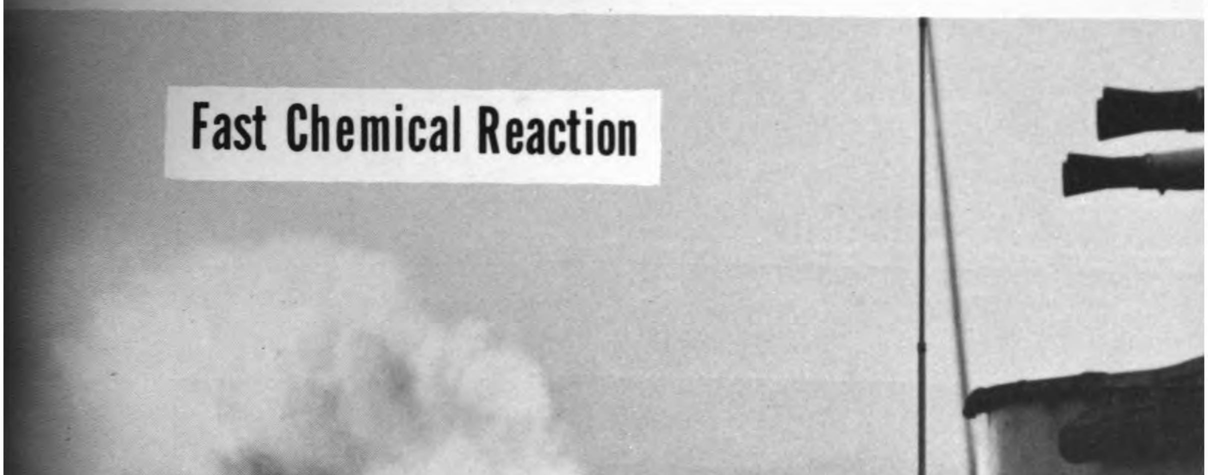
OFFICE OF NAVAL RESEARCH JUNE 1953

RESEARCH REVIEWS

Fast Chemical Reaction



NAVEXOS P-510

DEPARTMENT OF THE NAVY
WASHINGTON, D. C.

COVER PHOTO: A 16-inch gun aboard USS IOWA makes a perfect powder puff as her number two turret opens up in support of UN ground forces on Korea's west coast. The propellant charge in any gun must burn fast enough to propel the shell forward but not so fast that it acts as a high explosive and blows the gun to pieces. This is one of many reasons why it is important to be able to control and measure the rates of fast chemical reactions. For more about this, see "Chemical Reactions Behind Shock Waves" by Norman Davidson pages 19 to 25.

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Research Reviews endeavers to report briefly highlights of technical progress in research by Navy laboratories and contractors and the development of important naval research facilities. Articles which meet these broad criteria and possess a good degree of readability are welcomed. Manuscripts and changes of address should be sent to Code 740, Office of Naval Research, Washington, D. C.

Approved by Bureau of the Budget, 14 February 1952

In This Issue

Two University of Michigan scientists extract plant fossils from a rock in the Colville River bed three miles below Gubic, Alaska.

Searching for Plant Fossils in Alaska

Chester A. Arnold

... Curator of Paleobotany at the University of Michigan, is the author of three books in that field including an Introduction to Paleobotany.

An opportunity to search for botanical fossils in the Arctic was something I had long hoped for, and when the Director of the Arctic Research Laboratory at Point Barrow suggested late in 1950 that I present the matter to the Office of Naval Research, I got busy. The plan, as finally approved by ONR, was for a party of three to spend July and August of 1951 in the Naval Petroleum Reserve No. 4—an area a little smaller than Indiana which occupies northern Alaska between the Brooks Range and the Arctic Ocean.

The Colville River forms the eastern and most of the southern boundary of the Reserve, and its northern limit is the ocean beach. Its southern half lies within the Arctic Plateau, a rolling terrain with elevations ranging between 600 and 6000 feet that is cut up by streams fed by drainage from the Brooks Range. At its northern edge the plateau levels off onto the Arctic Plain which is practically featureless except for thousands of lakes and ponds and sluggish meandering streams that look as if they flow nowhere.

Human habitations there are limited to two or three small coastal villages such as Barrow and Wainwright, several oil-well drilling camps of temporary duration, and a few scattered settlements at the foot of the Brooks Range on some of the larger streams. The large Eskimo village of Barrow owes its present size to employment opportunities offered by Arctic Contractors, a civilian corporation that drills for oil under naval supervision. Except for this, the whole population of the vast area could probably be counted in hundreds instead of thousands. Travel within the Reserve is restricted to those who have special permission to enter it. In any case, the region is not readily accessible because of the absence of roadways and scheduled airline flights. Only one or two boats ply the north coast during the summer and call at the villages. The only means of getting around within the Reserve during the summer is by bush plane. As we were to discover, it is just as difficult to explore one's immediate surroundings in the summer because the tundra is so soft that even a one-mile hike is a strenuous, fatiguing experience. It is like treading on a thick innerspring mattress.

Our efforts during the spring months to get information about the location of fossils in this region produced nothing specific, and the trip would be largely for reconnaissance. However, there was evidence that fossils could be found by systematic search. An unidentified Eskimo reportedly had seen "pictures" of plants in the rocks at Skull Cliff south of Barrow. Coal is known to exist quite widely throughout the Reserve, and wherever there is coal the chances of finding fossils are good. Moreover, earlier geological parties had reported a few fossils along the Colville River and other streams north of the Brooks Range.

On July 1, our party, consisting of Dick Scott, Stewart Lowther, and myself arrived in Fairbanks. On July 3 we took the "linehaul" for the 3-1/2-hour, 600-mile flight from Fairbanks to Point Barrow. We crossed the Yukon River, the Brooks Range, the Colville River, and were soon over the wide flat half-land, half-water Arctic Plain. This area looked like an unreal world. Over the tundra we saw that unique phenomenon, the "patterned ground." The ground is plainly marked off into squares and polygons from 20 to 60 feet across—sometimes the pattern exactly resembles the street plan of a razed village. The pattern is not so evident to one on the ground except that the number of ditches seems unusual especially since they do not serve for drainage. They are sometimes six feet wide and four feet deep, although most of them are smaller. By digging down a few inches, one finds the cause of this striking phenomenon. Underneath the ditch is solid ice which extends downward for several feet in a wedge. These wedges make a network that produces the pattern seen from the air.

After crossing more than a hundred miles of lake-dotted tundra, the ice of the Arctic Ocean loomed ahead, and below, on the narrow beach that separates the tundra from the water, were the quonset huts of the Arctic Contractors' work camp at Point Barrow.

When the plane landed at the Point Barrow airstrip, we were met by the assistant to the Director of the Arctic Research Laboratory who took us by jeep the half-mile to the Laboratory. The Arctic Contractors' camp, in which the Arctic Research Laboratory is located, consists of about 200 quonset huts arranged in two principal "streets" along the shore. Because of the unstable condition of the frozen ground underneath, these streets, which are about one-half mile long, are paved with loose beach gravel. The only firm surface around is the airstrip which is covered with heavy iron grating that makes a serviceable though bumpy landing surface.

The quonset huts of the camp furnish living quarters for several hundred laborers, maintenance shops for machinery, laundry and dry-cleaning establishments, a gymnasium, movie theater, and hospital. Arctic Contractors supplies most of the facilities for the Arctic Research Laboratory.

Supported by the Office of Naval Research and administered by Johns Hopkins University, the Laboratory consists of three huts joined together. They house 17 laboratories for investigators, the director's office, a library, garage for "weasels," work shop, photographic dark room, and sleeping quarters for investigators. During the summer of 1951, there were about 40 investigators in the Laboratory representing some 16 universities and scientific institutions and engaged in many different biological and physical projects.

The entire Reserve is underlain by permafrost, (i. e., permanently frozen ground) which is amazingly deep, 1800 feet in places. During the short summers a surface layer thaws to a depth of one or two feet. This "active layer," as it is called, is not true soil in most places, but a partially decomposed peaty substance that supports a copious growth of lichens, mosses, dwarf birches, Arctic willows, and other tundra plants. It holds water like a sponge, and on level ground tracks made by motor vehicles immediately fill with water.

