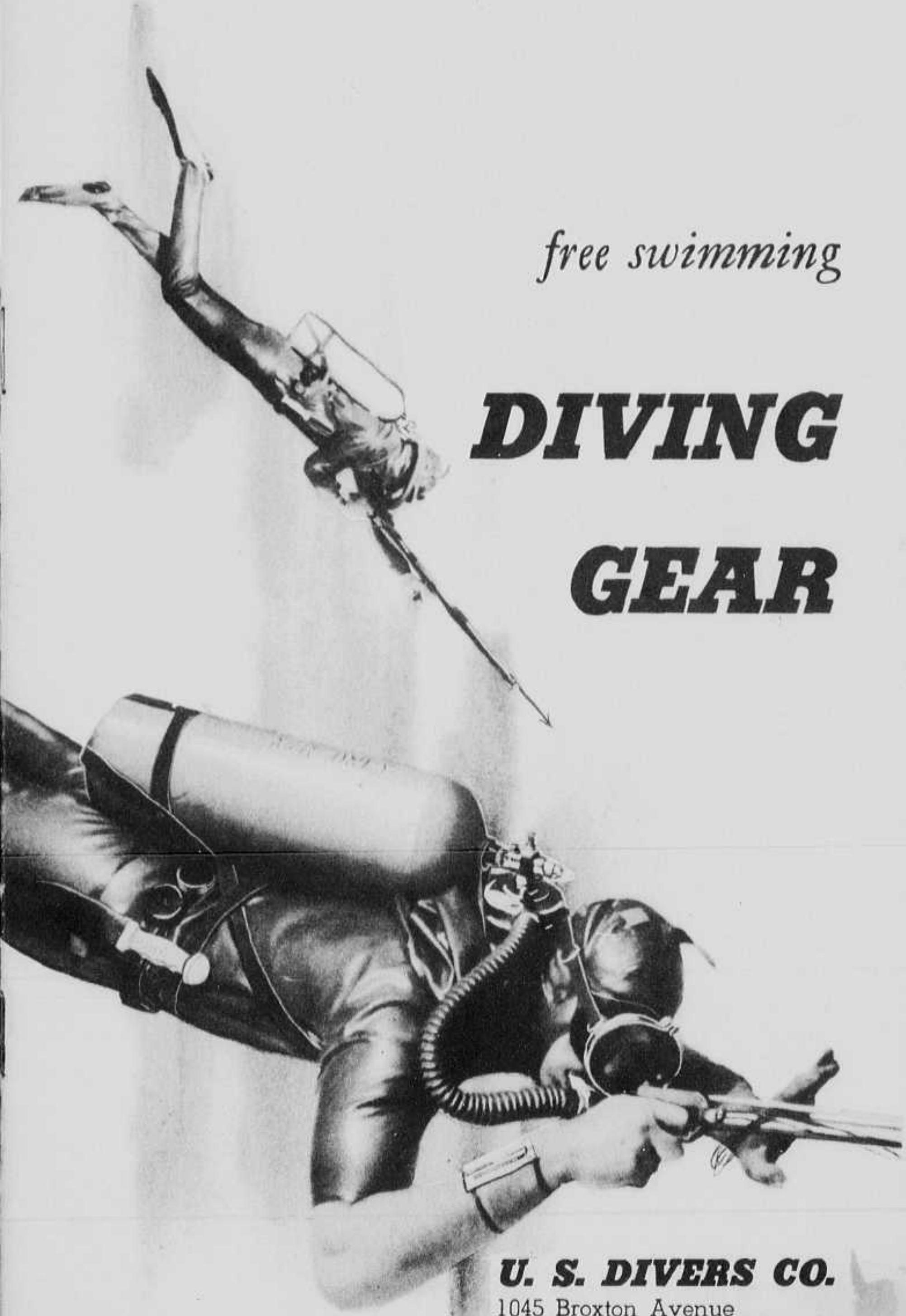
2 pamphlets unmounted page(s) 16-page pamphlet and
(notes, drawings, letters, etc.) 24-page pamphlet.

was/were filmed where originally located between page ____ and ____.
inside front cover

Item(s) now housed in accompanying folder.

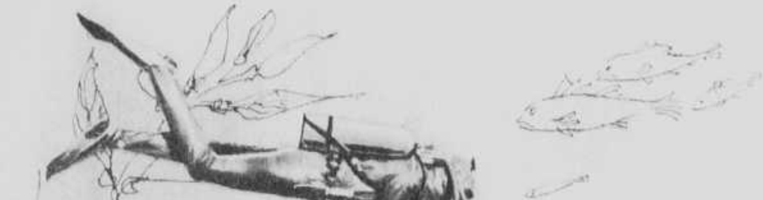
free swimming

DIVING GEAR



U. S. DIVERS CO.

1045 Broxton Avenue
W. Los Angeles 24, Calif.
ARizona 9-8750 • BRadshaw 2-1596



THE AQUA-LUNG

Until the invention of the Aqua-Lung, only highly trained specialists could explore the underwater world. This was an expensive venture, full of risks.

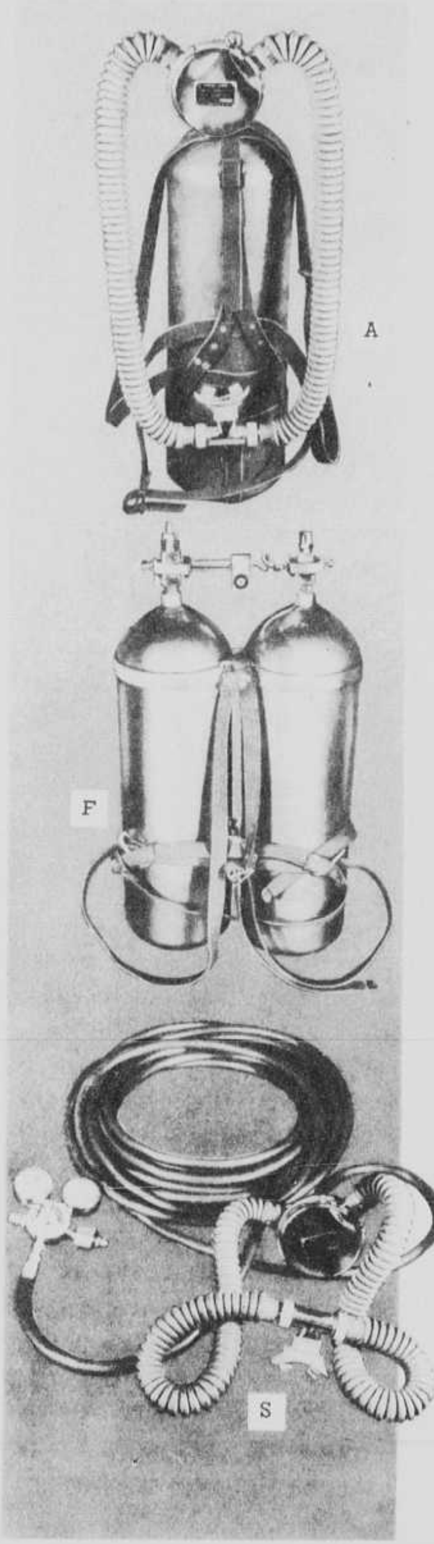
Now, thanks to this self-contained diving unit, any swimmer can dive among the wonders of the deep without training, below 100 feet and up to one hour, unhampered by hoses or lines.

No chemicals involved; no adjustments necessary.

The automatic demand regulator releases air only as needed at a pressure identical to that of surrounding water, irrespective of depth. This explains why the Aqua-Lung diver has no problem with his ears; the ear-drums, being exposed to equal pressures (water outside, air inside), will remain in a neutral state, free of pain.

The Aqua-Lung has been used for seven years without casualties; it is standard equipment in the French, British and U. S. Navies, at the Universities of California, Washington, Wisconsin, Stanford, and Southern California, Pomona College, Pacific Oceanic Fishery Investigations, Fish & Wildlife Service, U. S. Dept. of the Interior, Bureau of Reclamation, Scripps Institute, American Red Cross, shipping companies, harbor commissions, life guards, 20th Century-Fox Film Corp. (as in their masterpiece, "The Frogmen"). The Aqua-Lung is also successfully used by thousands of yachtsmen and sport fishermen.

The Aqua-Lung is popular-priced, uses only compressed air (available almost anywhere), is foolproof and needs little maintenance. It is not bulky and requires no helper. Just slip on the harness and swim down. The Aqua-Lung is weightless due to its buoyancy in water.



All Aqua-Lung models (A, B and C) feature an air demand regulator (D) manufactured according to the patented Cousteau-Gagnan principle.

STANDARD MODEL A (D+H+J+LA) features:

a large-capacity tank holding up to 70 cu. ft.,

a riveted harness made of strong webbing and brass hardware,

an air reserve device, built into the tank neck valve, which gives a 5-minute warning before the air supply is exhausted, allowing the diver to return without haste.

Average diving time: one hour. **150.00**

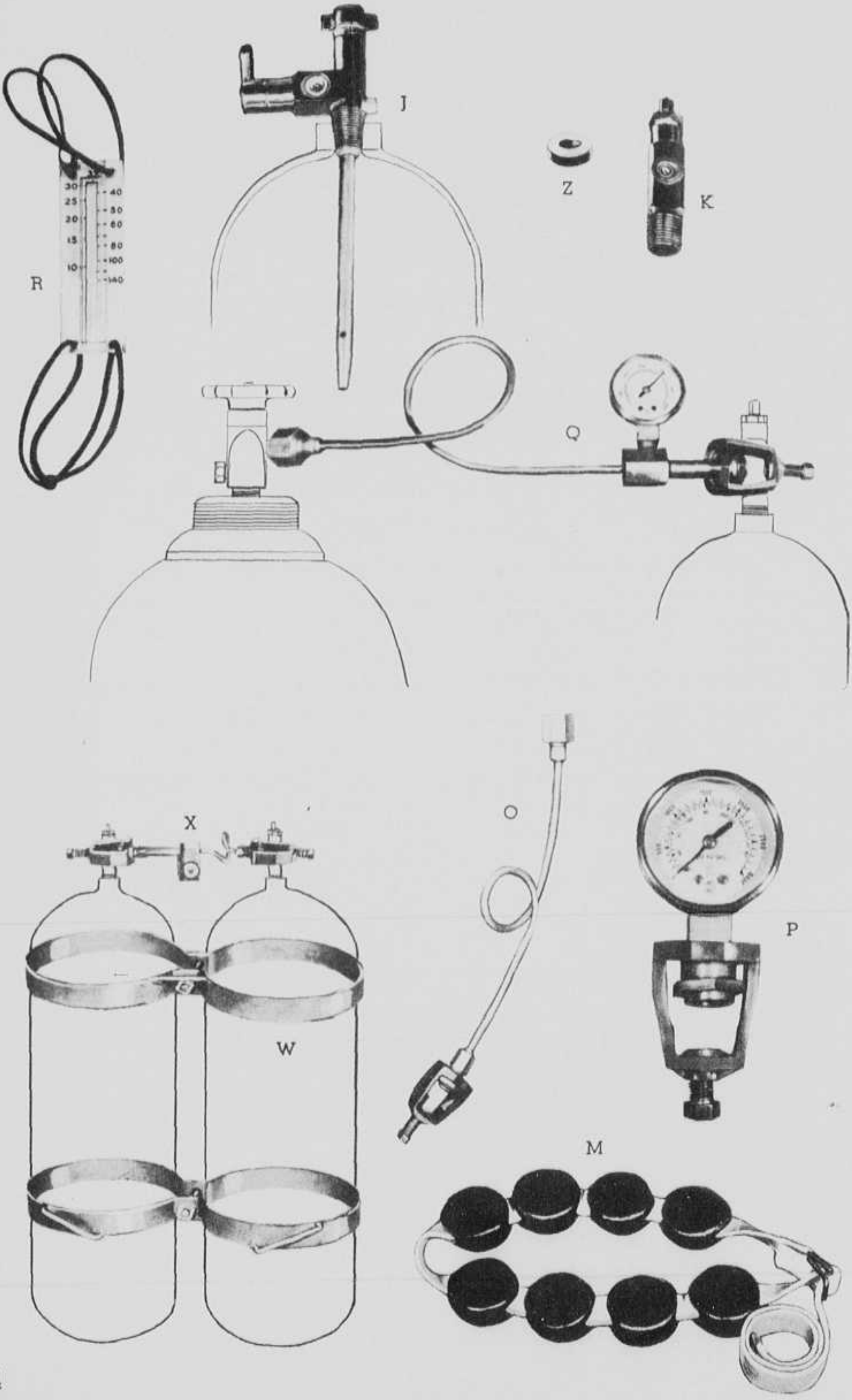
NAVY-TYPE MODEL B
(D+2H+J+K+LB+X+W)
has same features as A but carries a 2-tank block (140 cu. ft.). Due to its ingenious construction, it can be knocked down into two single tanks at will.

Average diving time: two hours. **275.00**

JUNIOR MODEL C (D+I+K+LC) features a smaller (38 cu. ft.) tank, lighter harness with japanned steel hardware, and no safety air reserve warning. Designed for shallow water use (to 35 ft.).

Diving time: up to one-half hour. **100.00**

HOOKAH MODEL S (DS+T+U), made so that the regulator only is strapped to the back of the diver. The air supply is fed through an air hose from large tanks or a small 150-pound compressor. Designed for work in limited areas during long periods of time, or where high-pressure compressed air is not available. **127.50**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AQUA-LUNG PARTS

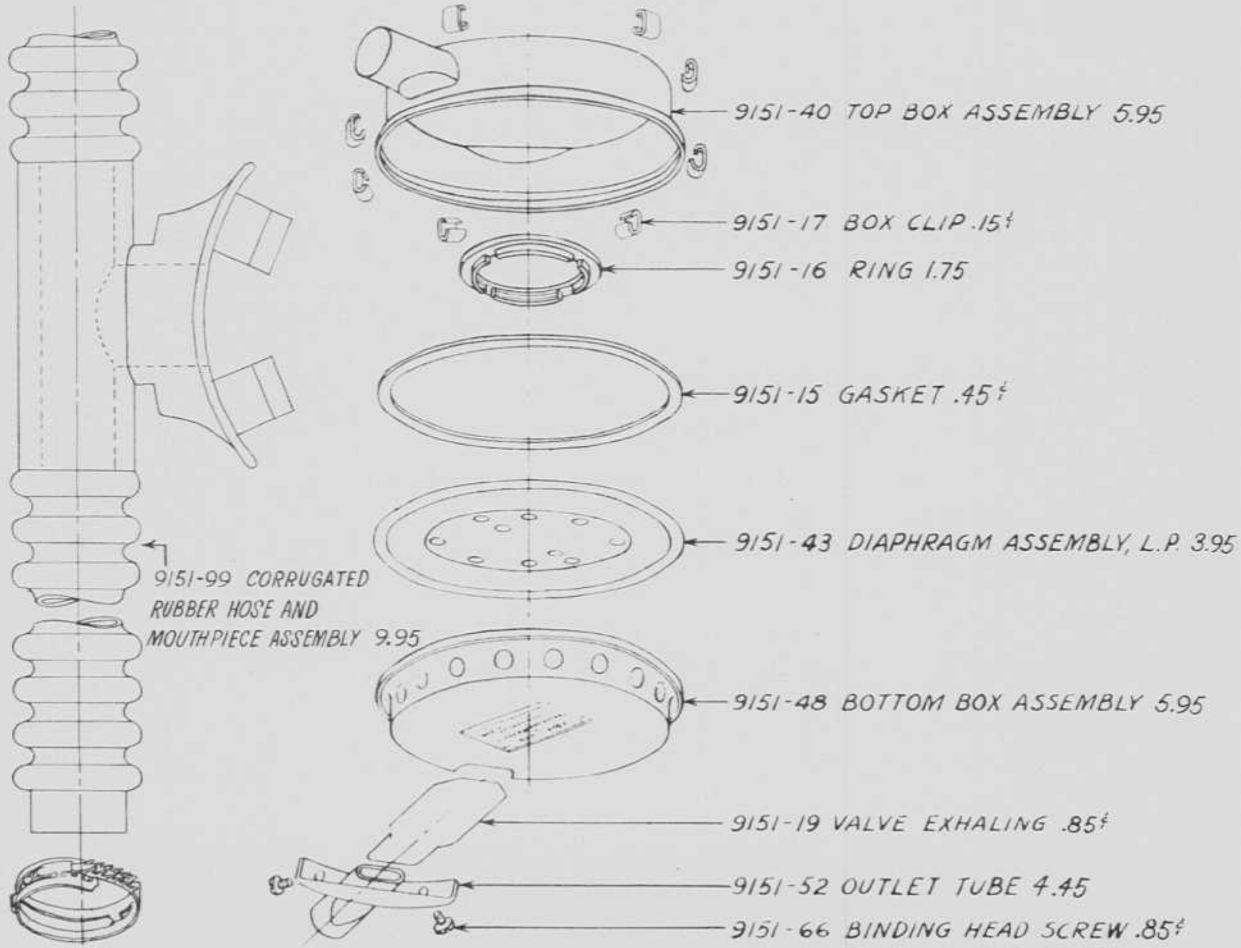
All component parts of the Aqua-Lung can be purchased separately:

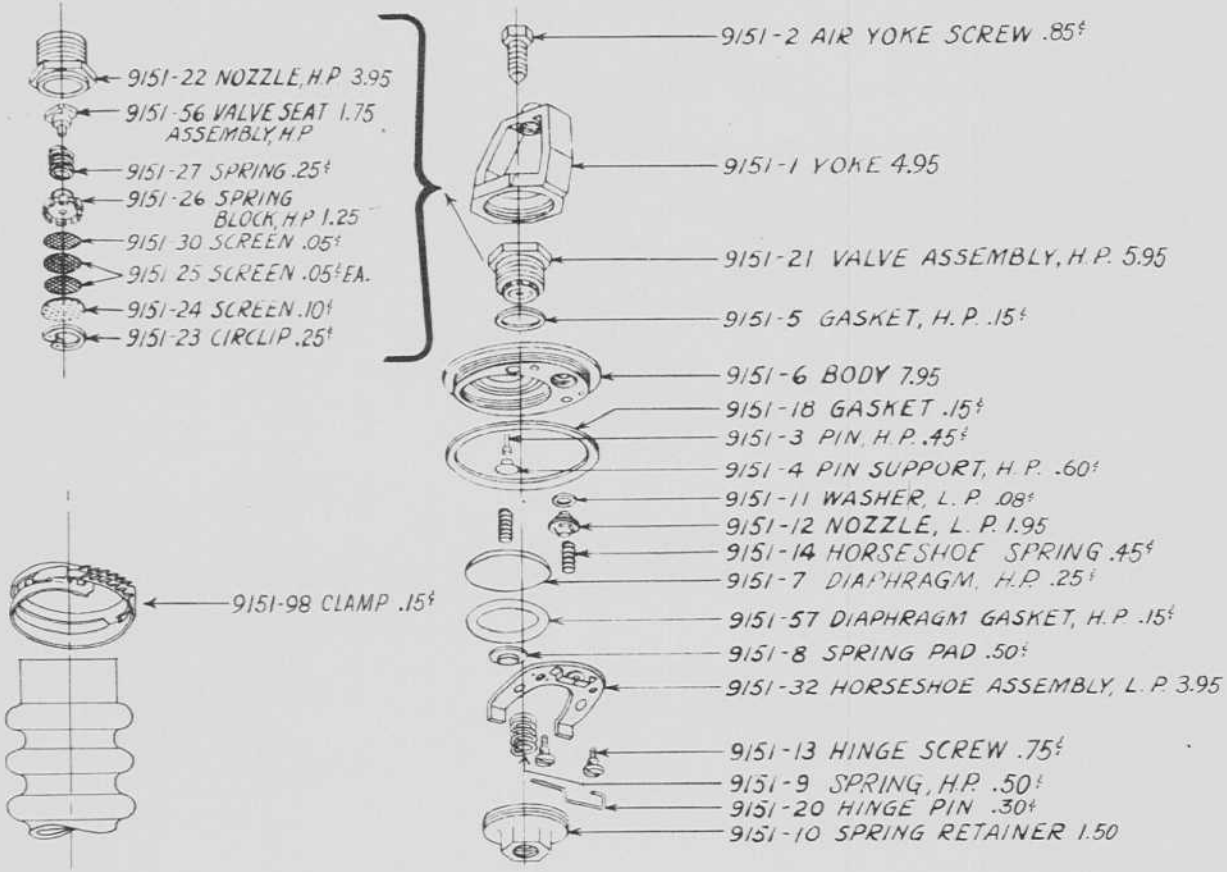
(D)	Aqua-Lung Regulator, complete with hoses and mouthpiece	**75.00**
(E)	Spare Standard Tank Block (H+J+LA) .	**75.00**
(F)	Spare Double-Tank Block (2H+J+K+LB+W+X)	**200.00**
(G)	Spare Junior Tank Block (I+K+LC) . . .	**40.00**
(J)	Standard Tank Valve with air reserve .	**25.00**
(K)	Junior Tank Valve without reserve . .	**7.50**
(LA)	Standard Tank Harness	**9.95**
(LB)	Double-Tank Harness	**8.95**
(LC)	Junior Tank Harness	**7.95**
(H)	Standard Tank, bare, parkerized, tested .	**40.00**
(I)	Junior Tank, bare, painted, tested . . .	**22.50**
(W)	Set of metal bands to fasten two tanks together, with bolts and nuts	**17.50**
(X)	Removable Yoke to mount regulator on double-tank block	**25.00**
(DS)	Hookah Regulator, with hoses, mouthpiece and harness	**75.00**
(T)	Air Supply Output Pressure Regulator, for Hookah, with input and output gauges .	**30.00**
(U)	Hookah Air Hose, 50-ft. length	**27.50**
(V)	Hookah Air Hose, 100-ft. length	**50.00**
(Y)	"Self-Contained Diving" booklet	**.95**
(Z)	Tank Valve Teflon Washer	**.30**

The following accessories are not included with either (A), (B) or (C), and their choice is left to the needs and discrimination of the diver:

(O)	Filler Attachment, to connect the Aqua-Lung to any standard compressed air supply fitting	**12.50**
(P)	Pressure Gauge, to indicate tank content before or after diving	**12.50**
(Q)	Combination Filler and Gauge (O and P), to permit simultaneous refilling and pressure reading	**20.00**
(M)	Weight Belt, adjustable to 8 pounds, advisable to offset the buoyancy of the Aqua-Lung. Effortless descents mean air saving, thus longer dives	**6.00**
(N)	Additional One-Pound Weight Piece . .	**.75**
(R)	Depth Gauge, wrist type, for exact reading of diving depth down to 140 feet	**3.50**

THE AQUA-LUNG REGULATOR





Cleaning and resetting of regulator, 10.00, plus parts if needed.