Patterned ground between Point Barrow and Wainwright.

The Arctic Plain is cooled during the summer by prevailing winds off the Arctic Ocean which carry an almost continuous layer of clouds that often drift along the ground. The annual rainfall is light, four inches or so, and, were it not for the low temperatures and lack of drainage, the country would be as dry as the Great Basin. However, because of the cold and cloudiness a light mist falls much of the time, and clear days are few. Farther south, on the Arctic Plateau, there is more rain but also more clear weather. Although the summer temperature at Point Barrow seldom goes above 60 degrees Fahrenheit one occasionally experiences 80-degree weather on the Colville River 200 miles inland. There the humidity is high, probably about 80 percent, and the heat becomes oppressive. Such heat, however, seldom lasts long. The first cloud that drifts over the sun sends the temperature tumbling 20 degrees or more in only a few minutes and one's coat must always be within reach. These sudden temperature drops may bring on mist or fog.

Lakes and streams on the tundra between Point Barrow and Wainwright.

Extending as it does from 150 to 350 miles beyond the Arctic Circle, most of the Reserve is bathed in continuous daylight throughout part of June, all of July, and part of August. However, even though the sun swings in a great circle around the horizon day after day, there is a noticeable increase in the activity of nocturnal animals, and the water-fowl begin to search for nesting places when the sun enters upon the northern half of its daily journey. Because of the continuous daylight, temperature changes other than those brought on by cloudiness are slight during the 24-hour period. If the sky is clear, it is almost as warm at 2 a. m. as at noon. Our Arctic sleeping bags were sometimes too warm for comfort.

A widespread notion about the Arctic is that it is inhospitable to life. This is most erroneous. Every inch of the tundra surface, except bare rock, is padded with growing things. Neither is it inimical to animal life. It seems to furnish an all too congenial habitat for the mosquito, and is the nesting place for numerous birds. Large mammals, the moose, caribou, grizzly bear, wolf, and fox find that they can compete more successfully here against a rigorous climate than against man in the surroundings of his choice. Another fact that one seldom considers is that conifers, which thrive in cool climates, do not extend as far into the north as the angiosperms which, with their almost endless ability to diversify, have established themselves and can hold out right on the Arctic shores. The gymnosperms are the only class of plants that does not exist in any form in the distant north. Although ferns are scarce, all major plant groups except gymnosperms are firmly established there.

The Arctic Research Laboratory was merely to be our headquarters while in the north. I knew that I could not count on finding fossils in the wet, soggy, flat tundra near Barrow, but would have to go inland some distance to find rock outcrops. So we decided to explore along the Colville River, using Umiat as the starting point for the first trip.

On Saturday, July 7, we loaded a tent, sleeping bags, collecting equipment, food for 10 days, and an 18-foot canvas boat into a shuttle plane, and went to Umiat, which is in the river valley surrounded by hills. There we found a camp similar to the one at Barrow, but smaller. After a few days at Umiat, we decided to explore the high cliffs along the river between there and Sentinel Hill about 25 miles downstream. We made arrangements to be picked up near that point the following week, and after a preliminary tryout with our boat, we set off on the afternoon of July 11. Stewart placed himself at the stern, Dick fixed himself a seat in the bow, and I took the oars. We were a little apprehensive as to how things might go. Our canvas boat was carrying a 1500-pound burden, and we had unpleasant thoughts of being stranded on some mosquito-infested island in the middle of the river without food or shelter. We expected to reach Gubic in a few days, but until then any encounters with human beings were improbable. Having no keel, the craft was a little difficult to steer, but otherwise it was quite maneuverable. Aided by the current with a speed of 12 miles per hour at places, we made good progress from the start.

During the next three days we made about 15 miles, stopped frequently, caught some Arctic grayling, and camped each night in the willow thickets that covered the gravel bars between the channels. Here the small trees furnished anchorage for our tent stakes and protection from the wind. Several times during the summer we had to lug our gear a few hundred feet to a good site.

The Colville River is a mile wide at places, and the shifting channels form a network of waterways that surround boulder-strewn islands. Because the permafrost does not extend beneath the river bed, the islands support the largest vegetation in the region, and the willows sometimes grow 15 feet tall. Where the ground is not too rocky it is covered with a thick carpet of Equisetum arvense, the "grass" of the river bottoms. The largest plants on the tundra, which begins abruptly at the edge of the river bed where the permafrost begins, are alders and dwarf birches (low straggling shrubs with stems the size of a pencil and a foot or two long).

Below Umiat the left bank of the river was flanked with high bluffs that in some places rose 300 feet or more. The rock consists mostly of bentonitic shale with some seams of impure coal and layers of coarse conglomeritic sandstone. The shale absorbs water and becomes highly plastic and sticky. As the surface thaws in early summer, large masses of mud become dislodged and slide down, accumulating in huge piles at the bottom. Many of these piles extend out into the water and have to be climbed over. The surface is extremely rough, reminiscent of lava flows, and not always firm enough to bear one's weight. Although there seemed to be no danger of sinking completely into the mirey mess, the mud was about as difficult to remove from shoes and trousers as paint. As these mud slides appeared every few hundred feet, they were major obstacles to our progress along the river bank. It was seldom possible to go farther than a quarter or half mile without having to return and get the boat. We saw places where the sliding mud had eroded deep gullies and sluiceways down the steep cliffs. Sometimes they were as neatly formed as if purposely designed.

There were other places where the thawed earth would adhere longer to the steep cliffs, and then come sliding and tumbling down in streams of dry dirt and plunge over the lowermost ledges like waterfalls. Across the river from our last camping site on this trip, at a place where the cliffs were unusually high and steep, great masses of loosened earth fell with a tremendous roar. During the last night there was an almost continuous rumbling.

On July 11 we arrived at Gubic, a well-drilling camp about 15 miles below Umiat. Here we expected to find more of our gear which was to be flown down from Umiat. But it had not yet arrived, and we prepared for a welcome rest. The next day we received the startling news that the plane had crashed and burned with complete loss of equipment. (Fortunately the pilot and only passenger escaped uninjured.) This meant that we had lost 20 gallons of gas for the outboard motor we had expected to use, our parkas, and other heavy clothing, as well as half our food. The cook at Gubic agreed to replenish our food supply, the weather so far had been too warm for extra clothing, and we decided that the outboard motor was not needed. So the following day we continued our trip.

Three miles downstream, a high bluff loomed in sight. We staked our tent nearby in some willows and started for the cliff. Immediately we saw fresh bear tracks in the mud. Then all at once Stewart let out a yell. It wasn't a bear, but a loose rock full of fossil plants. About the size of a desk top and a foot and a half thick, the rock was a mass of foliage, twigs, and cones—the remains of an ancient Sequoia forest.

Among the *Sequoia* fossils were a few dicot leaves, some other conifers that looked like yews, some ginkgos, and other plants. I later learned that we were collecting from the Prince Creek formation of the Upper Cretaceous. This particular rock had rolled down the cliff. Dick located the stratum from which it came high above the river bed not far below the tundra surface, but we had found all the fossils we could collect in the one rock.

The next day we reluctantly broke camp to go farther down the river. We found but few more fossils, however, and returned to Point Barrow on July 19. Back at the Laboratory we displayed our collection of fossils which were the first ones from Northern Alaska that most of the laboratory crowd had seen.

It was eleven days before we could get out again because transportation facilities were not equal to demands and the weather was bad. But on July 30 we loaded our gear into two small planes for a second trip, this time to begin about 130 miles above Umiat. We were taken to a gravel bar below the mouth of the Etivluk River, where our gear was unloaded. We could not have chosen a better spot. Upstream the valley was wide with no extensive rock exposures in sight. But downstream, within a mile of our camp, a series of hairpin turns began with high cliffs at each bend. We found plants at the second place we stopped the next morning, and a seam of pure black coal about ten feet thick extended the length of the mile-long cliff. We saw many such coal seams during the following week, coal that some day might be utilized by the gasification process (burning the coal underground and either bottling or piping the gasses).

Although fossils were nowhere as abundant as at the spot below Gubic, we found them at many places. The rocks were harder and we encountered no mud slides or dirt falls, so that collecting was easier. We were in a different geological formation, the Chandler formation of the Lower Cretaceous. There were more leaves and cones of *Sequoia* and more yew-like conifers. There were deeply cut *Ginkgo* leaves and fronds of ferns and cycads. One of the most abundant plants was the extinct genus *Podozamites*, a plant of uncertain affinities but suspected by some botanists to be an ancient relative of the podocarps. Only occasionally did we find a fragment of a dicot leaf, and at fully half the places we saw none at all. Chunks of silicified wood were frequently found. At one place we found wood that I later identified as *Cedrus*, generically identical with the modern Cedar of Lebanon.

There are very few place names in northern Alaska that collectors can cite in recording localities. Most of the larger streams bear names, and with modern maps it is not difficult to know within a quarter of a mile where one is. However, almost the only way to make a permanent record of a locality is to mark places on a map and publish a sketch of the map. Attempts to give latitude and longitude are usually not very successful; sometimes the meridians have varied as much as 10 miles.

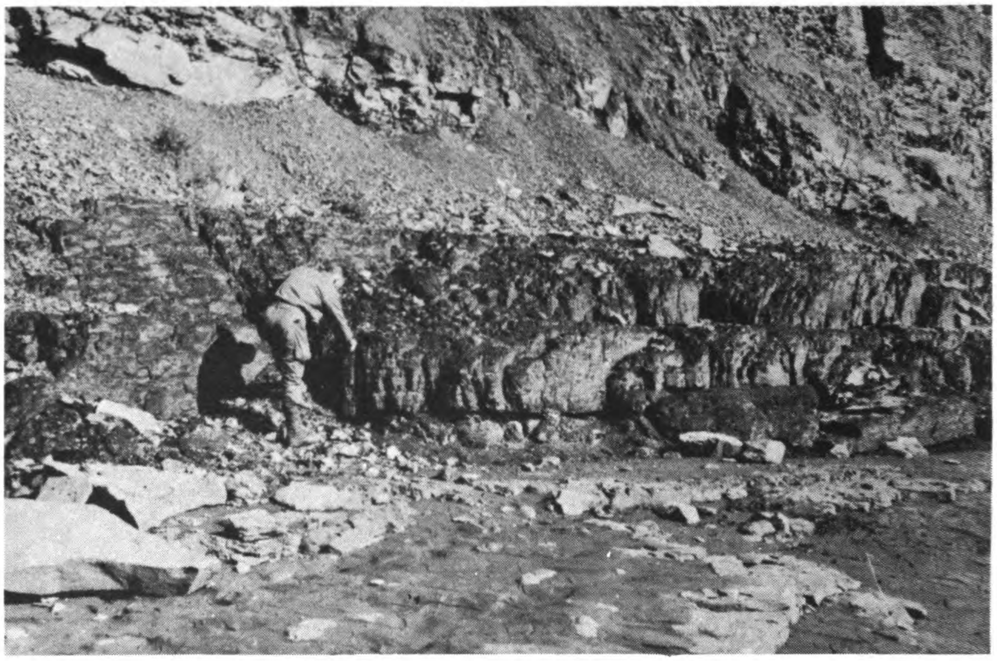
On this particular trip I had to invent a few place names where we found fossils. "Roaring Cliff" I called a spectacular bluff on the Colville River at least 500 feet high and a mile long that flanks the third hairpin curve we passed on August 1. The name was suggested by a heavy roar resembling that of a waterfall and caused by the wind along the craggy rim. That night we camped about midway around a prominent loop in the river that I call the "Big Bend." At that place the river sweeps around a curve that circumscribes almost two-thirds of a circle, changing its direction from east to west.

This piece of rock bearing compressed leafy branchlets of Sequoia and a fragment of a dicot leaf was found three miles below Gubic.

At the "Big Bend," which turned out to be one of the best collecting places of the summer, low cliffs of shale and sandstone with several coal seams extend the entire distance of more than two miles. Here we established camp, fortunately on a high and dry spot because during the first night it began to rain. By the next afternoon the steady drizzle had become a downpour. After two days of this, confinement in the small tent became too much for us and we ventured out to explore. We found that the river bank for about two miles was littered with highly fossiliferous rock that had fallen from the low cliffs. Quite unexpectedly, we had been stranded beside one of the best collecting places along the river, and, had the rain not halted us, we might have drifted past much of it. By afternoon our bags were full, the rain had stopped, and we started down the river again.

We passed the Awuna River which I had hoped to explore because of reports of silicified logs a few miles above its mouth. However, there was no suitable landing place and we had to pass it by. We then entered a comparatively long straight stretch of the Colville along which good rock exposures are sometimes miles apart. We stopped several times during the next three days and found some fossils. At one place the plants were clearly impressed in a rusty red shale. Since no traces of organic matter remained, it was evident that the whole formation had been burned. A coal seam had probably become ignited, baking the shale and everything in it. An ashy dust arose as we climbed along the cliff.

We were two days ahead of schedule when we reached the mouth of the Killik River where we were to be picked up. I calculated that we had come 85 miles in the past eight days. We were forced to camp 200 yards or more back from the river because the ground closer to the water was too rocky to drive tent stakes. It was here we began to realize that our food was running out. The planes would likely be at least a few days late coming for us, and our food would not last that long. The next morning at the river's edge, I was shocked into a state of near insensibility for an instant by a sharp piercing bark behind me. Not 200 yards away was the Arctic wolf, vociferously challenging our presence within his realm. Apparently he was as surprised as I. When my pulse subsided a bit I



Coal seam (about 10 feet thick) exposed along north bank of the Colville River between the mouths of the Etivluk and Awuna Rivers. Wherever there is coal the chances of finding fossils are good.

began to find him fascinating. I could not help being a little amused at having him at our door with our food supply in the depleted state that it was. He watched us for half an hour, barking belligerently all the time, then gradually backed away and disappeared into the willow thicket a quarter mile upstream. Northern Alaska is one of the few remaining strongholds of the wolf, but even there it faces extinction because of the fifty-dollar bounty offered by the territorial government for each carcass.

Next day, when two planes appeared in the sky, we knew that our fears had been for naught. The pilots made what seemed to us a rather hazardous landing on the boulder-strewn flat where we were encamped. As my eyes took in what looked more like a rock pile than a runway, I asked the pilot, "Can we take off from here?" "I think so," was the answer given with that Quaker-like reserve that seems to become ingrown into the bush pilot. Back at Point Barrow after a two-hour ride, we estimated that our two trips on the Colville River had totaled 120 miles. We had about 350 fossil specimens from 16 localities. Although both of the river portions visited had been selected at random, they had yielded quantities of well preserved fossils.

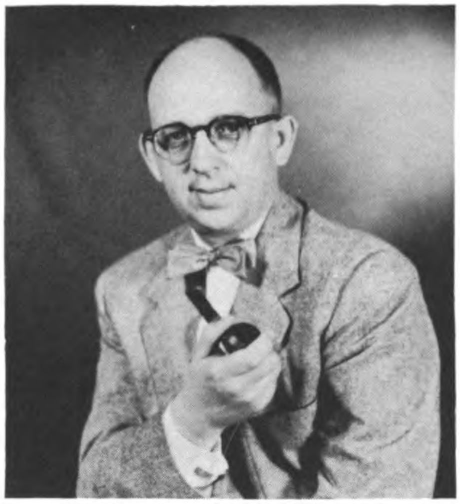
We had planned another trip to Wainwright and the Kuk River, but this had to be given up because of bad weather. Although it was still August, the Arctic summer was almost over; it turned windy and drizzly and the temperature dropped to near freezing. We spent a few hours at Atkasuk on the Meade River. There is a shaft coal mine here where the Eskimos dig coal in the winter. We found a few conifer twigs and some petrified wood where the rocks outcrop along the river.

North bank of the Colville River between mouths of the Etivluk and Awuna Rivers. The loose rocks in left foreground contain a few fragmentary plant fossils.