1102

1101

THE FROGMAN SUIT

Originated on the West Coast, this cold-water suit is the final development of countless experiments in the cold Pacific, for year-round Aqua-Lung and skin-diving enjoyment.

Made of pure-gum rubber, it keeps the diver warm and dry indefinitely, while retaining 100% maneuverability. Note exhaust valve to drain off trapped air and avoid buoyancy.

Easy to put on and take off, through the extra-large back-entry chute. **Available in four styles:**

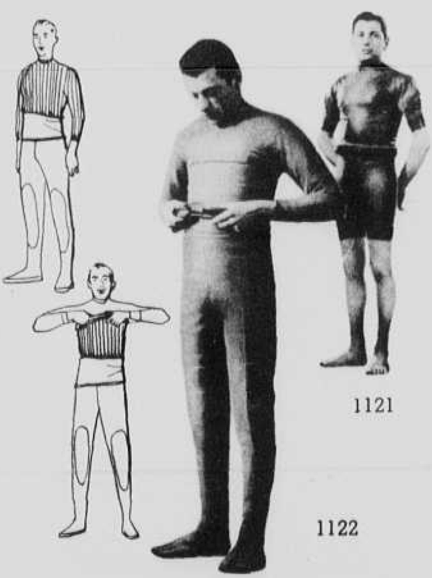
#1101—short legs and arms for water above 55°F . **42.50**
#1102—long arms, legs and boots for water below 55°F **54.50**
#1103—like #1101, but no hood **32.50**
#1104—like #1102, but no hood or boots **39.50**

While rubber keeps the diver dry, warmth is derived only from heavy underwear which builds up air insulation:

#1111—Extra heavy "Alaska" underwear for short suit **14.95**
#1112—Extra heavy "Alaska" underwear for long suit **17.95**

When ordering, be sure to include the following measurements: Weight, height, waist, chest, shoe size, length of arm (armpit to inside wrist), length of leg (crotch to floor), circumference of arm (2" above elbow), circumference of leg (4" above knee), circumference of wrist.

#1131—Hydrous silicate of magnesia; sprinkle on both sides of suit for better preservation of rubber . . . per can **.60**



1121

1122

THE PIRELLI SUIT

The only 2-piece suit available; enables the diver to get in and out without help. Used by the Italian Navy, and made by the most famous European rubber manufacturer. All vulnerable parts (knees, elbows, etc.) are reinforced, all seams vulcanized. Beautifully tailored in three sizes. Indicate height when ordering.

#1121—short arms and legs **47.50**

#1122—long arms and legs with feet **60.00**

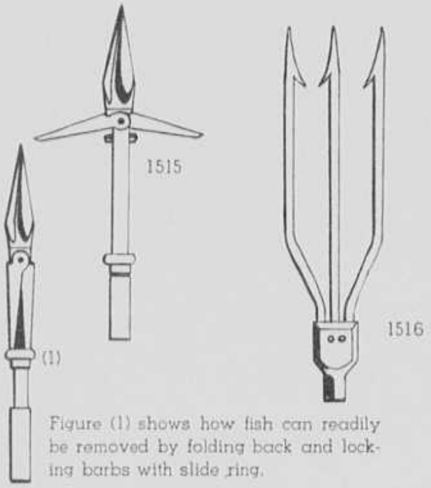
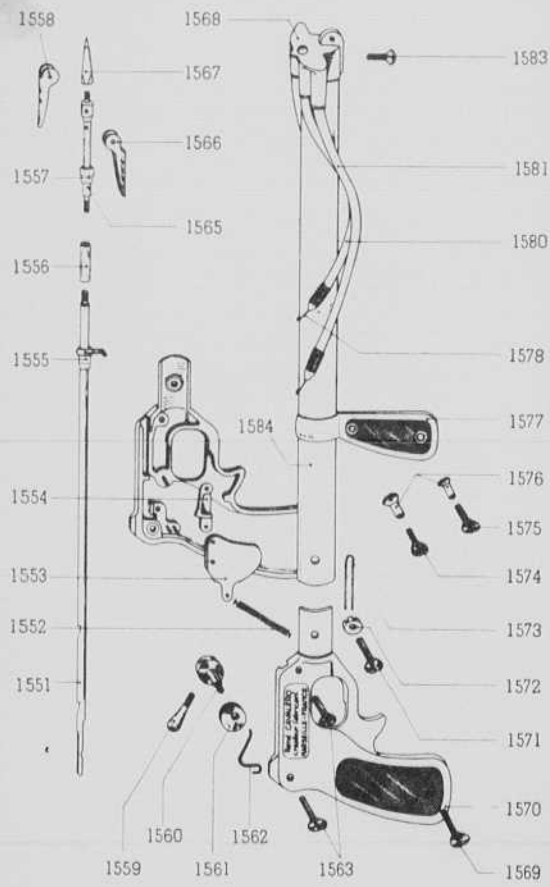
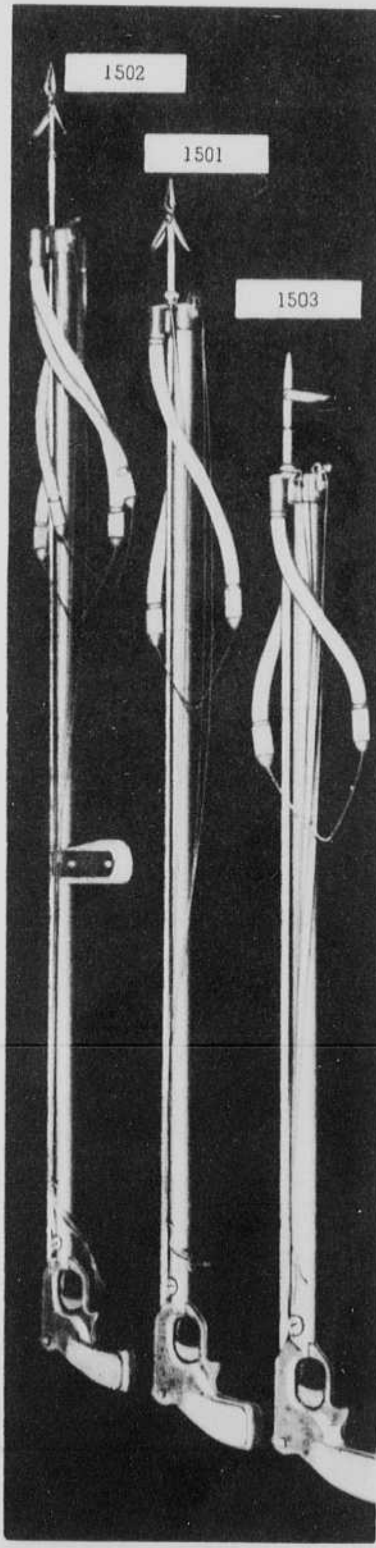


Figure (1) shows how fish can readily be removed by folding back and locking barbs with slide ring.





SPEAR GUNS

The Arbalete Crossbow, imported from France, remains the most efficient underwater spear gun yet developed. This popular-priced weapon has won, here and abroad, almost every competition during the past four years (such as the 1951 Laguna Beach International Spearfishing Championship in which the three members of the winning team, the Southern California Skin Divers, used the Arbalete, and such as the 1951-52 Southern California Midwinter Skin-Diving Derby in which the first-prize catch and 80% of all other prize-winning catches were made with the aid of an Arbalete, etc.).

Scientifically balanced to be weightless under water, the Arbalete is effortless to handle; even when held at arm's length for extra reach, the muzzle will not tip up or down. The ocean-blue dull finish blends with the water and does not scare the fish.

All Arbaletes are rubber-powered, thus giving the following advantages over spring and CO_2 guns: no mechanical parts to maintain, no rust to fight, can be reloaded easily under water, at no cost. Further, spring and CO_2 guns are noisy and scare fish, whereas the Arbalete is completely silent.

The Arbalete features a safety catch; the spear is attached to the gun by means of a braided nylon line. Note that the Arbalete is the only gun which, once the spear has been released, cannot be lost, as it would then float back to the surface.

#1501 **"Standard" Arbalete** (1 set of elastics), practical range: 14 feet (free spear: 35 feet) **25.00**

#1502 **"DeLuxe" Arbalete** (2 sets of elastics), practical range: 20 feet (free spear: 50 feet) **35.00**

#1503 **"Junior"** (small size for boys and women) **22.50**

Spare Parts:

#1511	Standard Spear, complete	**4.95**
#1512	DeLuxe Spear, complete	**5.25**
#1513	Junior Spear, complete	**3.95**
#1514	1-barb Spearpoint	**1.30**
#1515	2-barb Spearpoint	**2.95**
#1516	3-prong Spearpoint	**2.25**
#1517	4-prong Spearpoint	**2.50**
#1526	Braided Nylon Line (15 ft.) 400 LB. test	**.75**
#1551	bare spear shaft	
	a) Standard	**2.30**
	b) DeLuxe	**2.60**
	c) Junior	**2.20**
#1552	trigger spring	**.25**
#1553	trigger	**.75**
#1554	bronze sear	**.50**
#1555	slide ring	**.45**
#1556	connecting bushing	**.30**
#1557	barb ring	**.15**
#1558	outer stainless barb	**.25**
#1559	safety lever	**.10**
#1560	safety body	**.25**
#1561	safety eccentric disc	**.15**
#1562	safety spring	**.25**
#1563	top grip screw	**.15**
#1565	2-barb spearpoint body	**.75**
#1566	inner stainless barb	**.25**
#1567	spearpoint tip	**.95**
#1568	muzzle	
	a) 2-elastic	**2.95**
	b) 4-elastic	**3.95**
#1569	bottom grip screw	**.15**
#1570	complete grip	**9.95**
#1571	clamp screw	**.15**
#1572	clamp ring	**.20**
#1573	spring clamp	**.20**
#1574	center grip top screw	**.15**
#1575	center grip bottom screw	**.15**
#1576	center grip counter screw	**.15**
#1577	center grip complete	**2.50**
#1578	wishbone	**1.25**
#1580	elastic sling, each	
	a) Standard	**1.50**
	c) Junior	**1.25**
#1581	long DeLuxe elastic, ea.	**1.60**
#1583	muzzle screw	**.10**
#1584	dural tube	
	a) Standard	**4.50**
	b) DeLuxe	**4.95**
	c) Junior	**3.95**

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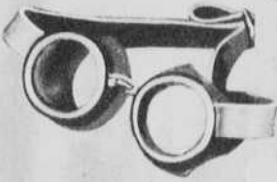

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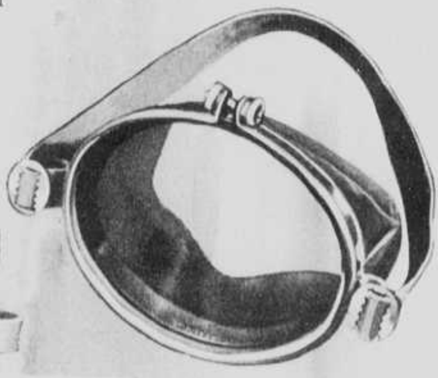

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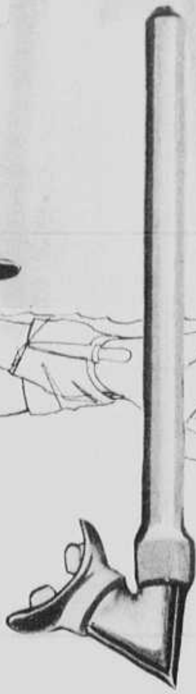

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FRENCH MASKS

Finest imported live rubber diving masks, 100% watertight. Recommended for long and deep dives. Feature **shatterproof** glass, the best insurance against accidents to the eyes.

#1211 **Squale, Navy type,** unsurpassed in design and quality, with short, soft skirt, comfortable fit on most sensitive faces. Will seal on rubber suit. Widest field of vision, solid stainless steel rim, shatterproof glass	**6.95**
#1202 **Champion DeLuxe,** universally accepted for its excellence, shatterproof glass	**5.95**
#1201 **Champion Standard,** same as above but with double-strength glass	**4.95**
#1221 **Squale Swimming Goggles,** so soft they cannot be felt when worn	**3.50**

Spare Parts:

#1234 Elastic strap for Squale mask	.50
#1235 Buckle for Squale mask .	.15
#1231 Elastic strap for Champion masks . . .	.50
#1236 Squale glass plate, shatterproof	1.50
#1233 Champion glass plate, shatterproof	1.50
#1232 Champion glass plate, standard	.60
#1237 Squale stainless steel rim	2.25
#1238 Champion DeLuxe stainless steel rim . . .	1.75
#1239 Champion Standard stainless rim	.85
#1240 Squale rim screws . . .	.40
#1241 Champion DeLuxe rim screws	.30
#1242 Champion Standard rim nuts	.15

FLOATING KNIVES with sheaths

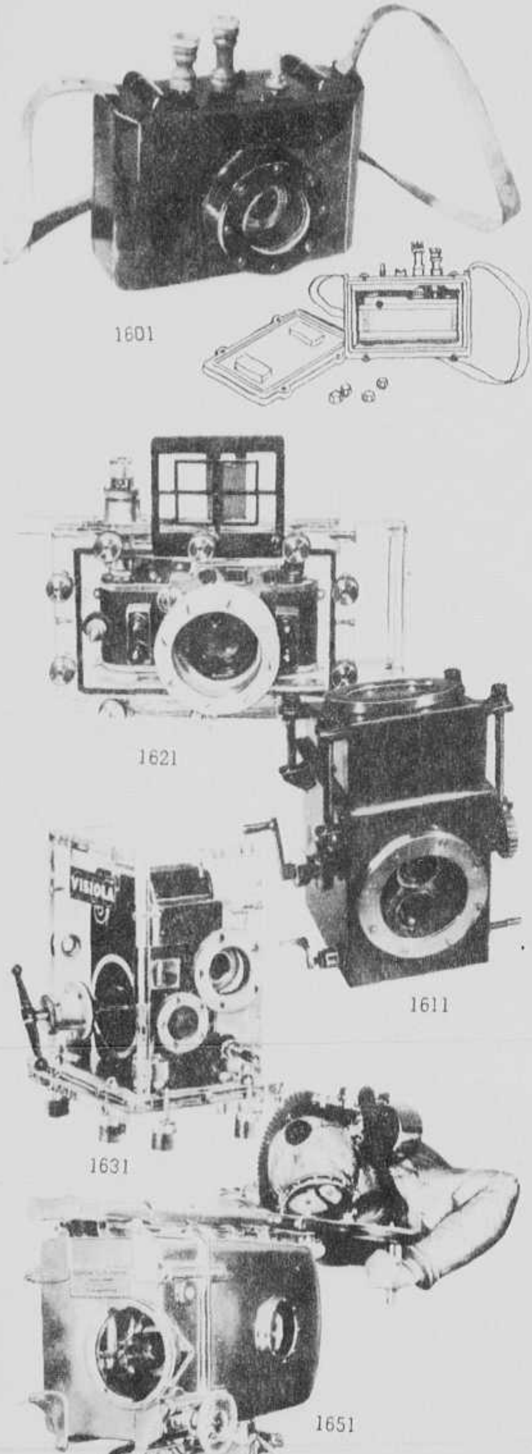
#1301—Knife, large, sharp stainless blade	**4.50**
#1302—Dagger, long, double-edged blade	**4.95**

Neither of these buoyant-handled weapons can be lost, as they float back to the surface. Handy for work above or under water. French imports.

SNORKLE TUBES

Made of plastic with rubber mouthpiece. An ideal device for skin divers. Permits breathing while keeping the eyes under water at all times, thus preventing glare of sunlight from blinding the diver whenever he looks up to reach for air.

#1401—Straight type	**1.95**
#1402—Features a ball attachment which automatically seals tube when immersed	**2.95**
#1411—Molded mouthpiece only	**.65**



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UNDERWATER CAMERAS

All units are pressure-resistant and watertight; the cameras are easily operated through outside controls:

#1601 **Foca Standard** (f 3.5 wide-angle) camera, complete with pressed aluminum submersible case. The camera can be removed and used on shore **245.00**

#1611 **Ondiphot case** for any Rolleiflex, made of steel and brass **175.00**

#1621 **Visiola case** for the Leica, made of plexiglass and brass **195.00**

#1631 **Visiola case** for motion-picture camera model Paillard-Bolex "H" (16 mm), made of plexiglass and brass **295.00**

(Items above are usable down to 40 feet.)

#1641 **C.T.M. "CG-18":** Morigraf 35 mm professional movie camera with pressurized housing (connected to a small Aqua-Lung, it breathes). Both spring and electric motors. Camera can be removed for use on shore.
f.o.b. Paris . . . **4,650.00**

#1651 **C.T.M. "CG-32":** The famous motion-picture camera used by Capt. Cousteau in the making of his prize-winning masterpieces. None better. f.o.b. Paris **6,750.00**

Look boxes, designed for underwater observation from boats, eliminate air reflection and optical interference.

#1701 Phantom Waterscope **13.95**

#1702 Standard Waterscope **5.00**

#1801 **Res-Q-Pak,** cigarette-package size, CO_2 operated, floats a 250-pound man upon squeezing . . **2.00**

#1811 **Underwater Flashlight,** watertight and pressure resistant, rubber; without batteries . . **2.95**

#1821 **Web Feet,** the best fins on the market: S (3-6), M (6-8), ML (8-9), L (9-11), XL **8.95**

#1901 **"Shallow Water Diving,"** by Schenck & Kendall . . **2.50**
(a review of all modern equipment and its comparative merit)

#1902 **"The Sea Around Us,"** by Rachel Carson **3.50**
(pleasant reading, packed with scientific data on the oceans)

#1903 **"Diving to Adventure,"** by Hans Hass **3.75**
(the most amazing book by the world's most daring diver)

#1904 **"I Like Diving,"** by Tom Eadie **3.00**
(an honest evaluation of the profession by a Navy diver)

#1905 **"I Dive for Treasure,"** by Lt. Harry Rieseberg **3.00**
(dreams come true, in scientific treasure hunting)

#1906 **"Treasure Below,"** by Comdr. Edward Ellsberg . . . **2.75**
(full of suspense and submarine thrills)

#1907 **"True Tales of Buried Treasure,"** by E. R. Snow . . **3.00**
(authentic facts on many lost fortunes)

#1908 **"Submarine Spearfishing,"** by Ivanovic **2.75**
(complete manual on spearfishing techniques and experiences)

#1911 **"Deep Diving and Submarine Operations"** **9.95**
by Sir Robert H. Davis (complete history of diving and equipment. Beautifully illustrated. 700 pages.)

#Y **"Self-Contained Diving"** digest, by Rene' Bussoz . . . **.95**
(a guide for the neophyte diver, with scientific information)

U. S. DIVERS CO.
1045 Broxton Avenue
W. Los Angeles 24, Calif.

Paul McComack, first-prize winner of the 1952 Midwinter Skin-Diving Derby, with his Frogman Suit, Squale Mask, Arbalete and catch.

Bud Abernathie of the So. Calif. Skin Divers, winning team at 1951 Laguna National Spearfishing Championship, with his Arbalete and Helms Trophy.

Self-Contained Diving

by

René Bussoz

PUBLISHED BY:

U. S. DIVERS CO.

1045 BROXTON AVE. • WEST LOS ANGELES 24, CALIF.

PRICE 95¢

Navy drill. A U.D.T. member cutting through a submarine net, using an Aqua-Lung, long rubber Frogman suit and Squale mask.

The Aqua-Lung

a self-contained diving unit

Until the invention of the Aqua-Lung, only highly trained specialists could explore the underwater world. This was an expensive venture, full of risks.

Nowadays, at low cost and without training, any swimmer can dive among the wonders of the deep, unhampered by hoses or lines.
The automatic demand regulator releases air only as needed, at a pressure identical to that of surrounding water, irrespective of depth. This explains why the Aqua-Lung diver has no problem with his ears; the ear-drums, being exposed to equal pressures (air inside, water outside), will remain in a neutral state, free of pain.

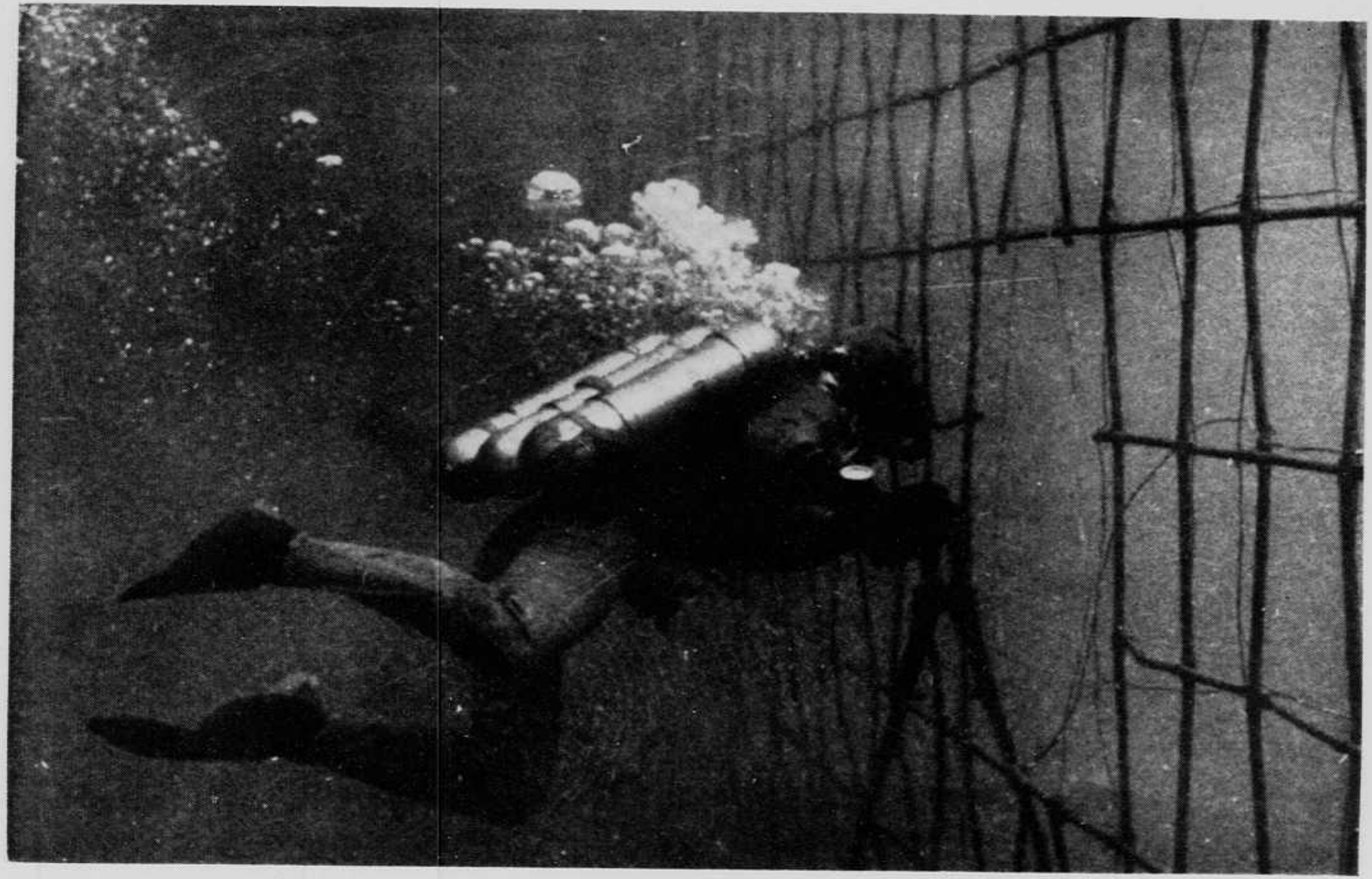
The Aqua-Lung has been used for seven years without casualties; it is standard equipment in the French, British and U.S. Navies, at the Universities of California, Washington and Wisconsin, U.S.C., Pomona College, Pacific Oceanic Fishery Investigations, Fish and Wildlife Service, U.S. Dept. of the Interior, Bureau of Reclamation, Scripps Institute, American Red Cross, shipping companies, harbor commissions, life guards, 20th Century-Fox Film Corp. (as in their masterpiece, "The Frogmen"). The Aqua-Lung is also used successfully by thousands of yachtsmen and sport fishermen.