The results of our venture into northern Alaska cannot be fully stated until the material has been completely studied. However, one fact stands out: There is an abundance of plant fossils in the region we visited. Another fact, one of significance in a more complete understanding of the geological history of northern Alaska, is that the rocks are not all Upper Cretaceous as formerly believed, but at some places are definitely older. Although the Prince Creek formation, from which we collected plants below Gubic, is Upper Cretaceous, all the beds encountered during the second trip along the Colville River are not younger than Lower Cretaceous. This is indicated by the scarcity of dicotyledons and the predominance of conifers, cycads, and ginkgos. How plants that now live only in warm or temperate climates once managed to thrive right under the shadow of the North Pole is one of the most challenging problems of science. All kinds of explanations have been offered for what seems to be an anomaly of nature, but none gives an answer that is entirely satisfactory.

Four Officers Leave ONR Key Positions

ONR wishes "Smooth sailing!" to four Navy captains recently detached: CAPT N. Lucker, USN, Assistant Chief for Research, who will command the USS TACONIC (AGC-17); CAPT F. V. Rigler, USN, Assistant Chief for Administration, released from active duty; CAPT C. W. Shilling (MC) USN, Special Assistant for Bio Sciences, who goes to the U.S. Naval Academy as Senior Medical Officer; and CAPT P. J. Burr, USN, Head of the Air Branch, whose next duty is Commander of the Air Force, Pacific Fleet.



Dr. Howard E. Page

Who's Who in Naval Research

The newest addition to the division-head family at ONR is Dr. Howard E. Page, Director of Psychological Sciences since last November. Appropriately enough, Dr. Page has had intensive training in the three main fields of psychology which are represented by the three branches under his direction: Physiological Psychology, Personnel and Training, and Group Psychology. For three years previously Dr. Page was Head of the Group Psychology Branch, a position which he still holds.

When Howard Page went to college he left Groton, Vermont, with the ambition of returning to his home town as a high-school teacher of mathematics. But at the University of Vermont he came under the influence of a psychologist who changed his outlook and aims, and the town of Groton no doubt lost a good teacher. After graduation, Page went on to Clark University to receive his Ph. D. in experimental psychology (his specialty: vision) in 1940. For less than a year he taught at Amherst College, then was called to active duty.

The Army kept him five years—selecting, classifying, and assigning troops. Returning to inactive duty as Lt. Col. Page, he spent a year at the Vocational Counselling Service, New Haven, Connecticut, then three years at the Naval Air Station in Pensacola, where he studied the problems of selecting pilots and evaluating training practice. "Here," says Dr. Page, "it became clear I had to make a decision—either in favor of more research or in favor of more administration of research."

His decision to come to ONR—which neither he nor ONR has had cause to regret—took him clearly down the path of administration. It also gave him the opportunity to investigate a third phase of psychology. His education had been in experimental psychology, in the Army he had done personnel research, and now he was to administer contracts in social psychology. With this background, with his easy direct approach to problems as well as people, and with the reputation he had created for himself in the scientific world, Dr. Page was just the man to direct ONR's psychology program.

Dr. Page lives in Arlington, Virginia, with his wife and three children—aged 5, 7, and 9. He is quite a carpenter, even carrying out such ambitious projects as building a cabin in Vermont! He also teaches a course in human relations in management at American University. When he needs a rest, he picks up a mystery story or does a bit of gardening. (SGF)

Salmon, Science, and the Sense of Smell

Arthur D. Hasler

...Professor of Zoology at the University of Wisconsin and specialist in hydrobiology

Warren J. Wisby

...Research Associate on the ONR project on fish behavior at the University of Wisconsin

with
James A. Larsen

...Science Editor, Univ. of Wisconsin News Service, lecturer on journalism at the Univ.

To commercial fishermen of the Great Northwest autumn means at least one thing--the famous salmon run in which the gamiest fish of the Pacific Coastal waters battle up into the torrential Cascade Mountain streams where they spawn. The fishermen's hope that the salmon will be there in great number fades a little each year as more and more of the migrating salmon go headlong into the great new dams in that area, to die before they breed. Despite the fact that each dam is designed to include fish lifts or ladders, no fishway has yet been devised which can permit an adequate percentage of the salmon to surmount these barriers. Many of the salmon cannot or will not use them. The result has been a marked decline in commercial fishing within the past decades.

The salmon takes his first long swim at a few weeks of age when he starts the trip downstream to salt water. He remains several years in the sea, and then returns to his home waters to spawn. On both journeys he encounters the dams and, at every encounter, the salmon ranks are cut to a fraction of what they were at the journey's beginning.

For hundreds of years the spectacular display of the migrating salmon has captured the imagination of men. The sight of one hundred pounds of fish hurtling into the air above a rushing waterfall was part of Indian folklore in the Pacific Northwest long before Rogers and Clark crossed the Great Divide. Its enchantment invests the commercial trade in salmon and increases the lure of the salmon for the modern sportsmen, who try every conceivable method of attaching one to the business end of rod and reel.

To the naturalist the salmon has been something of a mystery. What impulse sends thousands of salmon migrants back from salt water to spend every ounce of strength traversing hundreds of miles of mountain streams to breed in a gravel bed at some headwater? It is instinct, yes. But what subtle influences of water, light, air, or vegetation guide them unerringly to home streams to perform the function by which all species continue to exist?

Young salmon first see the light of day when they wriggle up through the bed of gravel over which their parents spawned. They spend the next few weeks feeding on the many forms of insects and small aquatic animals found beneath the fallen logs and among the weeds that line the stream bottom. Then comes the first of their urgent migratory calls. They begin to travel in search of salt water, as their parents did four or five years before and as their ancestors have done since time beyond memory.

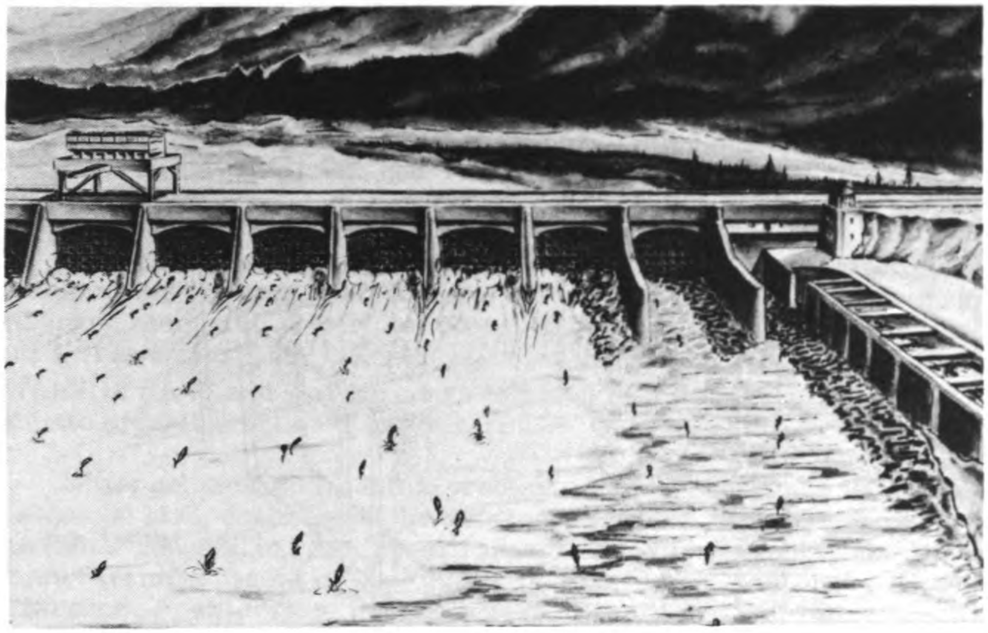
Once they reach the sea, many become food for larger and more aggressive fish, including older, bigger salmon, killer whales, and a score of other predatory species. During the years in the sea the salmon play at their game of "hide-and-eat" with the inhabitants of the sea. When sexually mature, the survivors again answer the call to migrate. This time they return to the streams where life began for them.