The Aqua-Lung, because of its special features, is unique. It represents the greatest advance to date in underwater breathing equipment. Among its many advantages is that it uses compressed air and operates on the open circuit principle, i.e., the air is breathed in from a cylinder and exhaled into the water, in the form of bubbles. No chemicals are involved. The mechanism controlling the air supply is completely automatic.

The Aqua-Lung must never be confused with similar equipment using oxygen and certain chemicals. This latter type of equipment operates on what is known as the "closed circuit" principle. Oxygen from a cylinder on the back is breathed in, and the exhaled gases are absorbed by a purifying device containing caustic soda.

Use of oxygen limits diving to 33 feet of depth, as this gas is extremely dangerous under greater pressures. Should the chemicals become moistened, the diver's lungs would be burned.

No such limitations or dangers are associated with the Aqua-Lung. The user is free of breathing worries.



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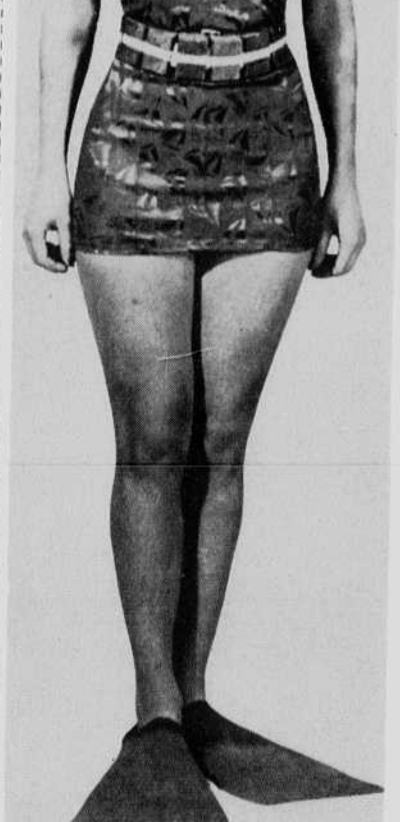


The Aqua-Lung meets all requirements for ideal submarine apparatus

Without exaggeration, it can be said that the Aqua-Lung meets all the requirements for the ideal underwater equipment. Its design is the result of years of experimentation by diving specialists thoroughly experienced in the many and varied problems of underwater work. Because of this, the Aqua-Lung is highly practical, expertly designed and engineered. In operation, the pressure of the air supply is automatically adjusted to the pressure of water at all levels, the air supply being adjusted to the normal breathing rhythm. Every available cubic inch of compressed air is used, thus increasing the scope of underwater activity.

While exhaling, the regulator shuts off, as there is never a continuous air flow. Breathing control will make the dive last longer.

The pressure regulator and outlet valve are completely automatic. In other words, the swimmer enjoys complete freedom to explore the depths or to carry out tasks underwater without having to bother about his air supply while doing so. The air supply regulators operate in two reducing stages, insuring easy and safe operation. There is perfect control of the air supply at all times as the pressure in the cylinder drops.

Seeing and breathing underwater

While it is important to see underwater, it is vital to breathe. In ideal underwater breathing equipment, it is therefore preferable to make these two functions entirely independent of each other. This is achieved in the Aqua-Lung by: (1) A flexible mask covering part of the face including the nose (to equalize the pressure within the mask) and fitted with a large glass eyeshield for seeing through; and (2) A separate mouthpiece for breathing, held securely in the mouth between the jaws. While it might appear that a mask covering the whole face, including the nose and mouth, would be more comfortable than one covering only part of it, the latter is safer. In case of leakage or damage to the former type of mask, a broken eyeshield, for example, not only would the diver be blinded but he would risk suffocation by being forced to breathe a mixture of air and water. Also, in such a mask, the large space inside might allow exhaled CO_2 gas to accumulate. This is dangerous, particularly at great depths.

Easy breathing is imperative regardless of swimmer's position in the water

When submerged, the difference in pressure of a few inches of water can become very important. The underwater swimmer must never experience the slightest difficulty in breathing, nor must there be any leakage of the precious life-giving reserve of air regardless of the position of the swimmer's body (head upward or downward, or whether he is on his back, stomach or side). The efficient, automatic valve in the Aqua-Lung completely takes care of all this.

Strength and durability of compressed air cylinders

The compressed air cylinders must have the highest possible safety factor, in view of the high pressure (in excess of 2000 p.s.i.) with which they are charged, and the fact that they may be subjected to continuous service in sea water and sometimes handled by inexperienced persons. Aqua-Lung cylinders meet all stringent Interstate Commerce Commission requirements.

Reserve supply of air

Maximum breathing safety for the underwater swimmer is ensured, in the standard Aqua-Lung, by a reserve air supply. This supply is brought into use when required by a manually operated lever. Experience has taught that the most reliable signal for warning as to when to use the reserve supply of air, should not depend on devices operated by sound, which are not safe and may rust, nor on so-called leakproof pressure gauges which can give false readings after shock, and whose glass may be broken. Furthermore, there is always the possibility of rupture or leaks in the connections and flexible hose required for connecting such devices to the high pressure air supply.

The method used in the Aqua-Lung is simpler and more positive. A special arrangement within the cylinder valve causes a restriction to the user's breathing when his regular air supply is nearing exhaustion. This immediately warns him that the reserve air supply is required, and also, that he must ascend at once.

Non-corrosive parts

All practical underwater equipment should, of course, be constructed of materials that resist the severe corrosion of sea water. Materials used in the Aqua-Lung more than meet this requirement.

Suitability of harness

The harness supplied with this equipment insures that the cylinder and the regulator for the air supply are properly positioned on the wearer's back and will not cause physical discomfort or other inconviences, even when the swimmer's head is pointed down. Its design is the result of long experiments in search of the ideal harness for such work.

The Aqua-Lung, therefore, meets all the conditions set forth for ideal underwater equipment. Evolved over many years of practical underwater experience, under all conditions, this apparatus successfully combines the skill and ingenuity of invention and industry with the practical needs of the diver and underwater swimmers. The result is equipment which may be used by any average swimmer with complete confidence, giving him the widest possible freedom under water.

Air supply

Check your classified directory under the heading "Oxygen". Most firms specializing in compressed gases can compress air. Linde Air Products, National Cylinder Gas and Puritan Compressed Gases have been very cooperative.

If the cylinder and neck valve are absolutely free of grease, oxygen may be safely used down to 33 feet of depth, maximum.

Refilling of tanks can be accomplished by means of one of the filler attachments listed under "Accessories".

Aqua-Lunging in California

Buster Crabbe (l.), Capt. Hal Messinger (r.), formerly of the U.D.T.s., and, in the center, the author. Malibu, 1949

detailed description *of* AQUA-LUNG EQUIPMENT

The Aqua-Lung comes to you safely packed in sturdy cartons.

Cylinders (A and B types)

Made of special steel alloy, to carry a working pressure of 2150 pounds per square inch as per stringent Interstate Commerce Commission specifications. Rust-resistant, parkerized finish.

A 10% overload is tolerated since World War II. Thus, the Standard Aqua-Lung can be filled to 2365 p.s.i. to contain 70 cu. ft. of air at atmospheric pressure.

The two-tank block, as used by the Navy, will thus carry 140 cu.ft. of air.

Air Reserve device

As mentioned above, certain internal arrangements within the air supply cylinder valve enable a reserve supply of air to be conserved for use by the swimmer when the main supply has been nearly used up. This reserve supply of air is built up under control of a special valve, as the total air pressure drops to approximately 300 p.s.i. The swimmer then experiences increasing difficulty in breathing, which warns him that only ⅛ of the supply is left. He should immediately stop whatever he is doing and open the valve of the air reserve by pulling down the rod mounted for the purpose on one side of the cylinder. Normal breathing is restored and the swimmer then knows he has just enough air to carry him safely to the surface without haste. When refilling the cylinders the air reserve device should be wide open.

Regulator unit

The regulator unit is the heart of the Aqua-Lung apparatus, controlling as it does the life-sustaining air supply. It is a round box-shaped assembly of chrome-plated brass. Though small, it is equipped with separate high and low pressure stages, which automatically adjust and perfectly equalize the pressure of the breathed air to that of the surrounding water, and also adjust the flow of air automatically to the breathing rhythm.

It is absolutely impossible for the adjustment of the unit to change during operations. The regulator is very easily connected to the cylinder by means of a yoke. Under the metal cover of the regulator, easily removable, is the rubber flap valve for exhausting the exhaled gases.

Mouthpiece for breathing

The rubber mouthpiece for breathing, also the result of much experimenting, is firmly held within the mouth and jaws and gripped by the teeth, while the lips close completely over the ridge.

Two flexible rubber hoses connect it to the regulator, one for inhaling, the other for exhaling. This arrangement eliminates all possibility of CO_2 accumulating to cause discomfort or danger to the user. Because of corrugations the hose will not kink shut.

Harness

This part of the equipment is very important, as it must maintain the position of the regulator on a level with the swimmer's lungs, irrespective of the position of his body in the water. It is so constructed as to leave him completely free to move at will in any direction.

RECOMMENDED ACCESSORIES (not included)

• **Face Mask**—should set gently on the face, without cutting, though it must be completely water-tight. A shatter-proof plate glass will prevent many accidents to the eyes. So far, only the Champion DeLuxe and Squale masks have been found satisfactory. Only the Squale mask features a beveled edge which allows a tight seal on a cold-water rubber suit.

• **Pressure Gauge**—indicates air content of tank before and after diving. Eliminates guess work.

• **Filler Attachment**—designed to connect the tank easily to any standard compressed air fitting.

• **Combination Filler and Gauge**—combines the two previous operations to permit simultaneous refilling and pressure reading.

• **Weight Belt**—8 pounds or more, adjustable to the individual, and advisable to offset the buoyancy of the Aqua-Lung. Effortless descents mean air saving, thus longer dives.

• **Depth Gauge**—fastens on the wrist like a watch for exact reading of diving depth at all times (Boyles law).

• **Dagger (floating)**—double-edged, rigid stainless steel blade with cork handle. Sheath designed to hook onto belt.

• **Res-Q-Pak**—the size of a cigarette package, attaches to the diver's belt and releases a 2-foot plastic water wing upon squeezing. CO_2 operated, it will float a 250-pound man.

• **Swim Fins**—a great variety on the market. A must.

• **Rubber Suit**—even in temperate climates, the water will be cold at depths of 50 feet or greater.

(a) short rubber suit covers the whole body except arms and legs. Satisfactory for summer use, and for water above 55° F.

(b) long rubber suit, same as above, plus arms, legs and boots, for any water temperature.

To accomplish its purpose, a rubber suit must be worn over heavy underwear and sweaters.

• **Snorkle**—while the equipment is weightless under water, it is felt when cruising on the surface. The snorkle tube will allow the diver to breathe and swim right below the surface without effort, before or after the actual dive.

UNDERWATER PRESSURE *and its effect on swimmer and equipment*

Pressure varies according to depths

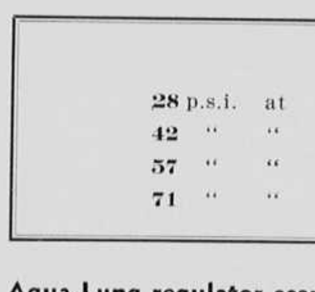
At sea level, everything is subjected to an average atmospheric pressure of approximately 14 p.s.i. To reduce that pressure by half, we would have to reach an altitude of 16,600 ft., but to double it, we need only descend 33 ft. in water. The following table illustrates this fact:—

TABLE I

28 p.s.i.	at	33 ft.	below	sea	level
42 "	"	66 "	"	"	"
57 "	"	99 "	"	"	"
71 "	"	132 "	"	"	"

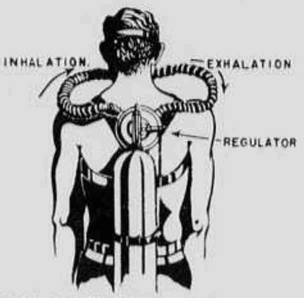
Aqua-Lung regulator assures comfortable breathing at any depth

Under water the slightest change in depth causes variations in pressure not encountered under ordinary circumstances on land. For instance, a difference of pressure corresponding to 8-12 inches of water would make breathing difficult. Again, it is an established fact that it is impossible for the human chest to withstand an outside pressure (exceeding the pressure within the lungs) of more than 6 ft. of water. That is to say, if a normal man tried to breathe under water by means of a hose inserted in his mouth and connected with the air at the surface, he would be unable to expand his lungs after he reached a depth of more than 6 ft. In view of this, the sensitivity of the Aqua-Lung regulator has been fixed to cause it to respond to a very slight difference of pressure (2 to 4 inches of water; therefore eliminating all breathing difficulties, regardless of depth at which the Aqua-Lung user is operating.



Exhaling problems in regard to the design of the apparatus

This difference of pressure sufficient to operate the regulator corresponds, of course, to a displacement level of two or three inches of water. If, therefore, the outlet for the exhaled gases happens to be more than two inches above the center of this diaphragm of the regulator, the latter would open automatically and the cylinder would empty itself. To avoid this, the outlet of the exhaling tube is placed very close to the diaphragm. Another distinct advantage of this arrangement is that the bubbles resulting from exhaling do not cross the swimmer's field of vision, but rather follow behind him. **Aqua-Lung is the only apparatus equipped with this patented device.**



IMPORTANT: Note position of regulator between shoulder blades. This is the key to easy breathing.

Duration of underwater operations with Aqua-Lung unit

Normally, the air supply is consumed in proportion to the rate of activity; it also varies from person to person. For example, a man resting uses approximately 0.25 cu. ft. of air per minute, and if moving about moderately, about 0.70 cu. ft. A Standard Aqua-Lung tank containing 70 cu.ft. would, therefore, allow a man to rest for about 4 hours and 40 minutes or to work moderately for about 1 hour and 40 minutes.

During submersion, breathing reflexes are not altered and the volume of consumption remains the same; but, as already explained, air is admitted into the lungs at a pressure proportional to the depth, therefore, the actual consumption of air normally expanded at atmospheric pressure increases. For this reason, the length of time a swimmer may stay down without fresh supplies of air, is inversely proportional to the absolute pressure at the depth of operations. Under ordinary circumstances, the Aqua-Lung unit will permit such periods and depths as the following:—

TABLE II

	1 Cylinder	2 Cylinders
At the surface	**100** minutes	**3** hrs. **20** minutes
At a depth of **33** ft.	**50** "	**100** "
At a depth of **100** ft.	**25** "	**50** "

With practice, these periods can, of course, be increased depending on the type of work performed. It is advisable to avoid undue motion as much as possible. This can be greatly facilitated by the rubber swim fins which permit almost effortless control and movement of the swimmer's body under water.

Economy of movement and effort (which conserves the air supply) can be achieved by ascending almost to the surface when an appreciable distance has to be covered, moving through the water, and then diving in the new direction to the desired spot. Such habits become routine after a while. In connection with air conservation, it is well to remember that being out of breath is the diver's number one enemy. In this connection, the weight belt will obviate unnecessary exertion during the descent, thus lengthening the time of the dive. The same can be said of the rubber suit. Cold, by tightening the muscles, results in excessive oxygen consumption.

Safety reserve—a warning

It should always be remembered that when the safety reserve supply of air is turned on, only 300 p.s.i. of air remains in the cylinder. Until a fresh supply is obtained, therefore, underwater operations must be considered at an end. Ascent to the surface should follow immediately. For this reason, the Junior Aqua-Lung, without air reserve, is called a "shallow water unit".

If, however, ascent is delayed until the air supply is exhausted, the situation, though serious, need not be desperate if panic is avoided. When breathing becomes difficult, it is because the remaining pressure in the cylinder is equal to the pressure of the water at the depth of the swimmer. The swimmer should ascend at once, breathing lightly, because, as pointed out previously, every 33 ft. upward the water pressure diminishes by 14 p.s.i., thus freeing about 800 cu. in. of air from the cylinder, which with care will continue to sustain the swimmer, while keeping calm and breathing lightly on the way back to the surface.

Regulating buoyancy

Regulating the buoyancy of the body in the water is a very important matter. If the user of the Aqua-Lung is to derive maximum enjoyment and satisfaction from its use, he must achieve equilibrium at all depths and angles. In effect, he must become almost weightless in the water. He should be able to go down or up, swimming without effort toward the bottom or the surface. In this, he will be greatly assisted by the rubber swim fins and the adjustable weight belt.

The buoyancy of a man varies according to the density of the water (fresh water or salt water) and also according to the density of the man's body and his lung capacity, i.e.,

(1) Compared to fresh water, sea water gives a swimmer additional buoyancy of about 1/30th of his own weight.
This additional buoyancy will, therefore, be about 4½ lbs. for a man of 135 lbs. and 7½ lbs. for a man of 225 lbs.

(2) The human lung capacity varies between 180 and 360 cu. in. and the density of a man's body can vary a good deal depending on his physique.

The Aqua-Lung equipment was designed to take into account all these factors, and, used with additional weights, is suitable for the most unfavorable conditions, i.e., a man having a body of high density submerged in fresh water. The swimmer must carefully determine, by experiment, the amount of ballast required to counterbalance his own buoyancy. The amount of ballast required varies from person to person, but generally ranges from 2 to 9 lbs. in sea water.

Weight of cylinders as related to buoyancy

In considering ballast and buoyancy, the following facts should be taken into account. The weight of 50 cu. ft. of air is approximately 4 lbs. Each cylinder used with the Standard Aqua-Lung contains 70 cu. ft. at atmospheric pressure when full. It would therefore weigh 5.6 lbs. less when empty. Reduction of weight in proportion to consumption would be 5.6 lbs. per cylinder.

Consequently, the user need not hestitate to start operations carrying a little overweight; an equivalent of half the weight of air per cylinder carried is a good rule. Being heavy at the start, the diver can descend easily, whereas air consumption makes him more buoyant and permits him to ascend without effort towards the end of the dive.

Maintenance

The utmost care should be taken in handling and maintenance of the Aqua-Lung. After using in sea water, the regulator valve and the mouthpiece should be rinsed in clean fresh water first, making sure that the inlet opening of the regulator is closed tightly with the thumb to prevent water from entering the high pressure block. After rinsing and drying, some fibrous grease occasionally should be inserted between the reserve air supply control lever and the body of the valve. The condition of the rubber flap valve, placed under the hood of the regulator, must be checked from time to time. To do this, remove the device holding the portion shaped like a duck's beak, by unscrewing the two screws fastening it to the case. This part should then be carefully cleaned to eliminate any salt deposits that may have lodged between the lips and which would affect its watertightness. It might even be necessary once a year to replace the rubber flap valve. When remounting, be sure that the flat part of the valve is not twisted around. The new valve should also be secured with good quality waterproof cement made for sticking rubber to metal (obtainable in most hardware stores), or fastened with strong linen thread thoroughly bound around the rubber where it fits over the metal tubing. A test to ensure that it is operating normally can be made by blowing into the mouthpiece. All equipment should be handled with extreme care. The valve must always be either completely closed or completely opened.

Rugged, and built for practical work, the Aqua-Lung unit requires little maintenance beyond these few elementary suggestions. With reasonable care, it will afford a great deal of pleasure to the enthusiastic swimmer. To the commercial user, for the more serious submarine tasks, it can be relied upon to give every satisfaction and undoubtedly will prove an investment of the greatest possible value.

The regulator should not be fastened to the tank until just before the actual dive; it should be removed immediately after diving, as it is a delicate piece of machinery which can easily be damaged during transport if left on the heavy cylinder.

Hints on

DIVING OR UNDERWATER SWIMMING

Divers using the convential type of equipment are always in danger of the following accidents and inconveniences:—

1. Crushing of the helmet as a result of a fall or hose breakage.
2. Suffocation caused by breakdown of pump or compressor, broken hose or helmet lens.
3. Blowing up, causing the air pressure to build up to dangerous proportions within the diving suit.
4. Oxygen intoxication in closed circuit apparatus.
5. Intoxication by accumulation of CO_2 within the helmet.
6. Inconvenience caused by nitrogen: (a) decompression troubles or "caisson disease" (the bends) and (b) drugging effects of great depths.
7. Excessive pressure within the suit when regaining the surface.
8. Pains in the ears.

All these hazards are eliminated in the use of the Aqua-Lung.

It should be understood at the outset that anyone physically fit and in good health, as is required for most sports, can dive and swim under water with the Aqua-Lung.