Now it is when the salmon--voracious as it may have been during its years in the sea--turns into an extreme conservationist. From the moment these great salmon, some of which weigh a hundred pounds, turn into the freshwater rivers and begin their heroic nuptial swim up miles of cold, fast water, they cease to eat entirely. Their digestive organs atrophy and diminish strikingly in size. On opening the belly of a breeding male for inspection of content, one finds almost no visible remainder of what was once an active, functional digestive tract capable of digesting fish swallowed whole. By the time they reach the breeding grounds they are literally skin and bones. It is not unusual for the skin of these old salmon to be frayed, hanging in shreds, or even rubbed off entirely from spots that have been scraped against rocks or logs.

Then, in the shallows over the gravel beds where they began their lives, these salmon migrants spawn. After spawning they turn belly-up and lifeless and are cast up along the shore. Thousands of pink eggs sink into the gravel bed to hatch, in due time, into another generation of salmon which will continue to follow the wordless command of instinct which directs their lives.

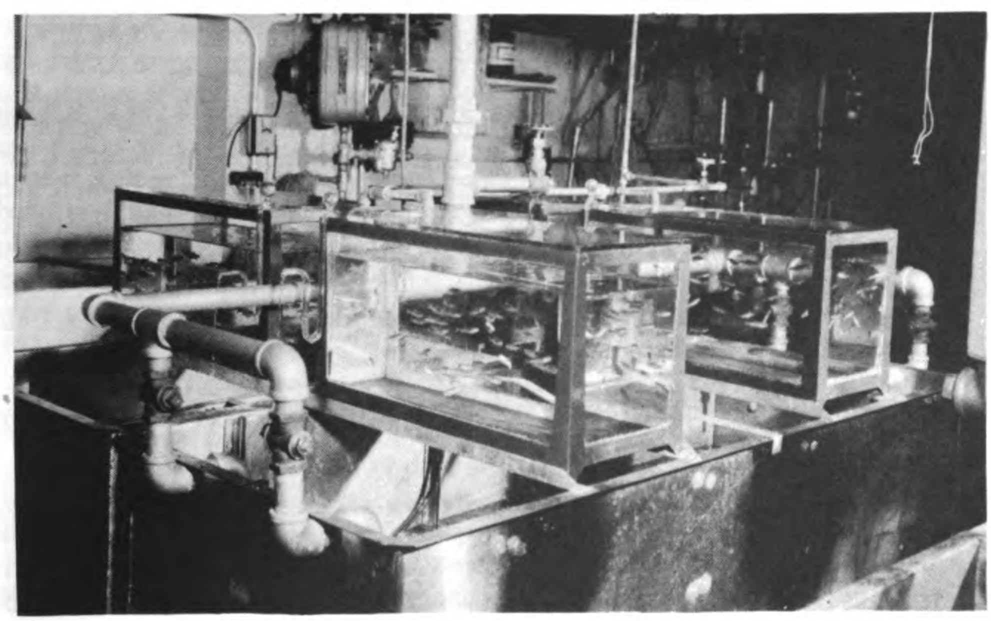
There are puzzles in this story, many of which will remain unsolved for years, perhaps centuries. One in particular has baffled marine biologists, its solution appearing at times tantalizingly close but never yet attained. HOW DO SALMON FIND THE STREAM IN WHICH THEY WERE HATCHED AND HOW DO THEY FIND THEIR WAY HOME FROM THE SEA? As late as 1939, a biologist named Scheer summarized all our knowledge of the salmon's homing ability by saying only that "...... salmon or trout hatched and raised in a particular region will, upon returning to fresh water, return in the great majority of cases to the same region, even from considerable distances."

There are records of marked fish straying from home streams, but the great body of evidence shows this to be the exception. A convincing experiment was conducted in 1939 by Canadian biologists named Pritchard, Clemens, and Foerster. They marked 469, 326 salmon before the oceanward migration, and of these nearly 11, 000 survivors returned to their parent stream. None was ever found in other streams.



This typical dam represents one of the hazards which migratory fish encounter. The fish lift is shown on the right.

A few scientists in the past have hinted at the possibility that a sense of smell may aid fish in migration. Not until 1951, however, was the idea proposed that home waters may carry a distinctive odor which serves as a guide to salmon in the search for their original habitat. This theory presents two distinct problems:



Between tests the salmon fingerlings live in these tanks.

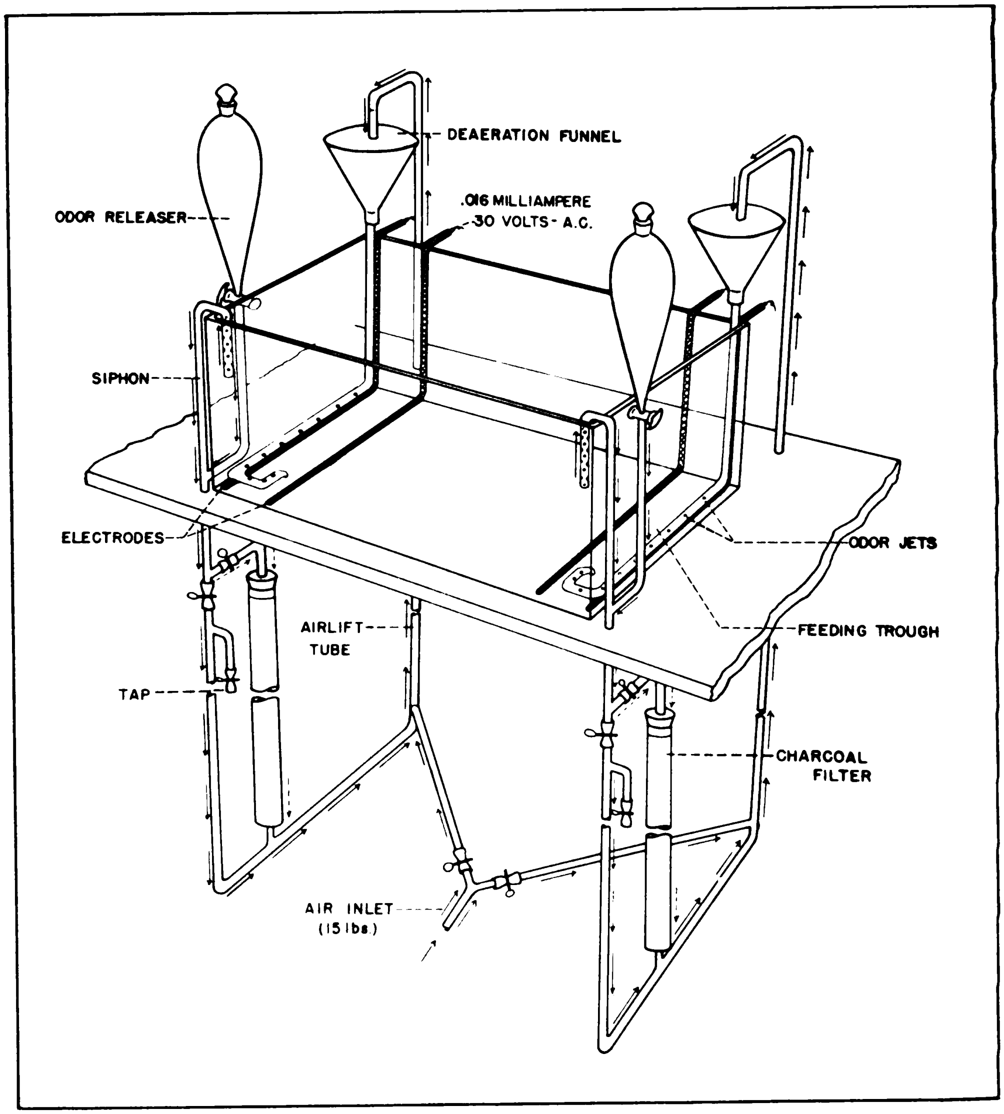


Diagram of experimental set-up used to show that fish could be trained to respond to extremely dilute odors. Even though the fish could not see, they quickly learned that one odor meant food in the feeding trough and that another meant a slight electric shock instead if they ventured into the feeding area.

1. Do streams have characteristic odors to which fish react? If so, what is the nature of the odor?

2. Can salmon detect and discriminate between such odors if they exist?

In order to answer the first question, a group of bluntnose minnows, an animal of proven olfactory acuity, was trained to discriminate between the chemical differences of two Wisconsin creeks. (See: Arthur D. Hasler and Warren J. Wisby. Discrimination of stream odors by fishes and its relation to parent stream behavior. <u>The American</u>

Naturalist 85:223-238 (1951).) The arrangement was such that the fish found food on entering a test zone in their aquarium when water from one creek was being piped in, and received an electric shock if they entered when water from the other was introduced. After a few weeks of training, the fish entered the test zone only after detecting the creek odor associated with food, and avoided the zone when the other odor was perceived.

Proof that the fish were actually smelling the odors was established by destroying the organs of smell of the trained fish, after which they no longer reacted to either test odor. It was also found that these fish could "remember" the differences between the stream odor for long periods of time, and that the odors to which they reacted existed in the volatile organic fraction of the water.

After solution of this initial problem, the next step was to determine if salmon, also, could detect the difference between the two streams. It was found essential to adapt special apparatus for testing salmon. After a short training period it was evident that these fish, too, could detect differences in water from the two creeks. On the basis of the evidence, it appears that substances in the water, probably from the vegetation and soil of the area through which the streams run, impart to each stream a distinctive odor which salmon can smell, remember, and recognize even after long periods of non-exposure.

It seems probable that the odors characteristic of individual streams can seldom be changed even by flood or by pollution. Each stream seems to possess an individual odor which it keeps year after year, enabling salmon to find home streams after long sojourns at sea. This, too, helps to explain the discovery in 1948 that salmon migrants unable to pass Grand Coulee dam yielded spawn that became established in adopted streams, and that eggs from these relocated fish yielded young salmon that "homed" to the adopted stream.

The evidence presented to this point is circumstantial. A mechanism has been outlined whereby it would be possible for salmon to return to their home stream even after a long absence. The theory is now being tested by exposing salmon to an artificial odor through the fingerling stage and then decoying them into a tributary below their home stream when they return from the sea. By conditioning salmon fry in this manner, scientists in the fisheries may be able to train salmon to return to selected waters to spawn, by-passing the streams wherein they would find too many obstacles. In this way, we might conserve one of nature's greatest resources—a source of food protein that takes all its nutrients from the sea.

The number of salmon in one year's catch on the Columbia River alone is sufficient to furnish the protein food needs for one million people for over a year. When this fact is considered, the effort spent trying to save the salmon seems well worth while. Most of the rivers running into the Pacific may eventually be dammed, and conditioning of salmon fry so they will return to adopted streams may help save the U. S. salmon industry.

New Findings on Blood Count of the Rat

Freeman H. Quimby

...Head of the Physiology Branch of ONR, has conducted research on sanitary bacteriology, chronic starvation, altitude respiration, and other related fields.

When William Harvey, celebrated English physician of the 17th century, discovered the circulation of blood, he hypothesized the existence of fine connecting tubes between the arteries and veins. It was not until the invention of the microscope 32 years later that these minute tubes (capillaries) through which the blood flows were actually seen. Since then there has been little consideration of the possibility that blood could normally encounter difficulty in passing through these capillaries. It was simply assumed that the blood collected in the large veins contained the same proportion of white and red cells as that in the capillaries. Clinical technicians have observed a slightly higher white cell count in the blood obtained by finger prick than in blood taken by venopuncture. Little point has been made of this fact, however, and no studies have been made of the question in experimental animals.

Several years ago there was noted a marked difference between the number of white cells found in blood from the hearts and from the tails of mice. No public announcement of this observation was made. Such an idea was so contrary to existing concepts that it was simply assumed to be erroneous. And thus it is that blood has continued to be regarded generally as homogeneous as far as its cells are concerned. Values obtained on blood taken from different parts of animals' bodies were thought to be essentially identical.

While conducting studies on starvation, Mr. Goff, technician at the zoology laboratory of the University of Maryland, and I took many blood measurements from white rats, the experimental animal most commonly used. Our data was clearly inconsistent with the previous views. The total number of white cells, in blood from the tails of animals which had been underfed for several weeks, exhibited a consistent pattern until the animals were sacrificed and the final white cell count was made on blood taken directly from the heart. Here it

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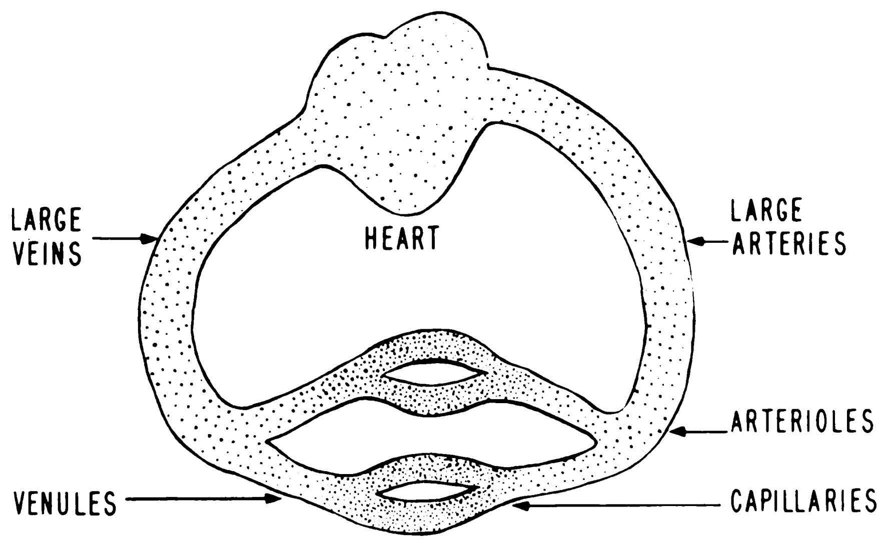
NOTE: The editors feel that this article is of interest, not only because of its scientific value, but also because the research was done by one of ONR's branch heads who spends his time administering contracts. To show that all scientists who "shuffle papers" are not "lost" to research, we asked Dr. Quimby to prepare a summary of this work.



This semi-schematic diagram shows the general relative distribution of white cells in the circulatory system. The vessels which carry the blood to the tissues gradually decrease in size on their way, and successive branching results in vessels of smaller lumen than the parent vessel. The vessels divide repeatedly and form a dense network of capillaries which in the tissues become so small and tortuous that considerable resistance is offered to the flow of the blood. Thus it is collected slowly into the veins. In the human body, where the capillaries vary from 8 to 20 microns in diameter, the linear velocity of blood flow is from .024 to .120 centimeters per second. This is very slow movement, indeed, but often there is almost complete stasis. The idea that these microscopic tubes offer resistance to the flow of blood is not new. The arterioles and capillaries have often been regarded as the principal stopcocks of circulation; however, the concept that these vessels offer a relatively greater resistance to the flow of blood cells than to the flow of plasma is introduced. Certainly no considered attention has been directed toward this fact, nor has its significance been assessed.

was noted that the count was very low. The sudden drop appeared to be due to the source of blood rather than to an experimental variable. In order to continue the original experiments on starvation, it became necessary to determine what the white cell counts were in those areas from which the blood is usually sampled for study. The results were startling—not only because there was a significant difference in the total counts of white cells in blood from the tail and heart, but also because of the magnitude of the difference. There were roughly four times as many cells in the tail blood as in blood from the heart. Immediately apparent was the significance of this fact in all experimental work conducted on blood itself, and in experiments on other topics where changes in blood cell numbers are a measurable effect of experimental conditions. For example, alterations in total white cell counts, as well as alterations in differing types of white cells themselves, have been used extensively as a qualitative and quantitative index of anxiety, fatigue, pain, hormonal effects, etc., in both animals and man.

This finding, however, was not readily accepted. Those who had depended upon or assumed the uniform distribution of white cells through the vascular system in the design of their experiments doubted our results as published, and repeated our studies. Their check results were disturbing. Although the same animals and apparently the same procedures had been used, their findings were not in accord with ours.