Pains in the ears

Regarding pains in the ears, this may be considered of little importance and can be eliminated by certain simple measures. As previously mentioned, as a swimmer goes deeper, pressure naturally increases on his body, which is indicated by its restricting effect on his lungs. The rest of his body remains practically insensible to the increased pressure, though it is to be expected that flexible cavities containing air or gases, such as stomach, intestines, etc. will be slightly deformed, but without noticeable inconvenience to the swimmer. On the other hand, sinus and ears (cavities with bony structures) fortunately are equipped by nature with tubes connecting them with the windpipe. Consequently, the air pressure within these cavities automatically adjusts itself to the variations in pressure imposed on the body and maintains equilibrium. Normally, sinuses are not affected by submersion unless the diver or swimmer has sinus trouble, or is afflicted with a severe cold in the head. In such an event, he would be advised not to undertake underwater excursions until the trouble has cleared up.

The ear is more sensitive to varying pressure because the tube connecting it to the windpipe (The Eustachian Tube) lets the air in only a little at a time; thus the eardrum under external pressure from the water on one side, receives a counter pressure on the inside spasmodically and progressively, in proportion to the clearing of the Eustachian tube. The clearing of this tube, which may take a little time, can be assisted by lightly blowing air (or snorting) through the nose into the eyeshield mask while holding it firmly against the face, and by making swallowing motions, as one would in an airplane.

The effect of diving or ascending from a given depth is more noticeable in shallow depths than in the greater ones, because there is less relative variation of pressure when the depth increases. For instance, a diver descending from 7 to 25 ft., finds the absolute pressure varying from 17 p.s.i. to 25 p.s.i. an increase of roughly 50%. On the other hand, a diver descending from 164 ft. to 184 ft. finds a variation in pressure from 85 to 93 p.s.i., an increase of only 10%.

To summarize, ordinarily a swimmer not equipped with a diving apparatus may suffer severe ear pain whilst diving because his eardrums are not given sufficient time to attain equilibrum. On the other hand, a swimmer using an Aqua-Lung does not have to worry about this, since he is carrying an air supply with him and can control the speed of his descent taking enough time to adjust his ears to the increasing pressure. Individual swimmers will learn to adjust themselves to these conditions as underwater excursions are repeated. Ears soon become trained. It is important not to attempt protecting the ears by inserting wax or plugs, whether water or air-tight, as this could cause damage to the eardrums with the pressure of water forcing them inwards against that delicate membrane.

Excessive pressure in lungs when reaching surface

This rarely occurs and may happen only if the diver restricts his breathing during a rapid ascent. In such a case, the volume of air in his lungs is increased as the external pressure decreases and may cause dangerous internal pressure within his lungs. It is therefore generally recommended that while ascending the breath should never be held but rather exhaled freely, and the ascent should be slowed up as the surface is neared.

Decompression problems

Among the gases in the air we breathe, such as oxygen, carbon dioxide, nitrogen, etc., only nitrogen dissolves mainly into the bloodstream. The quantity of nitrogen dissolved in the body during submersion is proportional to the depth obtained, and to the duration of the submersion.

If a diver or underwater swimmer ascends quickly after a long period of submersion, the dissolved nitrogen is released within the body in the form of bubbles or gas. When in large volume, these bubbles cause "the bends" or "caisson disease", as mentioned earlier, resulting in weakness, dizziness, pains in the back and legs, painful constriction of the chest, and have been known to cause lesions of certain tissues.

Two factors should always be remembered in connection with decompression problems: depth and duration of submersion are directly related and must not be considered separately. Failure to bear this in mind is responsible for most of the errors associated with such problems.

Greek divers fishing for coral, for example, have been known to dive to a depth of 165 ft. and return to the surface within a few minutes and suffer no inconvenience, simply because the nitrogen had not had time to dissolve in any appreciable quantity.

Similarly, the French diver, Frédéric Dumas, using an Aqua-Lung outfit, descended to a depth of 228 ft. and returned to the surface after three minutes, remaining only an instant at that depth. He suffered no ill-effects. This fact was hailed by the newspapers at the time as a seeming contradiction of an accepted natural law. This of course, was not true. The law governing such conditions was still valid; the diver merely had learned to accommodate himself to it.

It is interesting to note, that when the depth is less than 40 ft., the ascent is never accompanied by decompression troubles, no matter what length of time the swimmer is under water. This fact has been proved by experience for over a hundred years. A rate of decompression of 2.2 to 1 is insufficient to cause the formation of nitrogen bubbles in the body.

The simple rule then for beginners is to refrain from going deeper than 40 to 50 ft. For the more experienced users of the Aqua-Lung, the Safety Curve and Simplified Decompression Tables on pages 18 and 19 should be consulted.

The Safety Curve indicates the maximum time limit (at various depths) a swimmer can remain under water without taking special precautions. Such precautions will involve ascending in easy stages, as indicated in the Simplified Tables. For example, pauses in the ascent would have to be made at 30 ft., 20 ft., and 10 ft. respectively.

Since experience has shown that underwater swimmers, either through coldness, weariness, or neglect, sometimes may forget or deliberately ignore such rules, it is safer to limit the time spent under water to the periods shown on the Safety Curve.

The intoxicating effect of great depths

At depths of 150 to 200 ft., some individuals begin to experience a feeling of being doped, accompanied by a sensation of numbness. This is due to breathing nitrogen in the air under pressure. Harmless in itself it can become dangerous only because it may affect the swimmer's faculties and reflexes, weakening his natural instinct for self-preservation. The condition passes off as soon as the surface is reached. Here again, this can be avoided by refraining from descending to depths of over 130 ft. Experts with specialized training do, of course, descend to greater depths than this, but because of their training, are more protected against the risks.

SUMMARY

1. If the Aqua-Lung features an air reserve device, make sure the air supply is closed before submerging.

2. When returning to the surface after underwater operations, slow up the ascent when near the top, (take at least 90 seconds to ascend the last 35 ft.)

3. Avoid undue exertion under water.

4. Do not let the mouthpiece dangle in the water, as it would fill with water and make diving unpleasant.

5. Should any water seep into your mouth, swallow it, if deep under water.

6. Head and regulator should both be either above or under water, as air loss would otherwise occur.

7. Beginners and users of the shallow water unit should stay within 50 feet of depth.

8. Observe the safety curve rules and decompression tables if more than 1 cylinder of air is used below 50 feet during any 12-hour period.

9. Although record dives have been made to 300 feet, amateur divers should not exceed 130 feet.

SAFETY CURVE

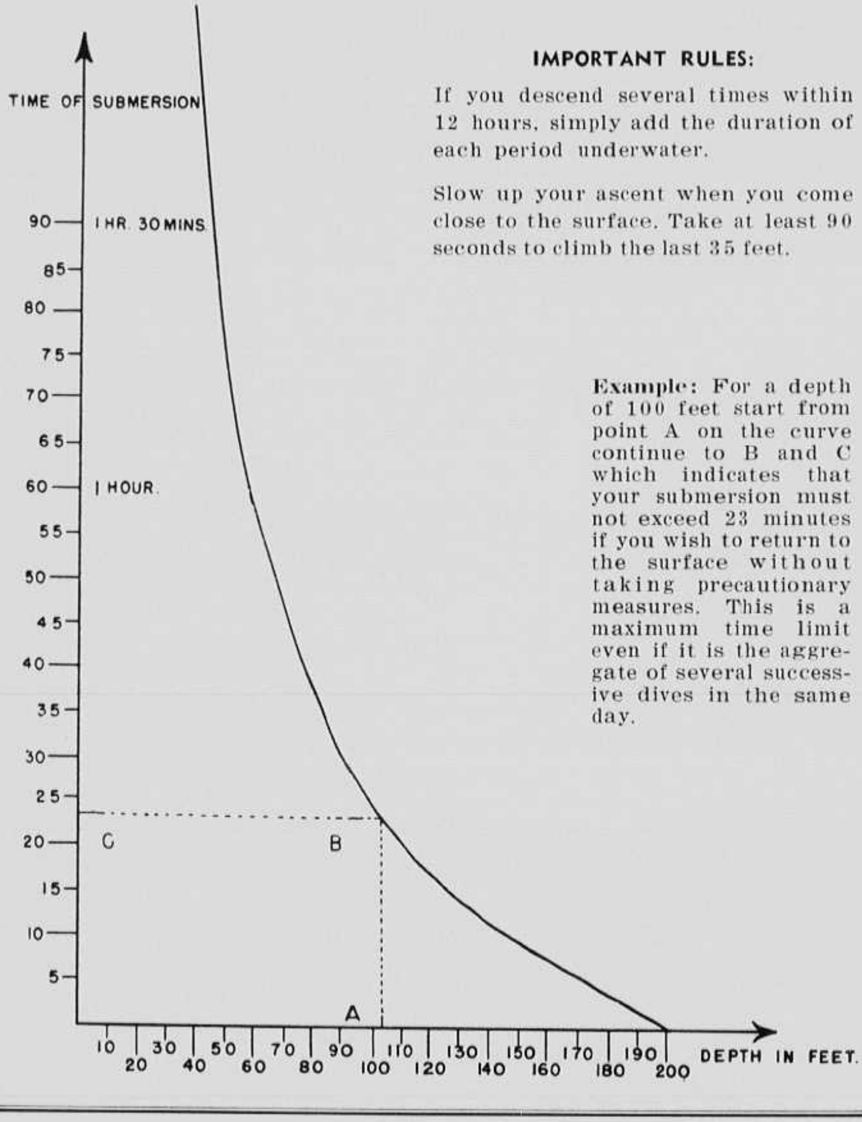
Indicating the Maximum Time Limit for Various Depths Permitting Return to Surface Without Special Precautions

IMPORTANT RULES:

If you descend several times within 12 hours, simply add the duration of each period underwater.

Slow up your ascent when you come close to the surface. Take at least 90 seconds to climb the last 35 feet.

Example: For a depth of 100 feet start from point A on the curve continue to B and C which indicates that your submersion must not exceed 23 minutes if you wish to return to the surface without taking precautionary measures. This is a maximum time limit even if it is the aggregate of several successive dives in the same day.



SIMPLIFIED TABLES OF DECOMPRESSION

Depth attained in meters and feet	Duration including time of descent	Pauses during ascent Duration in minutes of pauses at following stages:			Total duration of Decom-pression in minutes	REMARKS
		9 meters 30 feet	6 meters 20 feet	3 meters 10 feet		
15 meters or 50 feet	2 hours	. .	. .	2	2	No danger, remember to slow up the ascent for the last few feet
20 meters or 65 feet	50 minutes	. .	. .	. .	0	
	1 hour	. .	. .	3	3	
	1 h.15m.	. .	. .	9	9	
	1 h.30m.	. .	2	10	12	
25 meters or 80 feet	35 minutes	. .	. .	. .	0	
	50 minutes	. .	. .	7	7	
	1 h.10. m.	. .	16	15	31	
	1 h.30m.	. .	20	18	40	
30 meters or 100 feet	25 minutes	. .	. .	. .	0	
	40 minutes	. .	. .	12	12	
	1 hour	. .	16	16	32	
	1 h.15. m.	. .	27	21	48	
35 meters or 115 feet	18 minutes	. .	. .	. .	0	
	30 minutes	. .	. .	11	11	
	45 minutes	. .	16	16	32	
	1 hour	6	28	21	55	
40 meters or 130 feet	15 minutes	. .	. .	. .	0	
	30 minutes	. .	10	15	25	
	50 minutes	5	28	28	61	
	1 hour	13	28	28	69	

For depths exceeding 130 ft. the total time limit for remaining down without feeling ill effects, decreases rapidly. Only trained swimmers and divers should attempt descent to such depths. (See chapter, Hints on Diving or Underwater Swimming.)

THE FIRST STEPS

The equipment

Remove cylinder or cylinders from box. Check harness to make sure that it faces the opening of the outlet valve and that it is firmly attached to the cylinder. Connect the pressure gauge to the cylinder valve. During this operation, be sure that the washer of the valve faces the shoulder of the gauge. Open cylinder valve long enough only to take a reading on the gauge, then close it. Remove gauge. This reading indicates air content of tank, which is directly proportional to length of dive.

The regulator should next be connected to the valve and while tightening the bolt, check to see that the washer is properly in place and that both ends of the ringed hose are pointing upwards, then open the valve. If the connection is properly made there should be no leakage.

Assure yourself that your reserve air supply is fully closed. (Place the rod in the up position).

In strapping the apparatus onto the back, adjust the buckles of the harness and of the belt; the regulator should be placed near the top of the body, even with the shoulder blades. In this position the head, when bent backwards, will not touch the top of the regulator. For comfort in the water, your equipment should be adjusted beforehand to allow maximum freedom of movement.

Take the mask, moisten the inside of the glass eyeshield with saliva (one of the best anti-fogging solutions) then rinse lightly. Drain dry and adjust the mask to the face carefully. Put on the rubber swim fins. Insert the mouthpiece into the mouth and inhale two or three times to insure that the air valve is open. You are now ready to test the equipment in the water. Enter the water without misgivings. Float on the surface for a while with your face in the water and without swimming; breathe naturally to gain confidence.

Determine the amount of weight needed in your particular case by trial and error. When diving in the skin, the weight range should be between 6 and 9 pounds; with a short rubber suit, the range would be from 7 to 10, and with a long rubber suit, 8 to 12 pounds may be needed.

THE FIRST DIVE

The first dive

When possible, choose very clear water with a rocky and gently sloping bottom. After entering the water, remain nearly motionless, merely paddling very gently. You will quickly experience an exhilarating sense of freedom—one of the thrills accompanying the use of an Aqua-Lung. If you enter the water from shore, always remain within arm's length from the bottom. Just let yourself sink gradually. When the pressure begins to affect your ears, remember to swallow or blow into your mask through the nose. Take your time. As soon as relieved, continue your descent.

At about 25 ft. below the surface, you will have conquered any fear you may have had at first. In fact, you may be tempted to hurry back to the surface to describe your experiences. It is wiser, however, to relax, calm your breathing and study carefully your reactions. Stop moving and check your ballast to ascertain if it is correct for future use.

If it is possible to make use of a boat or barge for the first descent, drop anchor on a rocky bottom in about 25 ft. of water, and slide down the anchor chain, or rope, like a fireman sliding down the familiar brass pole in his station. This way you can descend easily, yard by yard, building confidence in yourself as you go. Descending in this manner also makes it easier to pause and clear the ears.

On reaching the bottom, let go and make your first attempt at submarine exploration using the anchor and rope as a landmark. The anchor chain or rope will also help guide you to surface again without much effort.

This first descent into the depths of a river, lake or the sea using an Aqua-Lung will open up a whole new world to you. You will be impatient to repeat your experiences and you will find yourself learning new angles about your equipment and its possibilities. You will be the envy of your friends until they too have procured an Aqua-Lung and experienced the new found thrill.

ATTENTION

ALWAYS USE COMPRESSED AIR

NOT OXYGEN

THE HOOKAH

(1) Principle and use of the Hookah

The Hookah, whose main component is a demand regulator operating on the same principle as that of the Aqua-Lung, is recommended for use in two cases: (a) for underwater work of long duration which does not require great freedom of movement, and (b) in connection with the use of a small portable compressor (150 p.s.i. output) where high-pressure compressed air is not available.

This system actually allows for an unlimited air supply to feed the diver, as the air source remains on shore or on a vessel and is not carried around by the diver himself, being connected to him by means of a flexible hose. Obviously, thus, the maximum movement of the diver is limited by the length of hose used.

(2) Description of the apparatus

The complete Hookah consists of:—

(a) a Hookah regulator operating on the same principle as the Aqua-Lung regulator. As in the case of the latter, this regulator feeds the diver through a corrugated hose and mouthpiece assembly. A specially designed harness allows for attachment of this regulator to the user's back.

(b) an air flow regulator with two gauges, mounted on the compressed air source, which may consist of either

(1) an air bank of one or more high-pressure compressed air tanks, or

(2) a low-pressure compressor with a small storage tank. (150 p.s.i. or more)

(c) a rubber hose which connects the Hookah to the air flow regulator.

This rubber air hose features fittings at the ends which permit it to be attached to the Hookah, at one end, and the air flow regulator, at the other. Additional hose lengths are available.

(3) Instructions for use of the Hookah

(a) Attach the air flow regulator to the compressed air source.

(b) Attach the proper end of the air hose to the output side of the air flow regulator.

(c) Open the valve on the compressed air source. The high-pressure gauge should now give a reading of the pressure of the source. However, no air should escape at this point.

(d) Open the low-pressure valve on the air flow regulator slowly in order to allow a flow of air through the air hose, which should be shaken vigorously during this process, to remove all traces of talc or foreign matter.

(e) Close the low-pressure valve again, so that the air flow ceases.

(f) Screw the other end of the air hose onto the Hookah regulator.

(g) Open the low-pressure valve on the air flow regulator again gently, until the low-pressure gauge shows a reading of 100 pounds per square inch (sufficient for diving down to 100 feet).

(h) To test the operation of the unit, proceed exactly as though testing an Aqua-Lung. (see previous instructions). The Hookah regulator is held on the diver's back at the level of the shoulder blades by means of the harness, the free ends of which should cross over the chest.

As a recommended precautionary measure, a calibrated line may be attached to the diver's shoulder, to which line the air hose can be tied at intervals, making sure to leave a slight slack between the tie-on points.

It is important to make sure that a minimum of 95 pounds pressure (as read on the air flow regulator) is maintained in the air hose at all times, so that the diver may be assured of a sufficient air supply while making his ascent in conformance with decompression or diving tables.

(4) Weighting of the diver

The diver may attach weights either around his belt, or on his feet, according to the orientation in which he wishes to move through the water.

(5) Maintenance

The Hookah maintenance instructions are identical to those for the Aqua-Lung.

Warning

Hookah units must be operated **only** on **compressed air,** to the exclusion of all other gases, particularly oxygen, whose use in such apparatus is extremely dangerous.

Los Angeles, California April 1, 1952

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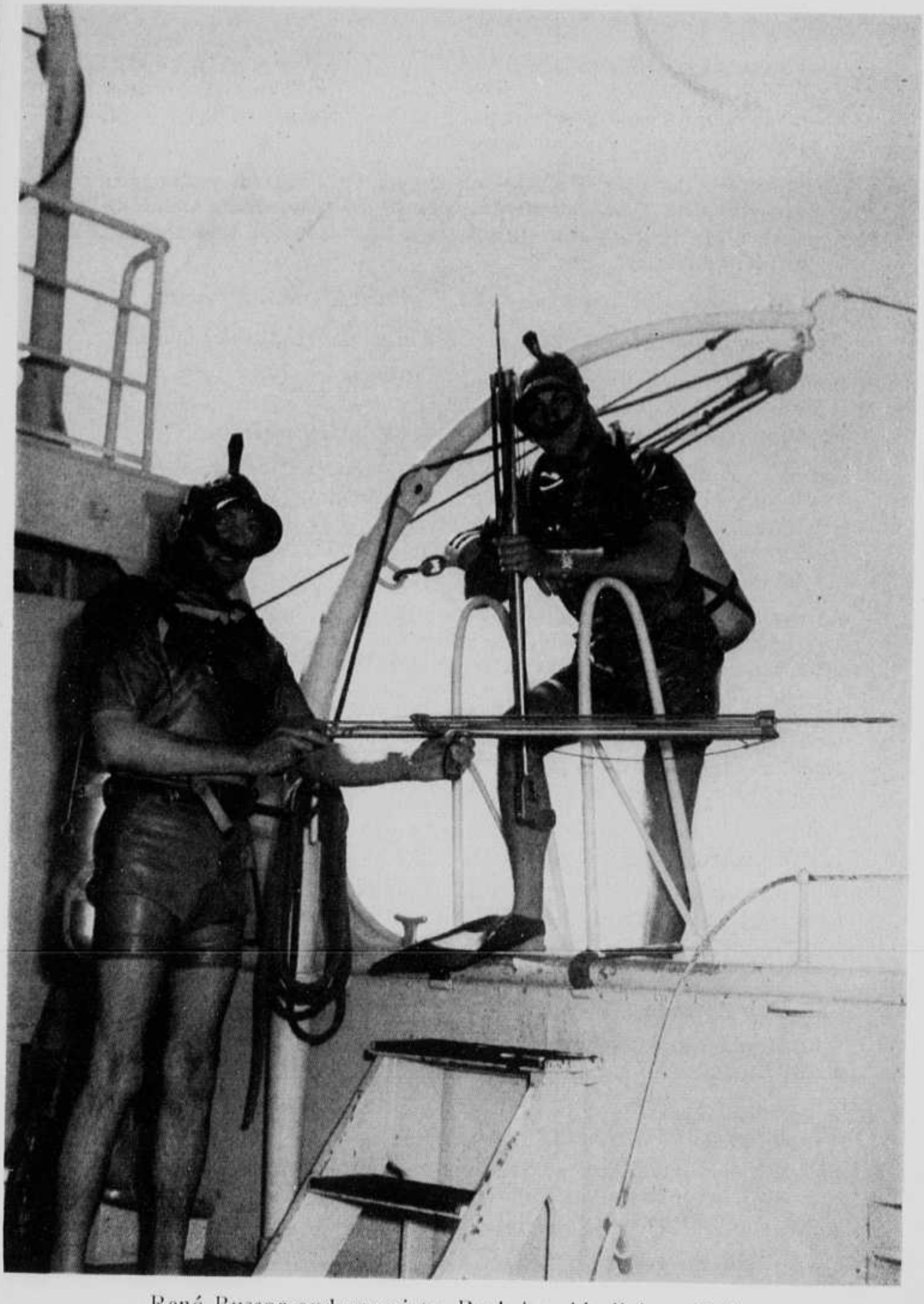
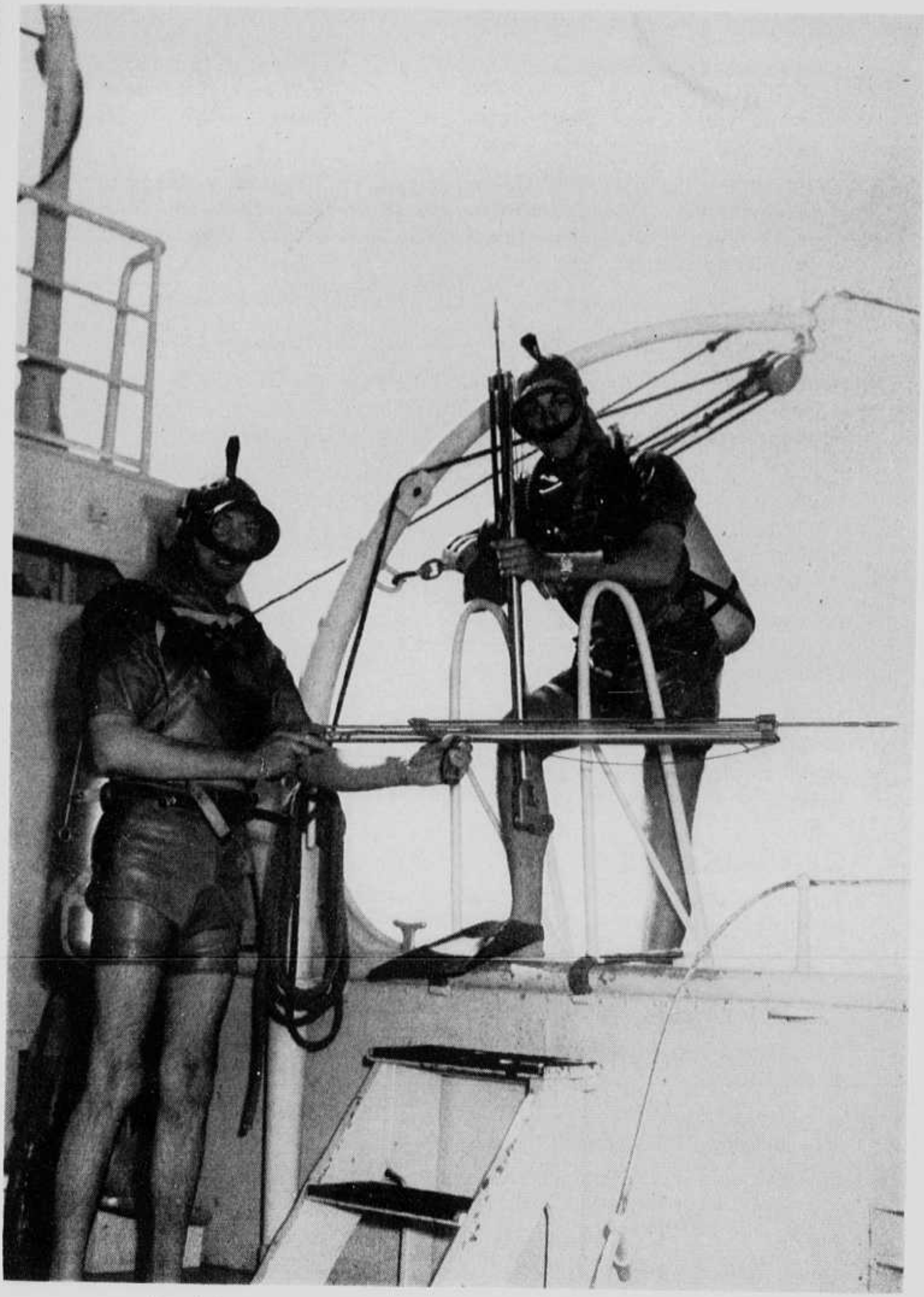
Los Angeles, California April 1, 1952



René Bussoz and associate, Paul Arnold, diving off the "Velero IV" (U.S.C.), complete with Aqua-Lung, short rubber suit, and the deadly Arbalete.

Palos Verdes, 1950



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MASSACHUSETTS INSTITUTE OF TECHNOLOGY

COMPUTATION BOOK

GENERAL INSTRUCTIONS

In all work in which *accuracy* and *ease of reference* are important, much depends upon carrying out the computation in a systematic manner. The following instructions, taken from the *Engineering Department Figuring Book of the Allis-Chalmers Co., serve as a guide in this matter.*

"All computations, of whatever kind, are to be made in these books, except in cases where special blanks may be provided for specific kinds of computation. Computations may be made in ink or pencil, whichever may be more convenient. Pencil figuring should be done with a soft pencil. All the work of computation should be done in these books, including all detail figuring."

"Each subject should begin on a new page, no matter how much space may be left on the previous page. The subject, with the date of beginning it, should be plainly written at the top of the first page of the subject."

"Work should be done systematically, and as neatly as consistent with rapidity. The books are, however, intended for convenience, and no unnecessary work should be done for sake of appearance only. Errors should be crossed off instead of erased, except where the latter will facilitate the work. Work should not be crowded. Paper costs less than the time which would be expended in attempting to economize space in making erasures."

"Where curves drawn on section paper (or sketches) are necessary parts of a computation, they should be pasted in the book, except where specifically otherwise provided for."

"Computations should be indexed, in the back of the book, by the person using the book."

* * * * * * * "

TECHNOLOGY STORE
HARVARD COOPERATIVE SOCIETY, Inc.
40 Massachusetts Ave., Cambridge 39, Massachusetts

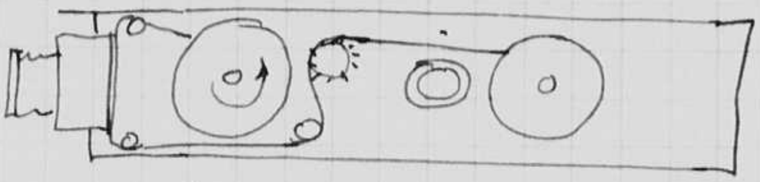
Harold E. Edgerton
Mass Inst of Tech
Cambridge
Mass.

August 4 1952.

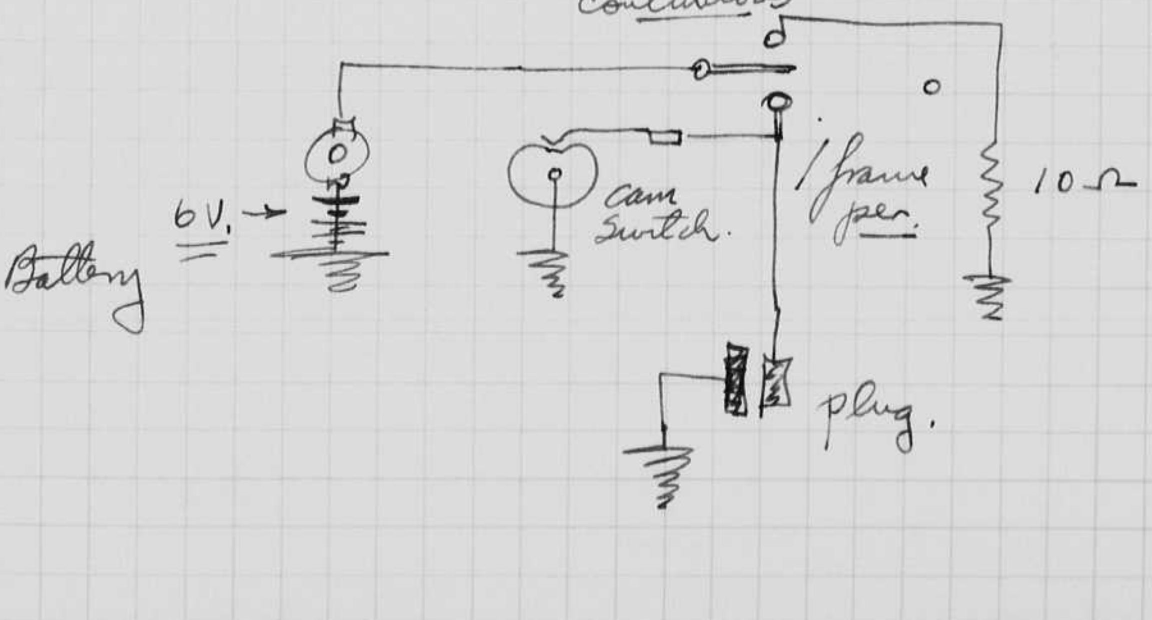
Underwater photography
experiments. —

August 4 1952
Harold E. Edgerton
Woods Hole Ocean Inst. aboard "Bear"

For the past few weeks an underwater camera and light have been made at M.I.T. J. Keefe at the RLE machine shop built the stainless steel case. The camera proper was built on a panel that just fit into a 5¼" I.D. tube case. The camera takes a standard 100 ft roll of 35 mm film. A photo of the camera works was taken yesterday. I hope to put prints in this book later.



A stiff belt is used to the take up reel. The recycle time is about 2½ seconds. A cam switch turns the camera off after a double 35 mm frame is wound. Recycling is arranged by a switch that shunts the cam switch



The 10 ohm resistor reduces the rate to about 1 picture for 5 sec.

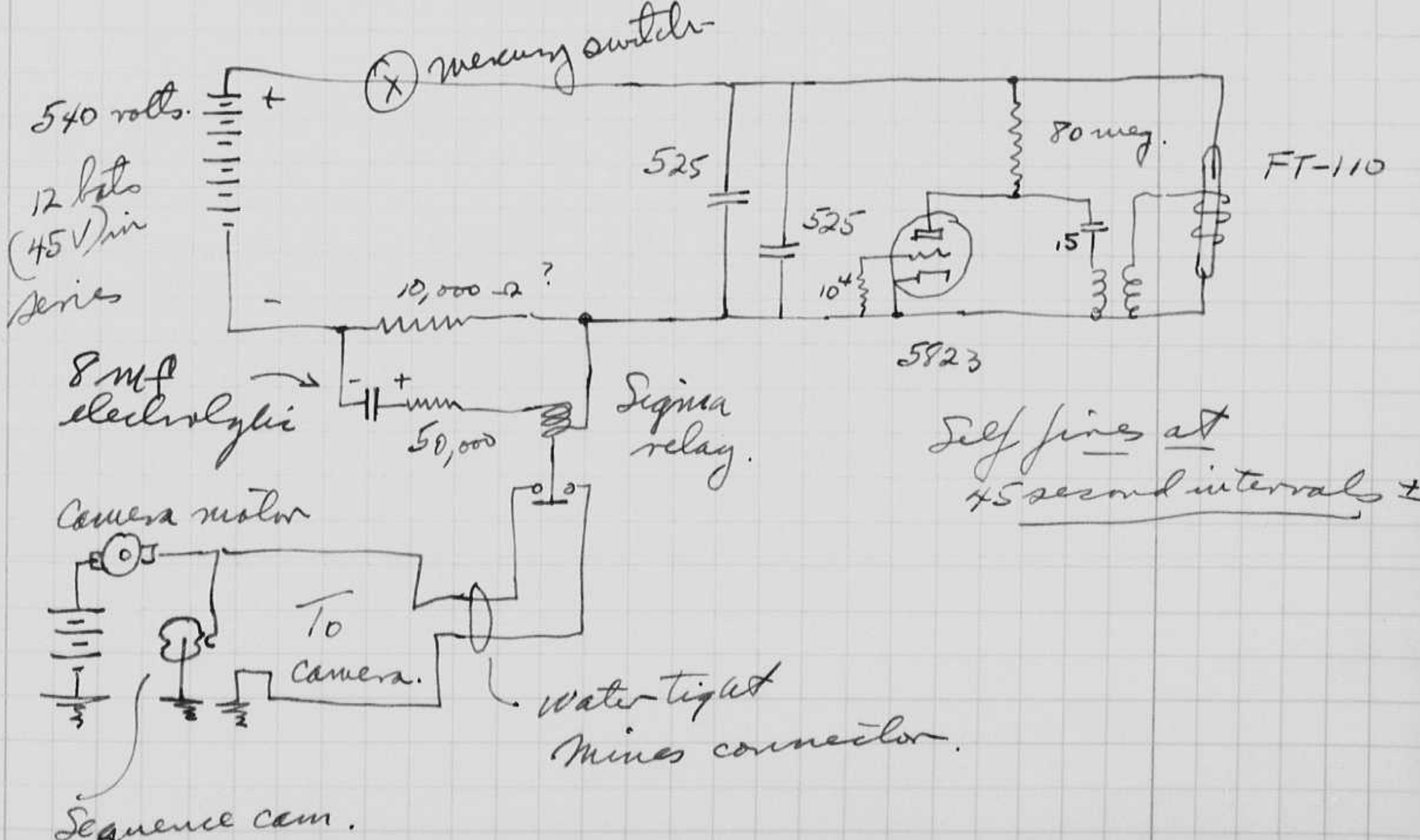
Aug 5 1952
"Bear" at WHOI.

Yesterday I drove from Cambridge to WHOI with my sons Bob and Bill together with the the underwater camera and lights. We arrived about 930 am and after making some strengthening rings for the clamps on one of the lights, went aboard the Bear where we spent the night.

After dark we lowered our camera and lamp off the stern of the Bear and allowed the equipment about 10 minutes of operation time. These photos were developed and showed little. One photo of the end of the boat above water was very good. One photo of the balloon was out of focus.

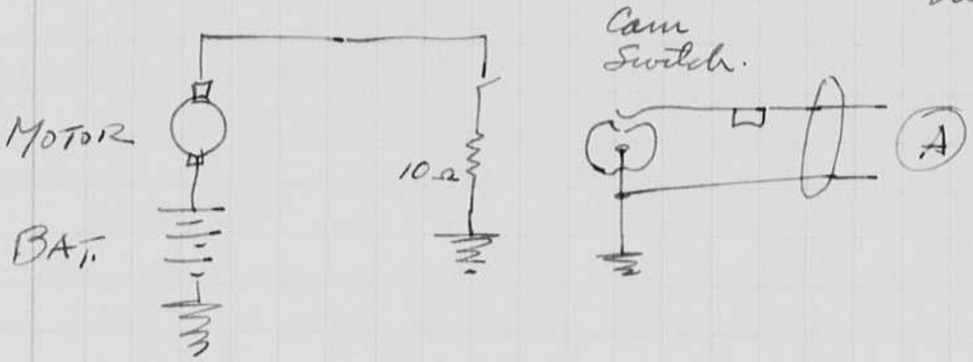
Two types of operation are possible with the camera. The first is described below.

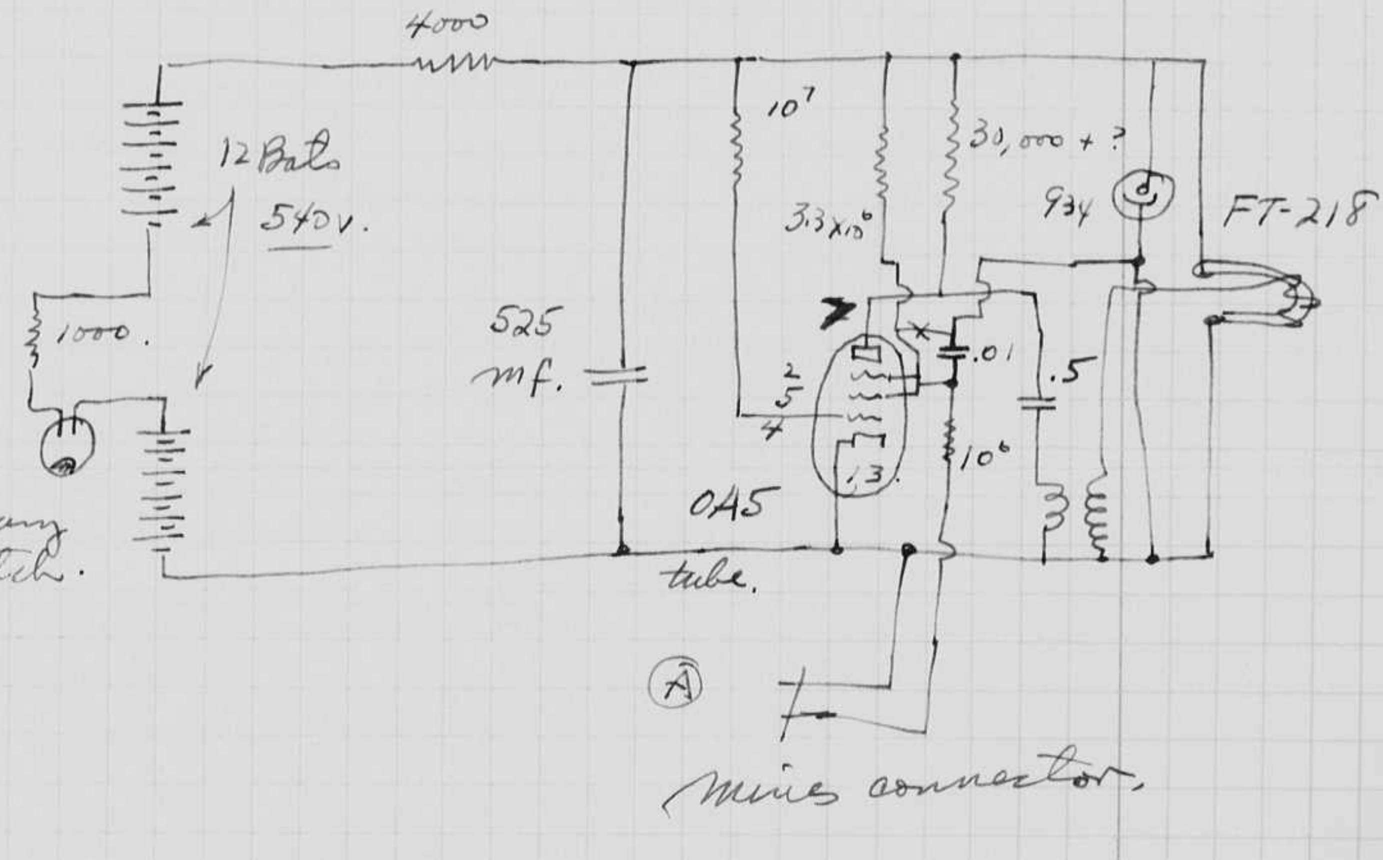
The strob lamp is arranged to flash at 45 second intervals.



The second method of taking photos involves a different flash tube equipment that is arranged to flash at 5 second intervals.

The camera now runs ~~with~~ continuously but with a 10 ohm resistor to slow it down from 2.5 sec to 5 sec per frame. The cam is used to fire the lamp as shown in the circuit below. An open circuit causes the strobotron tube to fire.





Aug 7 1952
on "Bear" about 50 miles south of Woods Hole.

We left on aug 5 from W.H. Some time was consumed in testing a 800 # lead sphere on a flexible jointed cable for horizontal pinging with a Edo sound ranging device.

We hove to while the Risk took off some of the sound men and a winch operator. then another delay while a mechanic came aboard to fix an inverter and the ice box.

In the afternoon we left Gayhead and headed south. a wind was blowing from the south and the waves were about 10 ft high causing the Bear to roll and pitch. We crused south until about 1 pm the following day aug 6, where we stopped when we sighted the Caryn.

The Caryn crew was also photographing the scattering layer. We did not pick up the scattering layer until we reach the position of the Caryn.

The camera and light were hooked together and lowered to find the scattering layer, this apparatus is described on page 5 of this book.

From Tex Hoadley's book p 107. Plus X film f 4
Scale set on 10 ft
(actually less than scale reading).

Roll 1 no shutter camera.

14.45 in water
14.59 270 meters 10° wire angle.
15.17 280 meters
15.31 290 meters
Vessel is rolling 20°-25°.
15 40 332 meters.
15 50 345.
16 02 Started the camera in to 300 meters after observing that the layer had risen since our 15.50 lowering. Stopped at 299 m

We thought the bobbing camera might be causing the scattering layer to change its position.

16.14. Started camera in at slow rate

16.29 250 meters. While bringing camera up noted on fathometer that scattering layer again got very heavy.

1625 Started lowering the camera

1629½ reached 250 meters started lowering slow to 280 m reached at 1630

at 1630. it was noted that the S.L. had taken a sharp dip but had not thinned. We are lowering the camera 10 m more to 289

1641 Fathometer (Volkwan) reports layer started up. Sharp layer.

(The chart will be interesting to study.

1752 up to 200 meters. < notes omitted on scat. layer

1808 bring up to see if light is flashing ok. Back down.

1826. camera @ 191 meters.
1900 Camera up and taken aboard ship

The fast cycling camera was now rigged for closeup photos of the scat. layer. A lens extender was used giving about a 1 to 1 photo.

Plus x film f16 was used.

The winch was accidently pulled up instead of down. The cable broke and dropped the camera and light to hit the rail of the ship and then the deck. Although the aluminum casting on the lamp was broken, I thought best to try the gear. It seemed to flash ok so we sent it over the side.

Roll 2. 2005 camera on and flashing.
2038 down to 10 meters.

2043 start up slow.
Back to first lamp (45 sec)

Roll 3 21.15 45 sec camera lowered to 21 meters

2200 camera lowered to 300 meters

2230 - 2235 camera lowered to 600 meters.

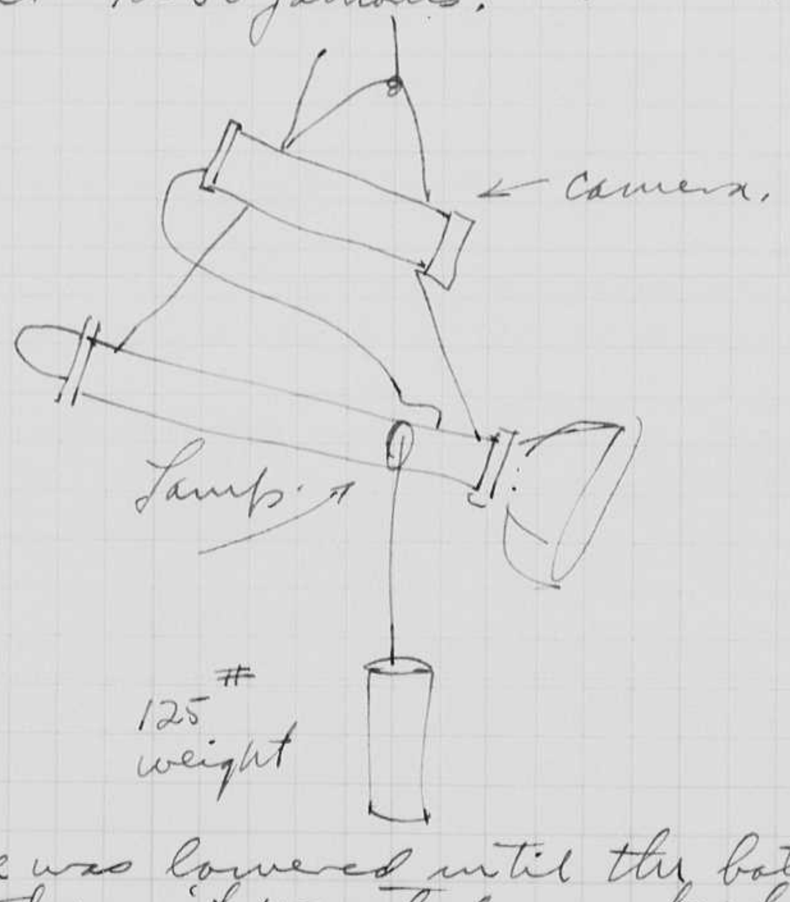
Brought up slowly. - flashing ok when brought aboard.