Convinced that this discrepancy was in appearance only, and that an unrecognized experimental variable was at the basis of the difficulty, we proceeded with investigations to clear up the confusion. It was noted that our "challengers" had used ether to anesthetize their animals before obtaining the blood samples. There was also the possibility that the variance was due to the difference in strains of white rats used.

In our new experiments, therefore, we tested two different strains of white rats known to be quite different in their response to experimental conditions and handling. We divided each of these strains into anesthetized and unanesthetized groups. Our results published in the American Journal of Physiology (Vol. 170, No. 1, July 1952) confirmed our original report and revealed the probable basis for the contrasting results. In the normal unanesthetized rats there was a marked and significant difference of white cell counts between heart and tail blood, but in rats anesthetized with ether this difference was abolished. Many experiments followed to find out the cause for this difference.

On the basis of known physical behavior of blood in small vessels, it was finally suggested that the chief factor in the relative concentration of white cells in the tail blood was the normal resistance of arterioles and capillaries to the flow of blood. This resistance affects the white cells especially, due to their larger size, and causes them to be held back and dammed up in the peripheral areas of the vascular system. Ether, as well as other substances which relax the contractile elements of vessels and increase their lumen diameter, reduces the resistance offered by the peripheral vascular bed to the flow of blood cells. This brings about a more even distribution of white cells between large and small vessels. Extrapolation of this finding leads one to hypothesize that, in conditions where there is peripheral vasoconstriction, decreased pulse pressure, or cardiac output, the formed elements of the blood are sequestered in the peripheral vessels so that what remains of the circulating blood is relatively limited to plasma. In extreme cases, of course, oxygen and carbon dioxide transfer would be seriously impaired. This might be corrected by administration of drugs which dilate small vessels, or perhaps just the simple application of heat would be effective. Although these differences in white cell concentration appear to be more pronounced in the laboratory rat than in humans, the fact of small vessel and capillary impediment to blood cell flow in mammals is hereby emphasized. The efficacy of hydrotherapy, massage, and exercise in stimulating peripheral circulation is provided with further theoretical and experimental validity.

Chemical Reactions Behind Shock Waves

Norman Davidson

...Ph.D., University of Chicago, is Associate Professor of Chemistry at the California Institute of Technology. During the war he worked for the Manhattan District.

Chemical kinetics is the study of the rates of chemical reactions. The study is worthwhile for two reasons—one practical and one theoretical. The practical reason is that chemical reactions are used to make useful substances or to convert chemical energy into mechanical energy. Obviously such reactions must proceed at a suitable rate, neither too fast nor too slow, if they are to be useful. The theoretical reason is that an understanding of the mechanism of a chemical reaction—a picture of how the molecules actually collide and rearrange—can be gained by measuring the reaction rate and its variation with the experimental conditions, such as temperature, pressure, or concentration of reactants.

It is relatively straightforward, in principle, to measure the rates of slow chemical reactions. One mixes the reactants and at a suitable time subjects the reacting mixture to a chemical analysis which indicates how much reaction has occurred. Alternatively, one can measure some physical property of the reacting system—for example, its color, electrical conductivity, or pressure—which changes as the reaction takes place. In practice, of course, a great deal of skill and hard work is required for a successful measurement.

Chemical kinetics is a comfortably big subject. There are many slow reactions whose rates and mechanisms have not yet been properly studied. Why then should chemists set up elaborate apparatuses (like the one described below which we have made) and go to a great deal of trouble to measure the rates of fast reactions? One reason is that some fast reactions are of considerable practical importance. An example of this is a high explosive which must react and liberate hot gases extremely rapidly if it is to perform its destructive function properly. On the other hand, a propellant charge in an artillery shell or a rocket must burn rather rapidly so that the hot gases generated can propel the shell or rocket forward—but it must not burn so fast that it acts as a high explosive and blows the cannon or rocket to pieces.

Acetylene is made by rapid heating and cooling of methane. If the cooling process is somewhat slower, carbon black is the main product. Both of these products are used in ton quantities in America, but acetylene sells for about one dollar per pound and carbon black for compounding rubber sells for about ten cents per pound. Thus, an understanding of the factors which control the relative rate of acetylene formation as against carbon formation may be of great commercial value.

A second reason for interest in fast reactions is theoretical. A simple reaction such as the attack of a hydrogen atom on a bromine molecule, $H + Br_2 \rightarrow HBr + Br$, is very fast; it probably takes place on almost every collision. Part of the reason why the reaction occurs so readily is that the molecular rearrangement is so simple. The hydrogen atom comes up on one side of the bromine molecule and attaches itself to the nearest atom, simultaneously ejecting the other atom. This example is typical of a large class of reactions frequently encountered. Precise knowledge of these simple molecular rearrangements is necessary as a basis for a theory which will enable us to predict what happens in more complicated cases.

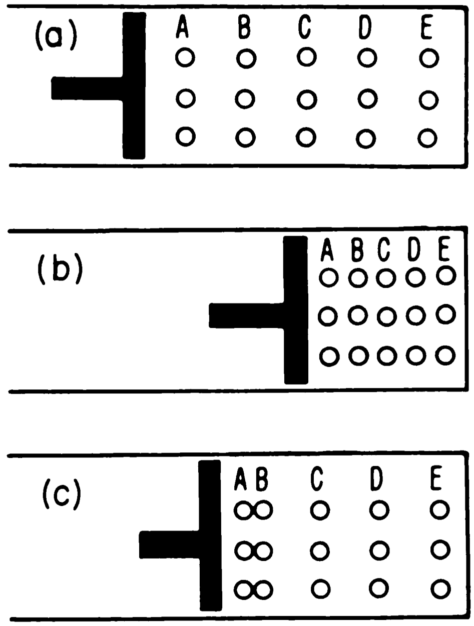
The two problems involved in measuring a fast rate are: (1) to prepare the reaction system so that there is a zero time when the reactants are mixed but have not yet reacted very much, and then (2) to measure the rate of reaction. The standard solution to the second problem, when one of the reactants or products absorbs visible or ultraviolet light, is to make rapid measurements of the change in light absorption by the system by means of a photoelectric cell and a cathode ray oscilloscope. This is a fast and sensitive method.

The most obvious solution to the first problem is to mix the reactants as fast as possible. This is fine. In fact, it is the only method for some reactions. But it takes a certain amount of time to mix two chemicals, and, if the reaction occurs as fast as the mixing, all one can measure is the rate of mixing.

Another general approach is to add energy, in some form or another, in a short period of time to a system which is not reacting. If this pulse of energy initiates a chemical reaction, the rate of this reaction can be followed by the method outlined above. There are several ways of realizing this energy pulse idea—by passing an electrical discharge through a gas; by shining a lot of light into a system in a short period of time by means of a high-speed flash lamp; or by heating a gas rapidly by compression.

The method to be discussed in detail here is an example of rapid compression. It is illustrated in the diagram on the next page. The gas in the cylinder is rapidly compressed and heated by moving the piston inward. The molecules are depicted as being stationary; they are, of course, actually moving quite rapidly in all directions and their average velocity of random motion is a measure of the gas temperature. The inward moving piston hits the gas molecules and thereby increases their velocity and temperature. This must be done so rapidly that the gas molecules are not cooled by collisions with the cooler walls of the cylinder. A small motion of the piston imparts additional motion to molecule A which then moves over and hits molecule B which then hits C and so on. The heating is transmitted from A to E at a velocity that is approximately the velocity of the molecules. If the piston is moving at a velocity considerably lower than this, then it does not move very far in the time required for its effect to be transmitted from A to E; the gas is being uniformly heated and compressed. This is depicted in (b). It is what happens in the normal operation of an automobile engine (with each piston going at about 4000 revolutions per minute); in the compression cycle preceding ignition by the spark, the piston compresses the gasoline-air mixture in about 0.0075 second; the piston moves at a velocity of about 1000 centimeters per second, which is about 1/40 the velocity of the gas molecule; and with a compression ratio of 6, the gas is heated by about $300^{\circ}C$.