Finis this day.

Today we reworked the camera where it was broken in the gate due to the bumps on the deck yesterday.

The 10" aluminum reflector was installed on the 5 sec interval lamp.

Roll 4. An attempt was made to photograph the bottom at 40-50 fathoms.



The device was lowered until the bottom was hit. then it was taken up about a meter and held while the ship rolled.

Notes.

1. It would be very difficult to change batteries at sea. I was under the weather most of the time. Bob and Bill spent about all their time in the sacks.

2. A fast rigging method is needed for attaching the lamp and camera on the deck to the winch and to the weight.

3. A camera with a shutter is really needed so that daylight will not interfere with the photography.

4. An on-off switch is required for standby condition while on deck waiting for the inevitable delays that come up.

5. The back plate should not turn on the camera and trouble is ~~bound~~ to occur due to the twisting wires.

6. Low impedance circuits are really needed!

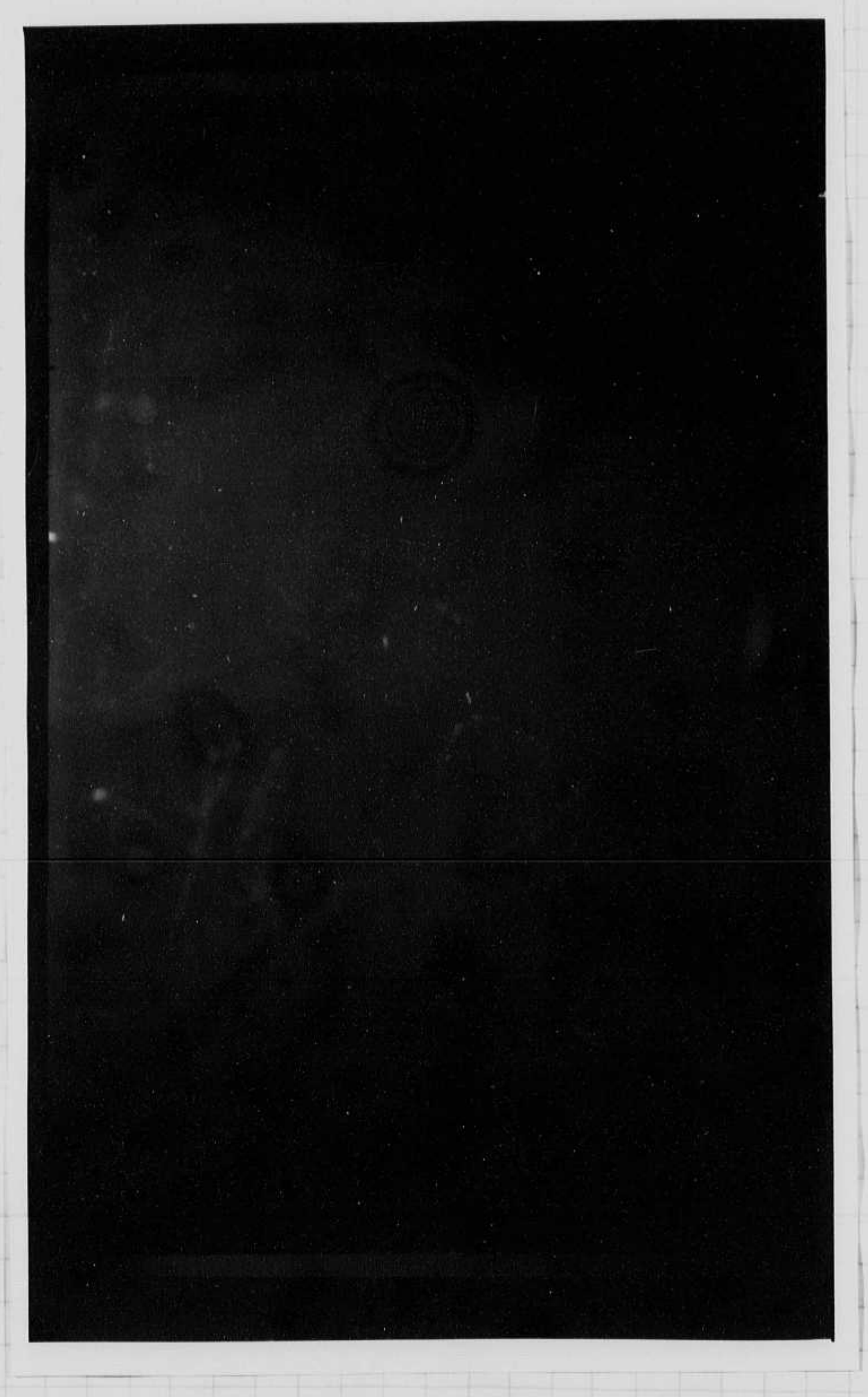
7. The Mines connectors did not seal pinching on 6 V. but may have on 200 with 1 meg input. However they were ok when dried and greased.

8. No trouble with O-Rings.

9. Camera condensation was very bad when the camera was brought up from deep and exposed to air. Some method should be devised to warm up camera. Also an effort should be made to reduce condensed water in camera on lenses and windows.

Position of photography of Scattering layer.

71° .5'
38° 50'



August 7 1952.
Harold E. Edgerton.

The Bear docked about 5 pm yesterday. We had trouble getting our car started due to moisture and the long delay while away. Whispering Willie and Dave Owen helped us to get the Plymouth started.

Today I had the negatives developed at the Master motion picture plant in Boston.

The first negative showed an animal on the fourth frame, thus about 3 minutes after the camera was put in the water. See notes on Roll 1 page 9. Also many of the photos showed spots of light. Dave Owen had reported similiar spots.

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71° .5'
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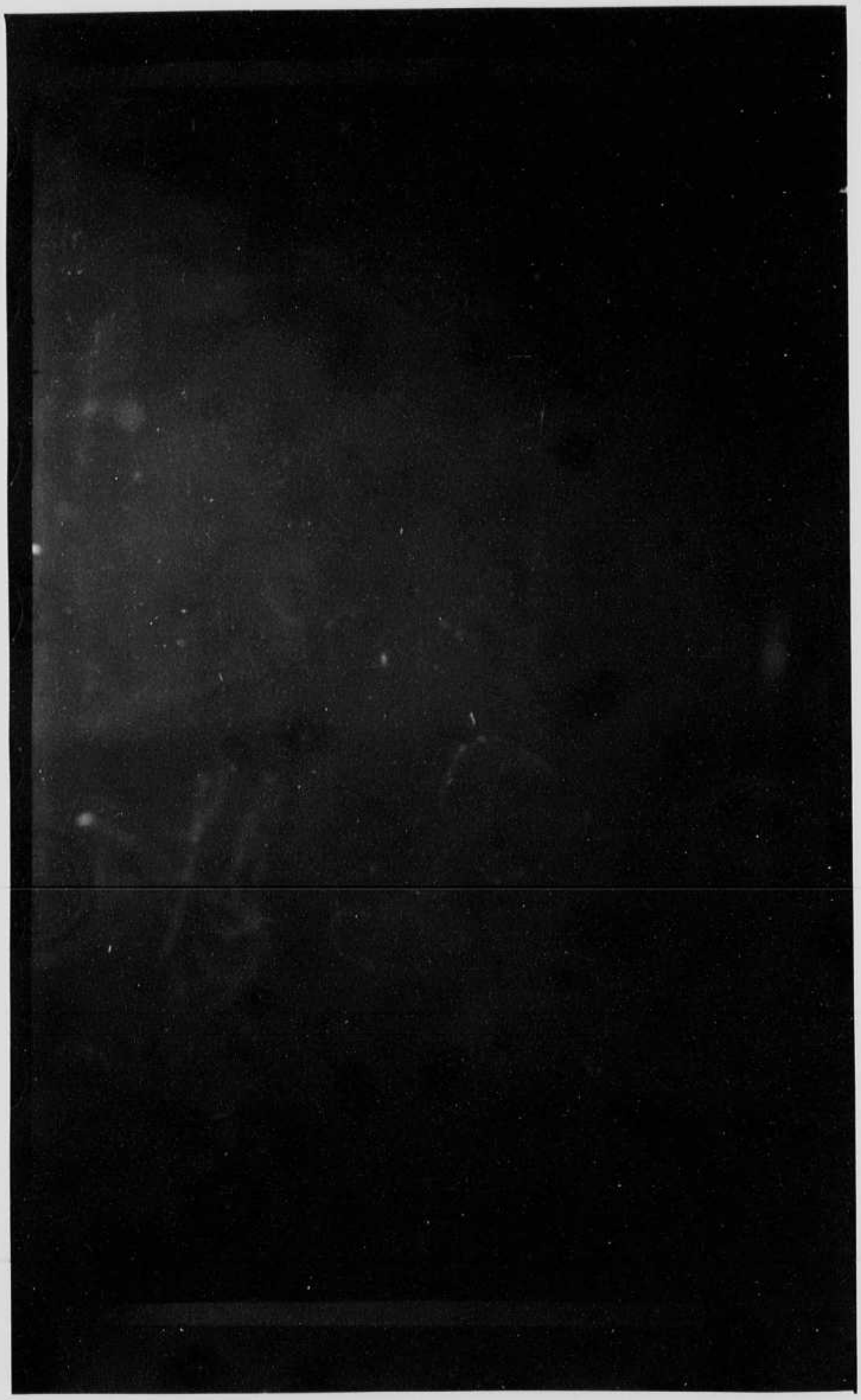

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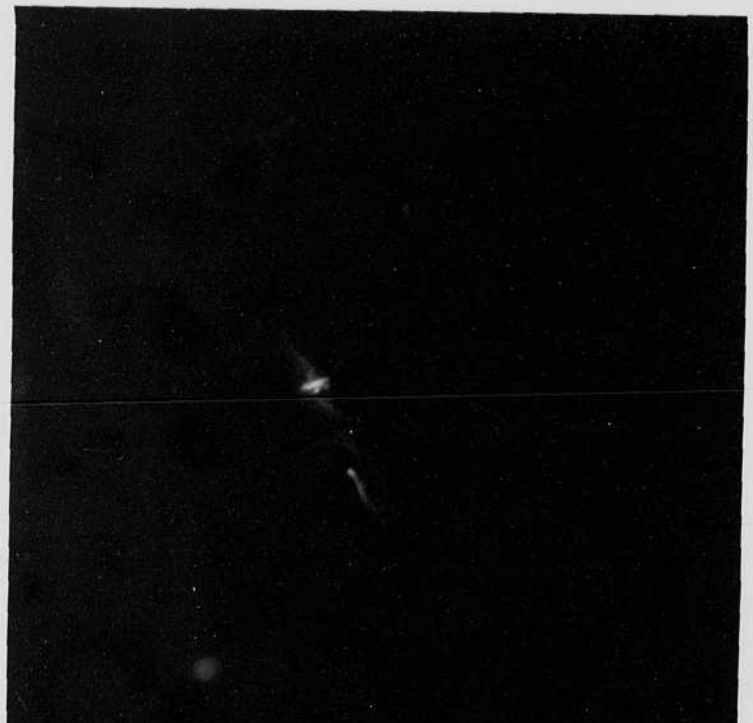
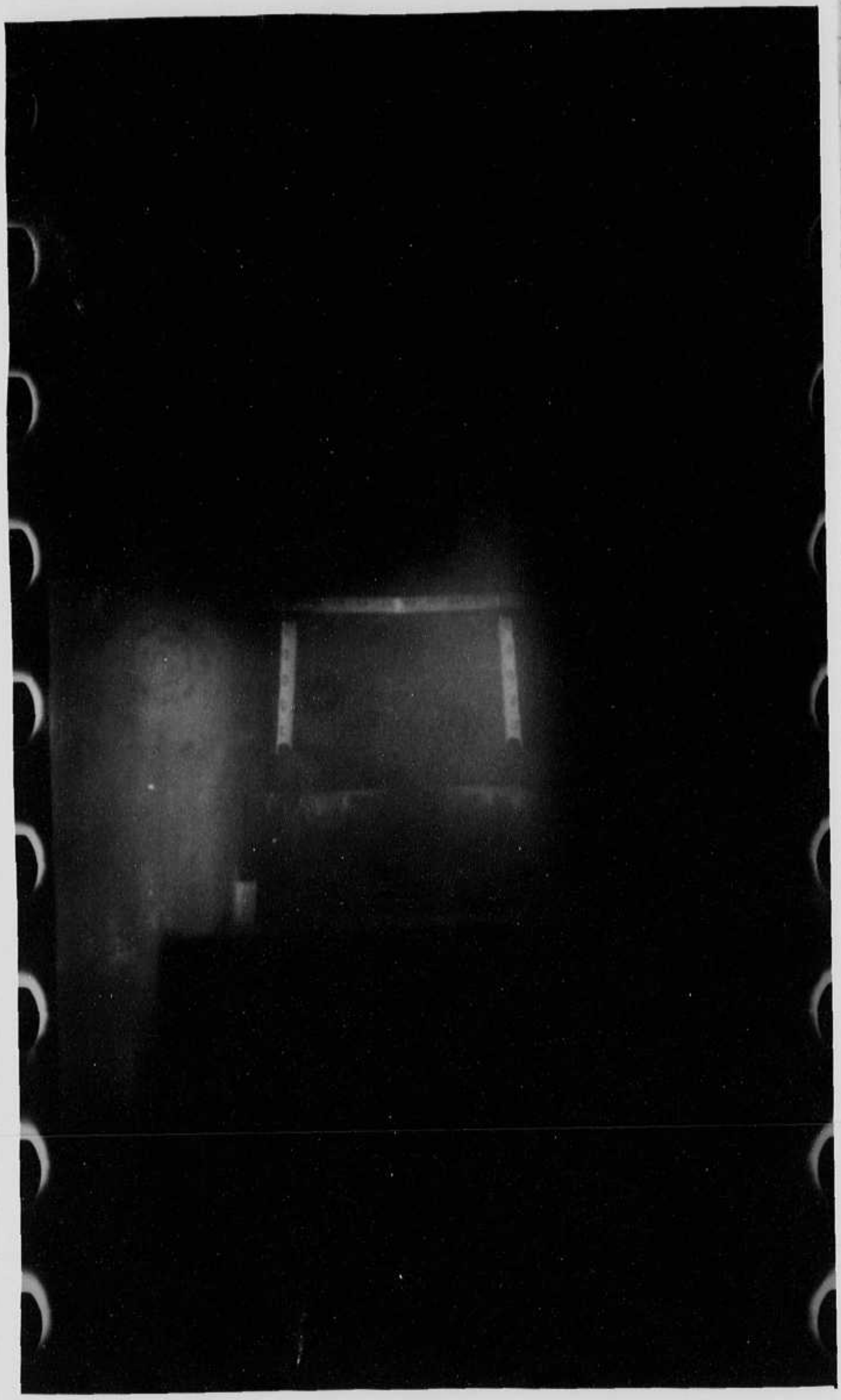


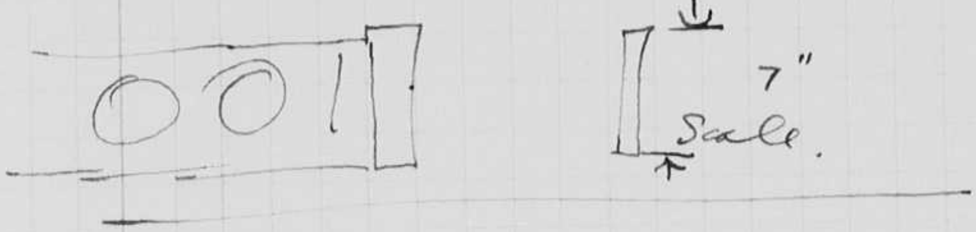


August 8 1952
H E Edgerton
Bob Edgerton
MIT 20D 102

Under water tests of conditions as used in Roll 1 on the Bear.

Camera set at ~~10 ft~~ 10M on scale. f 4. Actual distance is less than ~~this~~ since the lens is not set correctly at ∞.

Green flash.



Dark room sink.

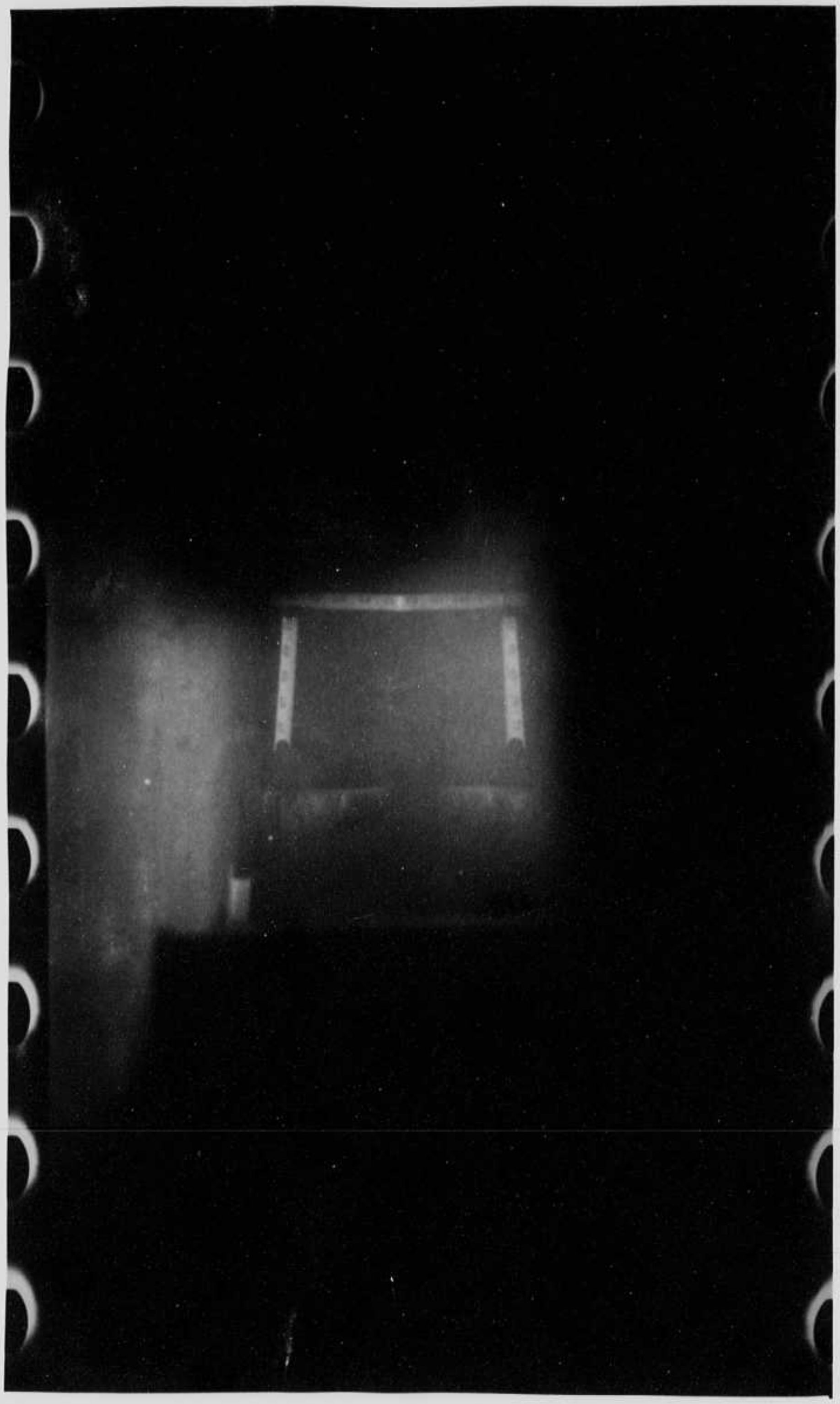
#1 Scale at 6" from front of glass plate.

# 2	6"	all overexposed
# 3	12"	
# 4	18"	
# 5	24"	~~experiment repeated~~
# 6	30"	~~with~~ towel over lamp.
# 7	36"	~~# a eliminated~~.

6"
3"
6"
9"
12"
18"
24
30
36.
42

The dial was ~~set~~ on 8 meters instead of 10

Note the last photo at 42" was just coming into focus.

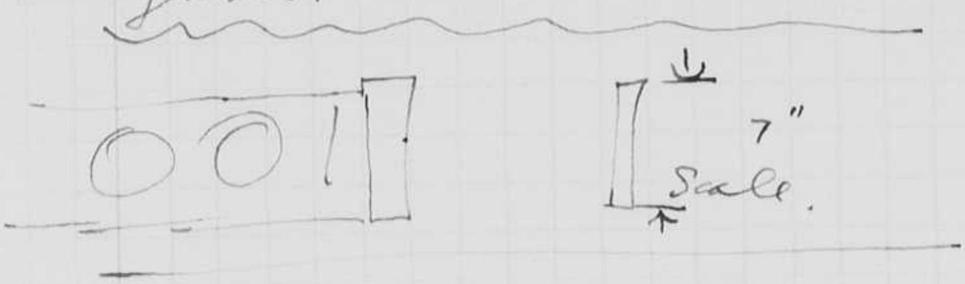


August 8 1952
H E Edgerton.
Bob Edgerton
MIT 20D102

Under water tests of conditions as used in Roll A on the Bear.

Camera set at ~~10 ft~~ 10M on scale. f 4.
Actual distance is less than this
since the lens is not set correctly
at ∞.

Green flash.



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# 2	6"	all overexposed
# 3	12"	
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# 6	30"	~~# a eliminated~~.
# 7	36"	

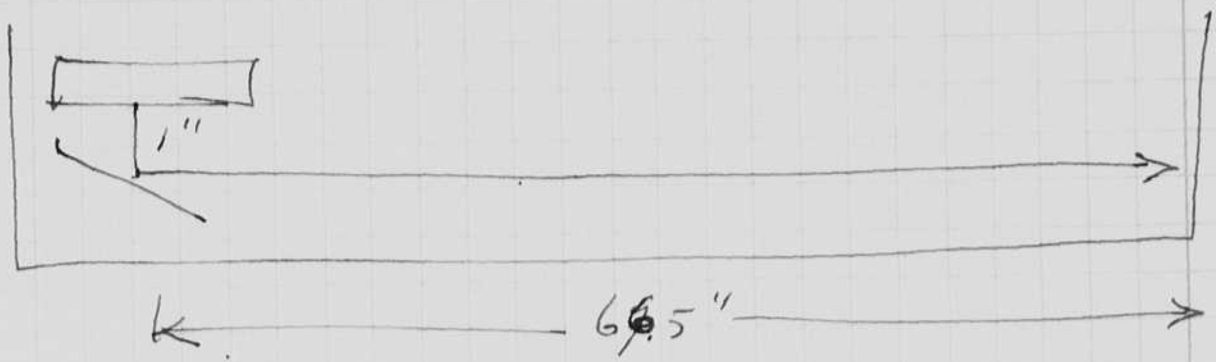
- - - - - - - - - -

6"
3"
6"
9"
12"
18"
24
30
36.
42

The dial was ~~set~~ on 8 meters instead of 10

Note the last photo at 42" was just coming into focus.

A mirror was then put in the sink as shown.



	#1	nothing sp.			
42"	#2	~~42~~			
54"	#3	~~F~~			
60"	#4				
66"	#5				
60"	#6				

67.5
25.5
—
42.0
13.5
—
54.0

67.5
42
—
25.5
6.
—
19.5
13.5
7.5
1.5

42"
48
54
60 — 5 ft
66. — 5 ft 6"

Focus is sharp at max distance 5'6". or **5'**.

A photo of a ruler was made to establish a scale.

The animal photographed was thus about 9 inches long, if in sharp focus.

Better estimate 7 to 10 inches in length.

Reference

Robt S. Dietz U.S. Navy Elect Lab San Diego 52 Calif.

Deep Scattering Layer in the Pacific and Antarctic Oceans.

Sears Foundation Journal of Marine Research
Vol. VII no 3 Nov 15 1948 P 450-442 Fig 1-3

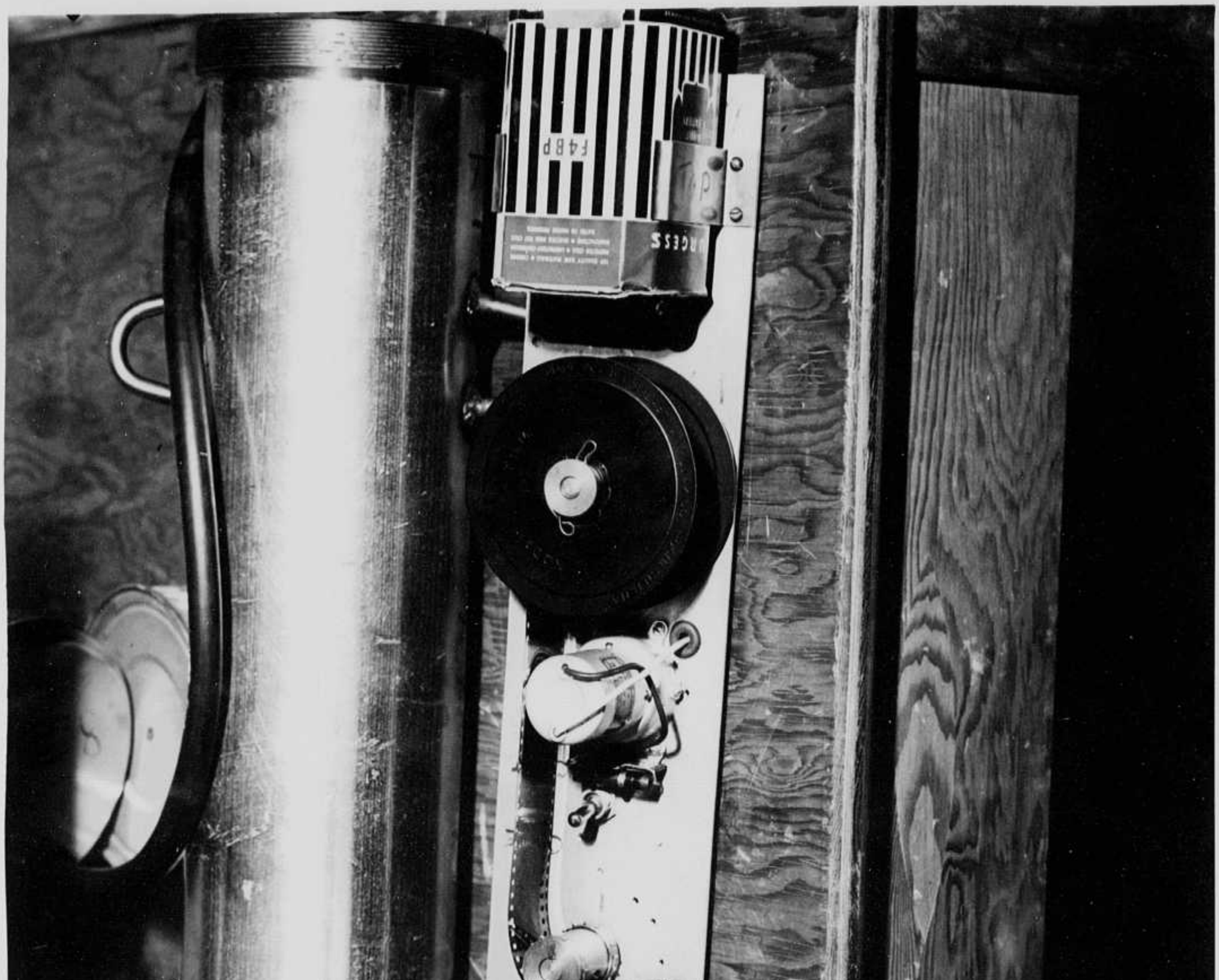
150 to 450 fathoms in Pacific
900 2700 ft.

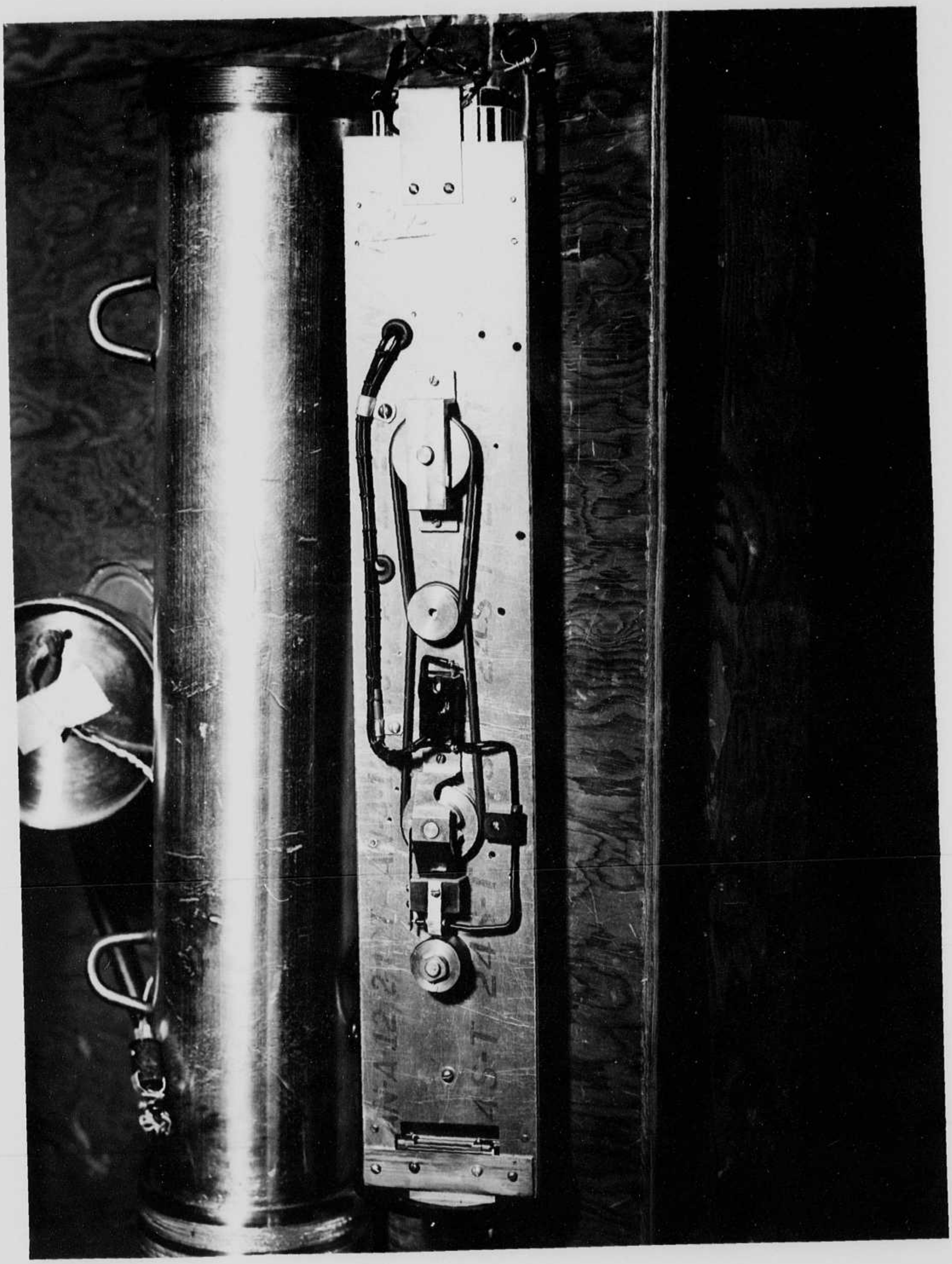
D.S.L. discovered in 1942

Diurnal cycle
zoo plankton
Copepods
Pelagic prawns
Euphausiids

Phyto plankton
Nekton such as fish or squid
Lyman (Squid). Sci Monthly N Y 66(1) 87-88

ECR CF Eyring
RJ Christensen
RW ~~Hait~~ Raitt.
} Univ of Cal. War Research.

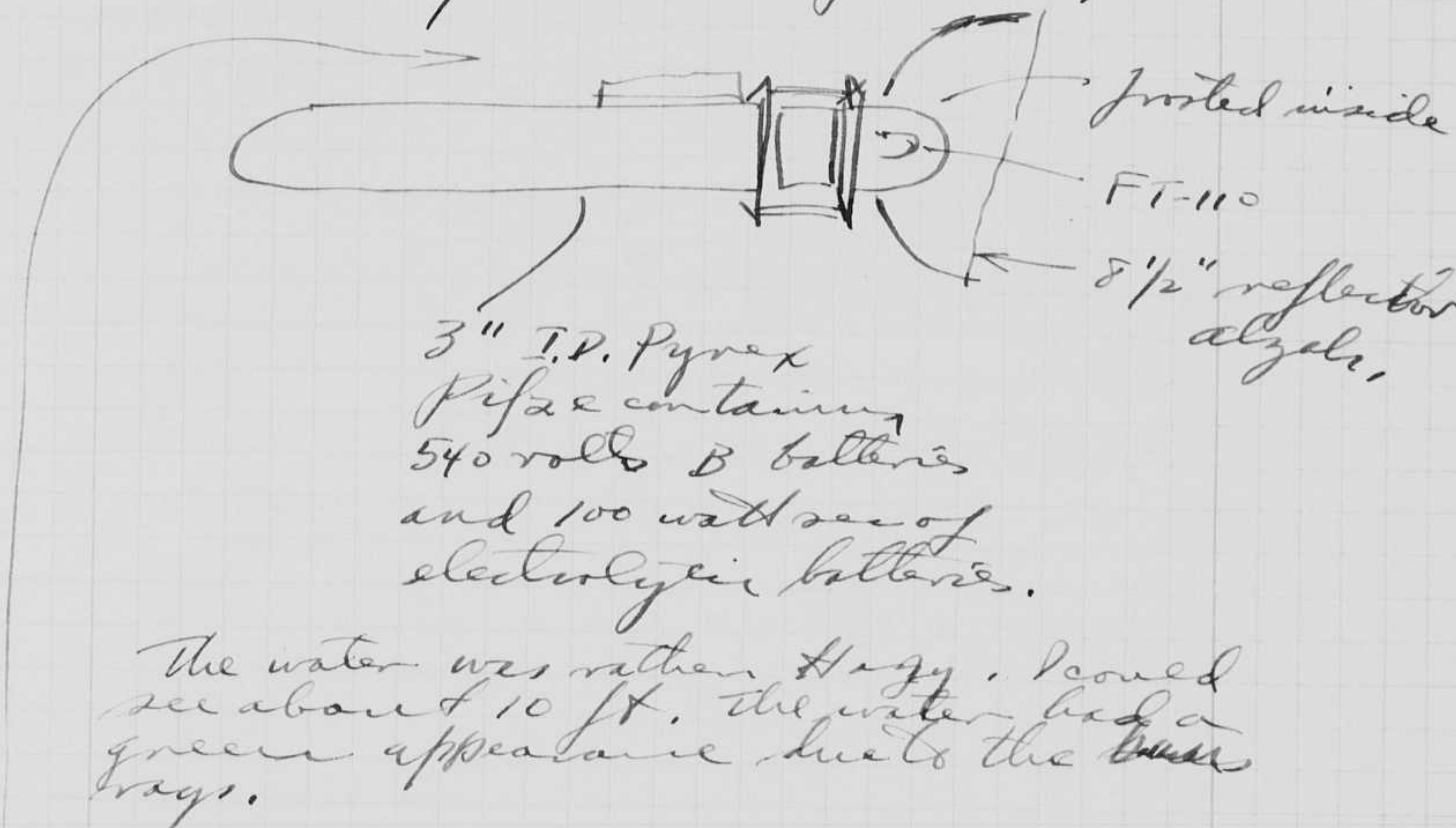

F4BP



Sept 1. 1952.
Harold Edgerton.

A camera and light system was tested yesterday in the ocean at Jolly Cove Rockport Mass. Bill Westell and my son Bob helped.

The system is as follows.



The water was rather Hazy. I could see about 10 ft. The water had a green appearance due to the ~~sun~~ rays.

Photos were taken on Kodachrome with the camera set for

f 3.5

D = 1.25 meters.

A board 2' by 10" was used as a plane on the camera light. The equipment was made buoyant. Modifications are being made today to slide the plane forward and to cut away a wood cover that makes the rear end too buoyant.

Tests were made last thursday Aug 28 in the M.I.T pool with the same equipment of page 26 with the addition of a side light of 200 watt sec - photocell controlled.

I was helped by my sons Bob and Bill a friend of Bill's, Reck was there also.

I had the aperture set at f 2.

Distance 1.5 meters on scale.

An entire roll of 20 Kodachrome was shot in the pool of the aqualung equipment and the camera itself, etc. the last photos were taken in the M.I.T. pool with a Leica through the window. the photocells on the under water lamps did the firing.

Sept 6 1952
HEEdg

MIT Pool tests.

~~Dept~~ Sept 4 Black and white tests

2" Lens at f 12.5 Plus x film 100 watt sec unit.
camera focused at 1.75 meters.

This film was over ~~exposed~~ developed?
by an unknown amount. Overdeveloping
is probably a good idea since it
increases the contrast.

Exposure seems ok at 10 ft but
begins to get thin. At this distance
a person is about covered.

I note that I have difficulty
in aiming the camera since I
cannot see through the
eye piece on the Visiola case.

On Sept 5 two Kodachrome daylight were
shot.

FILTER CC15 — Roll A 2" lens (50mm) f 3.2 1.5 meters.

FILTER CC15 — B 35mm Lens f 3.5 1.5 meters.

The side light of 200 watt sec
was used on some of the
photos. This equipment has
been revised so that the
photo electric cell is more
effective.

Black and white

35 mm Summilux lens at f11
Plus x film.
1.5 meters focus.

1. Daylight view (no flash) of lab.).
Light meter at

2. Ditto but with flash
3. Lab view of pumps etc. ▭
4. " " " " " ▯

---

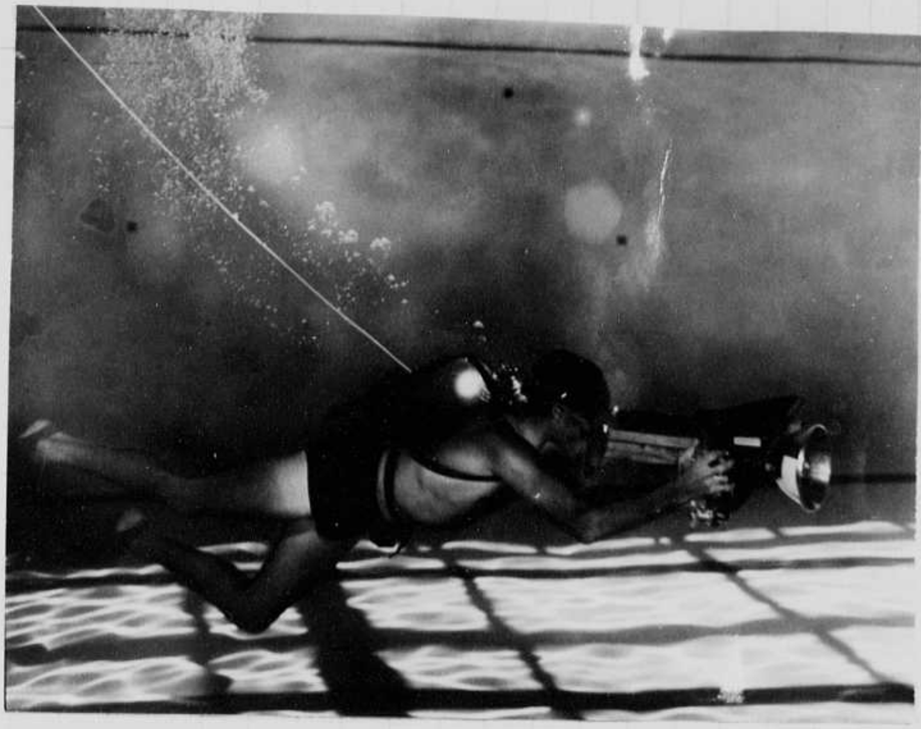
at M.I.T. Pool.
3 ft.

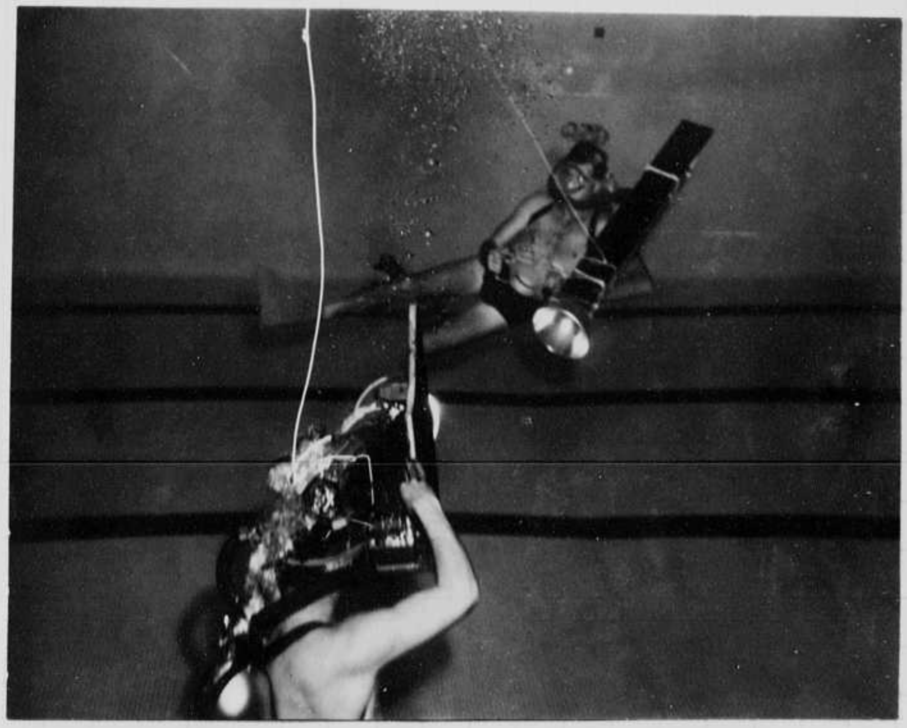
6 ft

9 ft

12 ft

15 ft.





Letter from O.E. Sette. Sept. 12. 1952

Sonic reflecting layer cannot be found at will. Good results at ~~div~~ divergence - convergence ~~where~~ where plankton are richer than anywhere else.

Hugh M. Smith departs Honolulu Oct 1, return Nov 21.

Letter from Otis Barton BENTHOSCOPE. Aug 21 wrote from Pier C Long Beach Calif. Pacific Towboat & Salvage Co.

E.R. Fenimore Johnson.
Fen John 90 Cricket Ave Ardmore Pa.

Scientific Monthly - July 1952
K.O. Emery
Submarine Photographs with the Benthograph.

Historical Development in U.W. Photography
Henry S Moncrief.
PSA Journal vol 17 Nov 1951

The deep sea layer of life Lionel A Walford
Scientific American Vol 185 No 2
August 1951

Aug 1948 Physics Today C Iselin
VI No 4

✓

Deep Sea Photography.
E Newton Harvey & Edward R Baylor

Sears Foundation Journal of Marine Research
Vol VII No 1 Apr 15 1948 p 10-16.

Photography of the Ocean Bottom.
Maurice Ewing
Allyn Vine
J. L. Worzel
Journal of the Opt. Society
V 36 No 6 307-321 June 1946

D.S.P in the Pacific and Ensenada Oceans.
Robt S. Dietz
Sears Foundation J of M R
VII No 3 Nov 15 1948

Vernon Brock T. Fish. Univ. H.

Henry Kierstead N.E.L. Photo Lab.

Bob. Dill Ocean Nov 15 Nov 20 to 25.

Robt Dietz " Kwaj & Fiji.

500 miles.

A Scripps boat or two will be at Eni. for a short time - say several weeks. Bob Dill will be aboard.

From Ewing Sept 22, 1952.

Jap M. W. camera   Geo Phy
Univ. Tokyo.

Sept 24 1952
arrived in Honolulu last night by air. Now at Hale Kulani Hotel on beach room 2110. Wyckoff and family were also on the plane a United Strato liner.

I went to the Fish and Wildlife service and met Harold Smithers (Sette was out). W.F. Royce Garth Murphy etc.

Arrangements were made to ship the UW camera from Boston to be used on a cruise of the Hugh Smith

Bill Goslin came about 4 pm and we went for a swim at Waikiki beach. I took a roll of Kodachrome with the cork unit. More weight is needed to keep it down.

Roll 1. Daylight Kodachrome at f 3.5 1.5 meters.
The water was murky - yellow?
Shots were made of Goslin
Coral heads - small fish etc.
Surf was bad for me but Goslin said it was quiet.

Sept 26 Thursday.
Hale kalani Hotel
Honolulu

Took rolls 2, 3, 4, at Hanauma Bay
Koko Head yesterday

f 3.5 35 mm lens.
2 meters ± –
CC 15 filter (89)?
Daylight Kodachrome.

William Gosline } Univ Haw
Dick Stroup }
Ike Ikehara } Bur Fish &
Dick Shomura }. } Wild life.

Friday Sept 27 1952

Met Miller, Lt Donald, USN in morning — Went to Eastman with film shot the day before.

Then went to Fisher and Wiel tiffe on Dole ave to fit Robot to lamp and sync. tested in the swimming pool at Univ Hawaii for leaks — water and electrical — O.K.

Made a trip to Hanauma Bay in the late afternoon. Dick Stroup was there with two friends
Bill Monahan
2843 Park St
Calvin Brisk
3860 Tantalus.

Several films were exposed on Kodachrome in the Leica as marked on the boxes. I used a CC 15 filter on all shots.

E. L. ~~Herne~~ Hearne and wife at Hanauma Bay. in some photos

Sat Sept ~~28~~ 27 1952

A B Egerton

Took plane at 9am for ~~Kail~~ Kona
Kailua ~~Honolulu~~ Hawaii

Vernon Brock met us with a truck to take our 400 lbs of apparatus to the Lihikai Hotel. Roy's place.

Jimmy Pa 2302 Hoonanea St
Georges G. Gilbert 1307 N Vineyard St
Yoshio Yamaguchi Bd of Agr and Forestry.

Leon Wollard
1553 W 52nd St ~~LA~~ 62 Cal AX 30297
United pilot with plenty of cameras.

→ We went by car to Capt Cook's bay - then took a boat at Lester's place. Sonny Boy Henry Lester Jr. was our pilot to see the monument. One of the boys knew where the tablet was located in the water where Cook had his trouble with the natives. I tried to take an under water photo of it with the red flash.

Kealakekua Bay.

Sunday Sept ~~29~~ 28 1952

Harold E. Edgerton.

Kona Bay.

~~Ke~~ KEAHOLE point.

We took a boat at the Kona bay and went west by north. A large square light house was passed first. then several miles further we saw another light house near a place where the lava rocks had ~~B~~ gone down to the sea. At this light house point ~~we~~ the Brock crew layed out their 300 foot line for the fish survey.

Brock took the Leica with the 100 WS unit using Black and white films the focus was set a ~~3~~ 2 meters (air) and the aperture at f 11. He endeavored to record the fish survey group, Dilbert and Yamaguchi.

A second roll of film Kodachrome was exposed at 1 meter at f 8 CC15 filter. Brock reported many fishes.

He then ran a roll through the Robot camera using a guide factor of 20 to 30. no filter 1/100 sec.

A third roll of film Kodachrome was put in the Leica. I shot 5 or so ~~exposures~~ - then the film would not wind. I came up for lunch - freed the wind and re assembled the camera. Unfortunately I caught the clip ~~over~~ the Edge of the plastic case. this made the camera leak. Sad! I flushed the camera with fresh water twice and let it dry.

Monday A.E. Edgerton
Sept 29 1952.
Likikia Hotel. Kailua Kona Bay Hawaii.

We went by car today to the city of Refuge Honaunau south of Capt Cooks Monument.

Brock and Miller went down about 150 feet with the aqualungs into a hole in the bay.

Brock used the Robot with flash while Miller used the Fenjohn camera movie.

I went down about 50 feet but my ears hurt some.

Brock shot some photos at 50 ft down of an eel that was speared by Gilbert.

Then the Robot failed to flash the tube. I changed batteries at the Hotel - the thing still did not fire. A coil is probably shot or the flash tube.

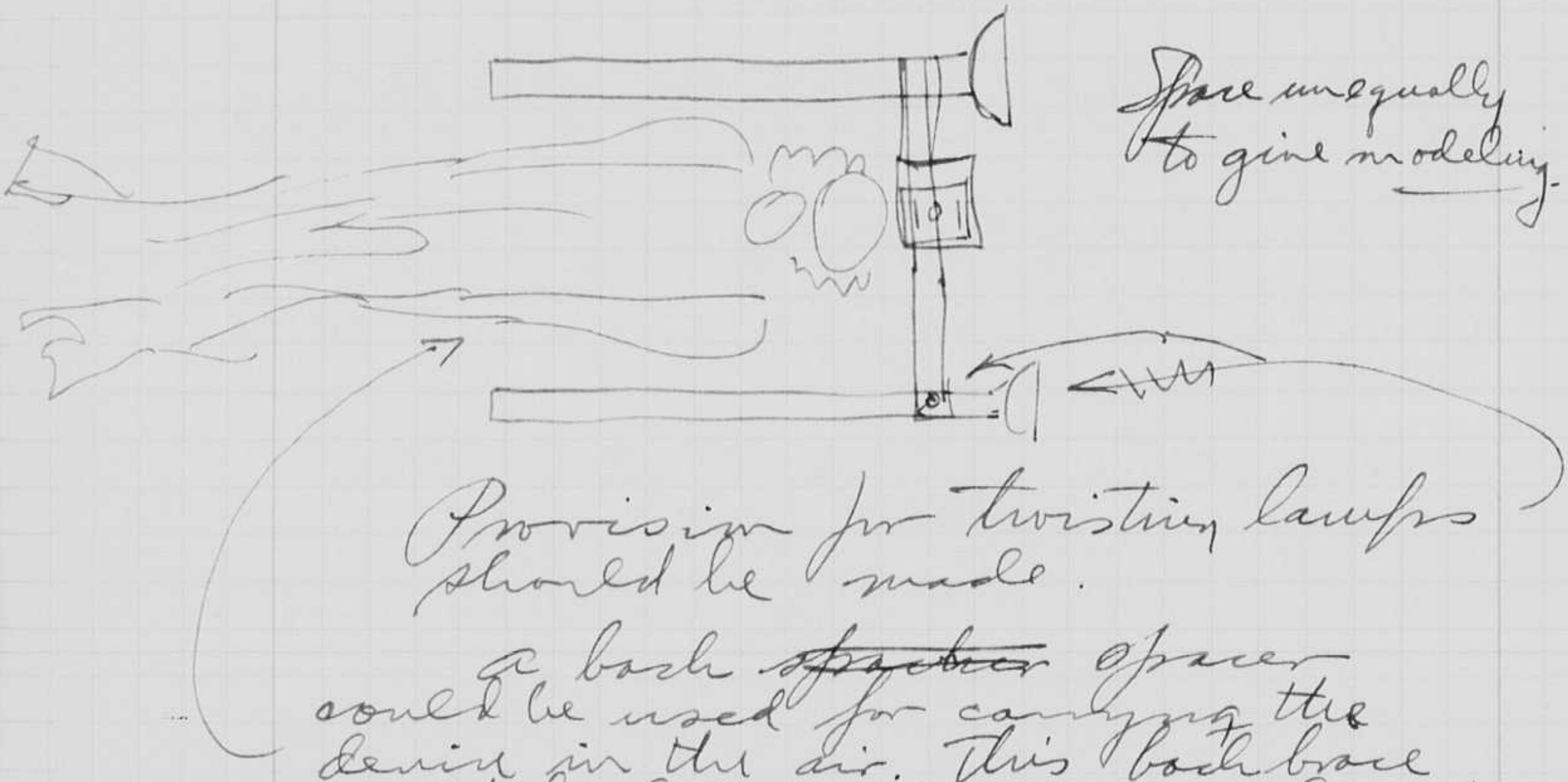
I sent the camera to Oahu this morning via Wollford. (Wollard).

Sept 29 1952 Kona.
Harold E. Edgerton.
Comments upon present design of U.W. Lamp and suggestions for new model.

Balance is very important - both total and fore and aft. The square job seems to be about right.

More light could be used for Kodachrome and color film.

Two lights could be used on the same camera with a support between the two.



Provision for twisting lamps should be made.

A back spacer spacer could be used for carrying the device in the air. This back brace could be taken off with a clamp when the device is put in the water.

Oct, 4. 1952,

The entire party at Kona left by truck and car for Hilo on the morning of Sept 30. Lt Miller and I took an army plane to Hickam field.

Returned apparatus to the Fish and Wildlife office for repair and adjustment. The Leica is in very bad condition after flooding at point, Weather hot with rain.

On the Oct 2 I went with Miller to the sub base at Pearl Harbor. He took a sequence of photos of a diver leaving the escape hatch in the tower.

Then we went to the mine demolition base at Barbers Point where we met Lt Brooks of the U.S.N. Mine Disposal Unit-1.

~~Two~~ rubber boats with six men were assigned to us for use at Nanakuli Beach.
(or Maili Point)

My boat was flipped over by a large wave in about 6 ft of water. Nothing was damaged. It was exciting to have three men, two aqua lungs, and a camera with strobe plus fins, masks etc come down on top of me in the water. The water was not clear at this place due to the Kona (South) wind.

~~Oct 3 (Fri~~ Evening of Oct 2 Garth Murphy tested the 2000 ft camera in the Pool at Uni Hawaii. Although there was a slight leak the photos were ok. A series were taken on Super X at f 5.6 at several distances to show depth of field.

Oct 3. Tested flash equip, Robot, exposure meter, and Fenjohn for magnetic fields. The meter was the only device which had much effect in the field. All the others are safe a 4 ft away.

 Oct. 4, 1952

HE Edgerton.

R.P. (Kailua 62251)

Lt Clark USAF pilot assigned to Hickam field invited us to work with him in his boat on the north side of the island. I called Lee Carr and he went with us. Clark lives at Kailua. From there we went to his landing on the ~~west~~ South side of the Mas Kaneohe Bay.

We went north past coconut island to two islands that were covered with birds. Frigates and sooty terns.
Moku Manu.
(Island Bird)

There is a large cave in the north side of the largest island.

We anchored on the leeside of the largest island and went under sea with the aqualungs. Don took movies of fishes and the still camera.

I shot quite a few photos of the propeller and the rudder of the ~~boat~~.

Miller then took the still camera and shot some fish on the bottom at 30' ft deep.

H E Edgerton
Oct 5 1952

Took day off - went swimming in beach at Waikiki off Halekulani Hotel. Took tanks to Sub Base for refilling

Gave talk at Halekulani Hotel in evening. Showed some fish pictures.

Large white fish at Hawaii in schools.
Opelu Kala
Naso hexacanthus

Butterfly fish
Kihi Kihi
Heniochus acuminatus

Orange spot Surgeon fish

Pakui Kui
Acanthurus achilles.

Notebook # Aug 4, 1952 - Oct. 19, 1952

Filming and Separation Record

____ unmounted photograph(s)

____ negative strip(s)

4 unmounted page(s)
(notes, drawings, letters, etc.)

was/were filmed where originally located between page 54 and 55.

Item(s) now housed in accompanying folder.

MIT Honolulu

~~This meeting~~
Today ~~I wish~~ it is my pleasure to show you some pictures – in particular some pictures of underwater subjects. I am here in Hawaii to test out an experimental type of flash equipment that seems to have some uses for underwater still picture photography. This effort is being sponsored by a small grant ~~from~~ the National Geo Society to M.I.T. where considerable development effort has been expended upon electronic flash systems.

The underwater world is more vast than the above water, in fact more of the earths surface is covered by water than not. Furthermore the deeps are deeper than the mountains are high

HALEKULANI

HONOLULU 15, HAWAII

Those who endeavor to learn of the mysteries of the sea have many methods - all of which are employed by oceanographers and geologists. One of the most powerful methods for visual observation is the camera. The object of my effort is to make this medium for research more powerful.

Every device is a compromise. I hope to get under water camera devises to be well designed and easy to use by a host of people who endeavor to learn of the under sea world.

One riding in a glass bottomed boat gets a preview of the under water world. However one who dives especially with the new Aqua Lung equipment actually becomes a part of the new world. He floats

HALEKULANI

HONOLULU 15, HAWAII

with the greatest of ease. Everything is different. Above him is the flat top ceiling - the top of the water above which we live. To him it is a surface to avoid - a boundary.

As a diver goes down he notices that the red light fades very quickly with depth. At 30 or 50 feet down even in the clearest water - the reds are gone. As he goes below a hundred feet - everything becomes dark. Now photography requires light - lots of light and this is where I come in.

For some years a group of us at M.I.T. have been developing stroboscopes and high speed flash devices for taking records of rapidly moving devices and subjects.

HALEKULANI

HONOLULU 15, HAWAII

Probably many of you are familiar with the electronic flash system. I have a portable type here which has the ability to take many photographs. The speed of the flash can be very short. and as many pictures as desired can be taken.

This kind of lamp is what is needed for underwater scenes.

HALEKULANI

HONOLULU 15, HAWAII

 Monday Oct. 6. 1952

Lt Miller and I left for Kailula (Kailua) with Brock at 9 20 am. Here we met

Kameke S.S.

Mealor Leonard

Daniels S.W

Thomas L.D.

MacDonald R.M.

All above from the mine disposal unit no. 1. Barbers Point. this group brought two rubber boats, and aqualung equipment from their station.

We went by navy boat to Bird Island, the swells on the ocean were very large and there was a strong current. I did not go in but Miller and Brock did for a while. Brock shot 40 color shots on the Robot.

Upon return Miller packed his gear for departure to Washington on the Mars tomorrow.

I am scheduled to go on Wed Oct. 8 via Mats to Eniwetok.

Oct. 17 1952

Alice Bogaluva Eniwetok atol

H E Edgerton
Frank Strabala.

Teletronic checkout. #

The 160" cassegrain teletronic #8 was brought to this island on last Saturday by Whitney & Norton. It was installed in the south wall of the concrete photo house looking out the upper right hand port. (looking at Bokab site).

Checkoff list.

Film holder with xxx film. (Rapatronic type holder)

1. Check image and focus.
2. Take zero photo 1/10 sec.
3. Cross polaroids.
4. Close slow shutter and cock.
5. Open ~~fast~~ shutter.
6. Install fuze shutter.

7. Check plugs and cables.
8. Set switches "on"
   Low voltage
   High voltage
   10 us delay.
   Set delay for 4 on scale (10 us).
9. Set 3KV variac to max (134. V)
10. Set 24 KV to 110 volts.
11. Remove front cover.
12. Turn Fidu marker on.
13. Install film holder and remove slide.
14. Check switches on bat. supply lower level.

 Cont.

Strabala returned to Parry Island at 3.30 pm by Duck. I went as far as "Gene" Island where I lined up the Sun flash with Jack O'Donnell's help. We put the entire 10,000 watt sec into one lamp without an extension cord. It was located at the fence about 200 ft from the building.

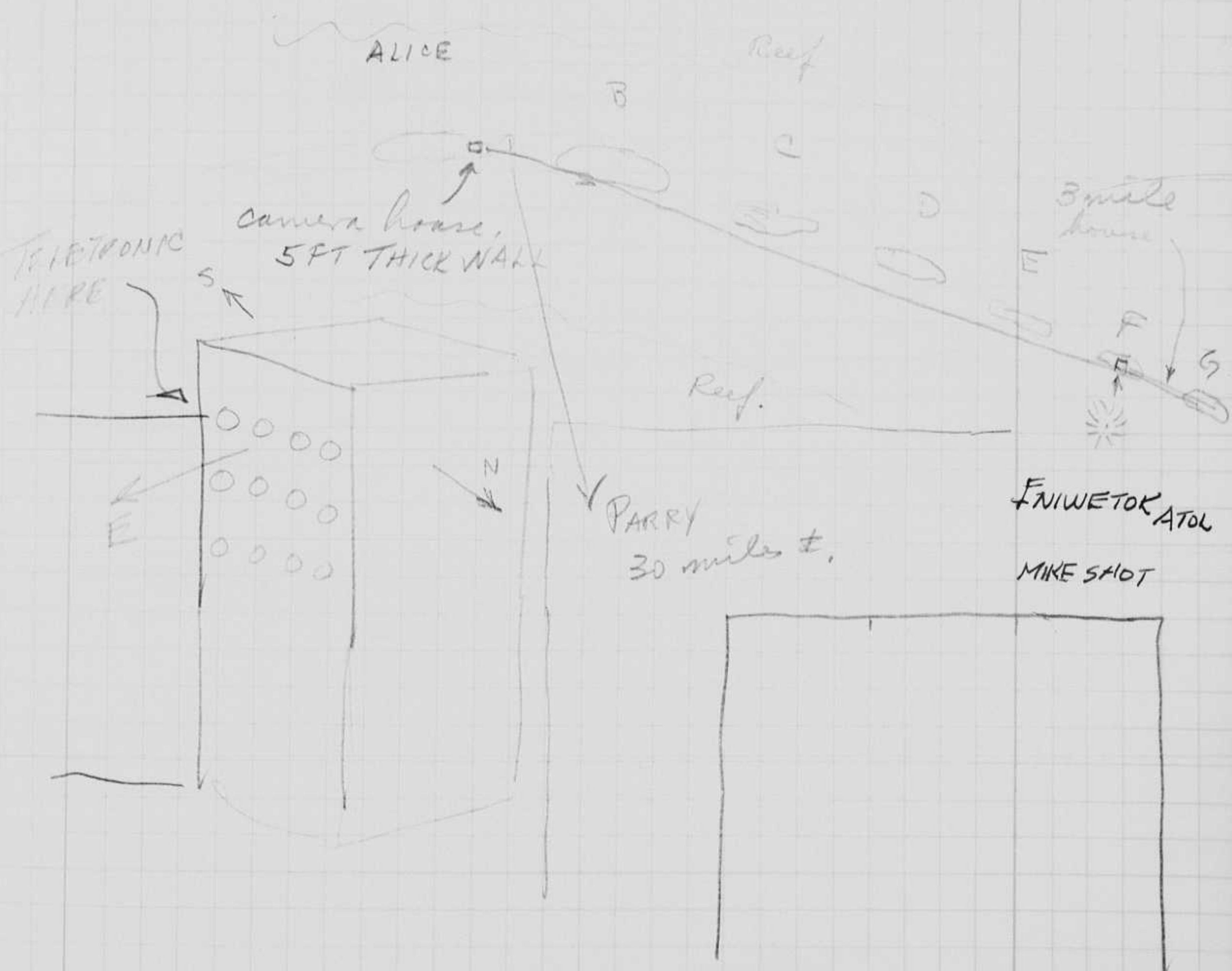
I have the 160" Cassegrain focused on the bomb house. The shutter will be open when the sun flash goes off. Aperture is about f/20. Unexposed polaroids give about Density 1. to 1.5. Tri X film.

Oct 19 1952
H. E. Edgerton.
"Alice"

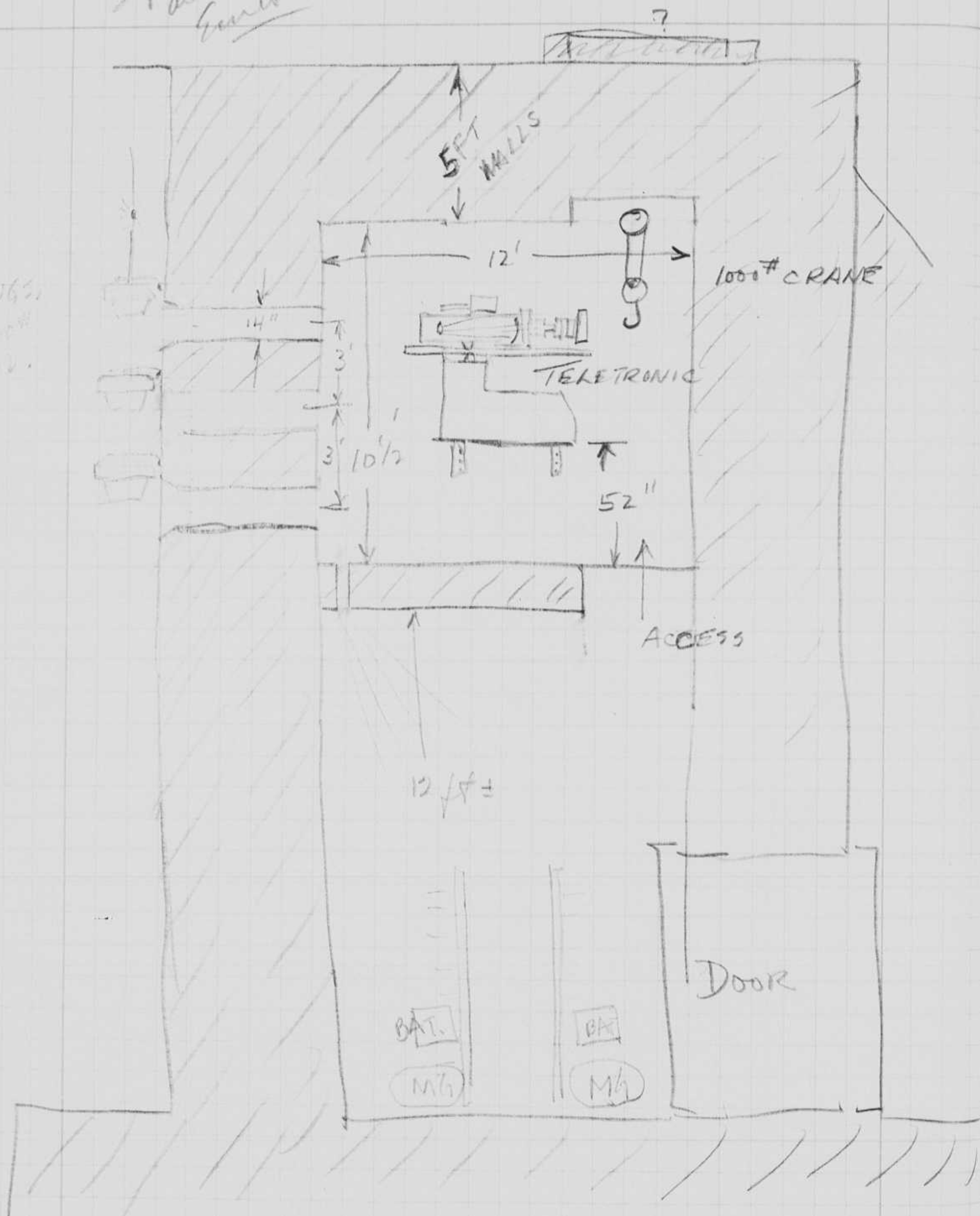
Wyckoff came from Parry Island yesterday afternoon. We met at "Zero" island and came here by duck at 530 pm.

Photos were made of the ~~tower~~ house on microfilm film - 100 sec ~~exposure~~ exposure. Wyckoff regards the exposure thin but ok.

The Sun flash is now set up for about 50 ft from the bomb. I hope to make an exposure tonight of the zero position. Tents and work trailers were to be removed from the line of sight.



Oct 19 1952 "Olive" Eniwetok. SOUTH WALL OF BLOCK HOUSE.



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