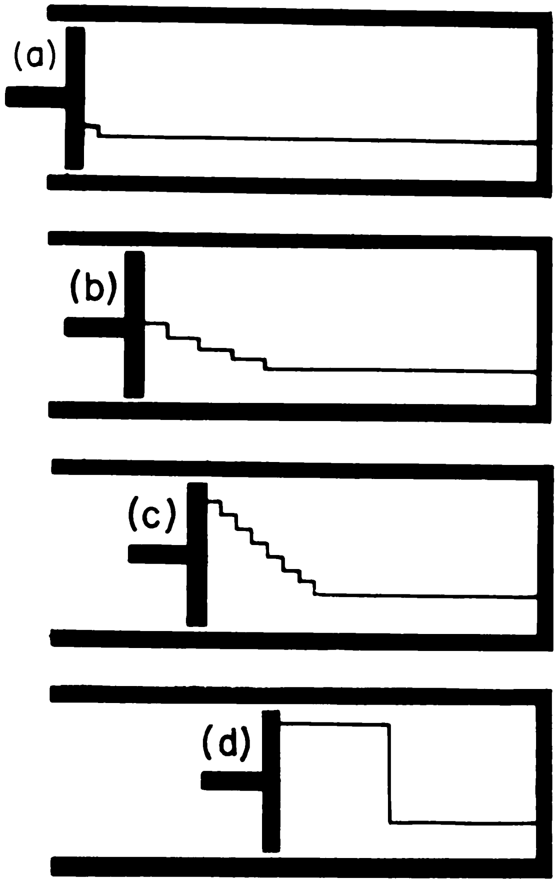
Suppose it is desired to heat the gas more rapidly and the experimenter manages to get the piston moving at a velocity comparable to or greater than that of the molecules. Now he must worry about the fact that the piston moves an appreciable distance while the pressure and temperature are being transmitted from molecule A to molecule E. In effect, molecules A and B are heated as much as they are going to be before molecules D and E are heated at all, as depicted in (c). The compressional pressure wave which travels from left to right down the cylinder has interesting and surprising properties which we now consider.



(a) The molecules A, B, C, D, E and the other molecules inside the cylinder are going to be compressed and heated by the inward motion of the piston. (b) The piston has moved in slowly and the molecules A, B, C, D, E have been compressed into a smaller volume and have been heated. (c) By rapid inward motion of the piston, molecules A and B are compressed and heated before the pressure disturbance reaches molecules C, D, E.

In (a) of the diagram on the next page, a small compressional pressure wave has been generated by a single inward jerk of the piston. This pressure wave travels from left to right along the tube at a velocity which is the velocity of sound in the gas—sound being a collection of such small pressure waves. This velocity is approximately the average velocity of the molecules, because the disturbance is transmitted by one molecule moving over and hitting the next one, etc. Obviously, this argument is not an exact one so that the velocity of sound and the average molecular velocity are not exactly the same. In fact, the average velocity of gas molecules is $\sqrt{3\kappa T/m}$, where κ is Boltzmann's constant, m is the weight of a molecule, and T is the absolute temperature. The velocity of sound is $\sqrt{\gamma\kappa T/m}$; γ is a number that depends on the heat capacity of the gas; it is 1.67 for simple, monatomic gases, and about 1.05 for octane, a typical molecule of ordinary gasoline.

In (b) more pressure steps have been generated by further inward jerks of the piston. These travel along the tube, pursuing the preceding one. Each pressure step moves through gas which has been heated by all the previous compressions. Therefore, each step travels faster than the one in front of it and catches up with it. The final result therefore is a single large step-shaped pressure wave. This is called a shock wave.



A shock wave is formed because the rearward pressure steps of a large pressure wave travel faster than the front ones and catch up with the front ones. In the diagram the pressure steps are generated by the inward motion of the piston. The magnitude of the pressure is indicated by the height of the line inside the cylinder.

A shock wave is a wonderful way to heat a gas molecule in a hurry. Each molecule in its path is hit and heated as the wave moves down the tube. It takes only a few molecular collisions for each molecule to pass through the shock front that is to go from the unshocked, unheated condition to the shocked, heated condition. Therefore, at atmospheric pressure, where each molecule undergoes about 10^{10} collisions per second, it takes between 10^{-10} and 10^{-9} second to heat up a molecule of a gas by passage of a shock wave.

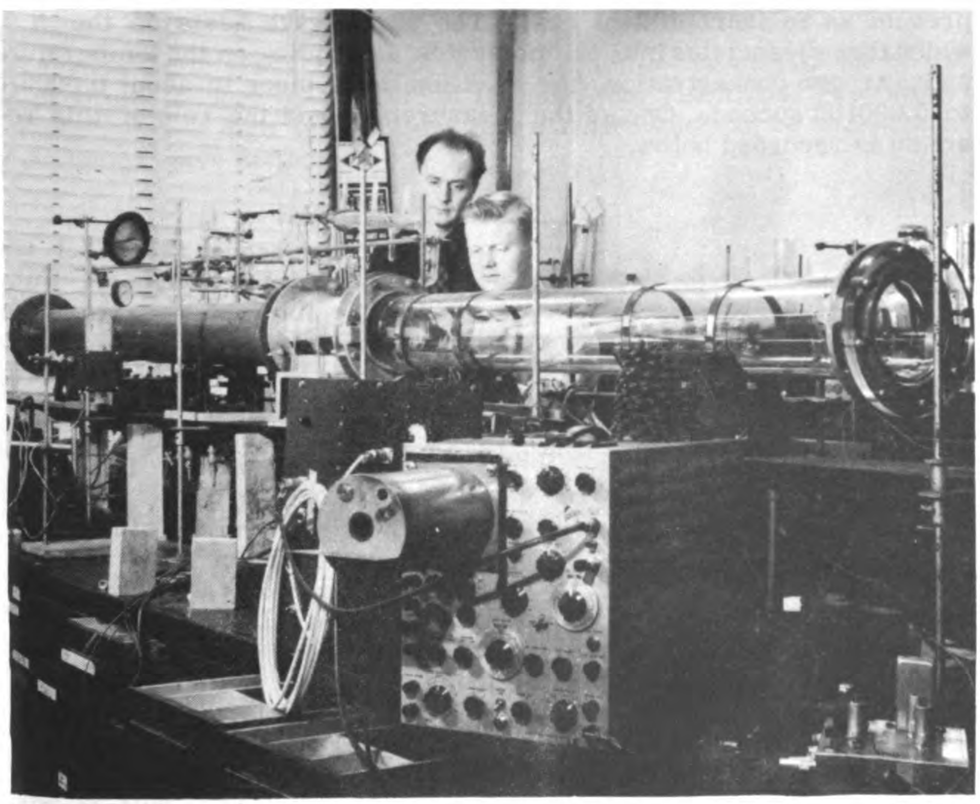
The only impractical feature of the rapid heating apparatus described so far is the piston—to move it at a velocity of 1.1×10^4 centimeters per second (2500 miles per hour!), which would be required to heat air from room temperature to 1000°C, would probably require that the piston be propelled by a cannon. It is practical however to push on one gas with another gas. The device for doing this, called a shock tube, is illustrated in the drawing, p. 25. In this diagram, a membrane M separates the tube into two compartments. The one on the left, labelled H, contains high-pressure gas to push the piston; the compartment S on the right contains gas, at a lower pressure, which is to be compressed and heated. When the membrane M breaks (or is broken by touching a pin to it), molecule A' from the high-pressure side moves over and hits molecule A, A hits B, B hits C, and the compressional pressure wave travels down tube S. At the same time, B' pushes on A', C' pushes on B', etc. That is, the high-pressure gas in H expands and pushes on the low-pressure gas in S; it plays the role of a piston.

With this device it is comparatively easy (that is, just an ordinary difficult scientific job) to generate good shock waves. For example, with a pressure of about 1 pound gauge of air in S, a pressure of about 130 pounds of hydrogen in H produces a shock wave which travels through the air at a velocity of about four times the velocity of sound and heats the air up to 1000^{o}C. (It is assumed here that the hydrogen does not mix with the air and react with it but simply pushes on it. Because of their low mass, hydrogen molecules have a high molecular velocity and are good pushers.)

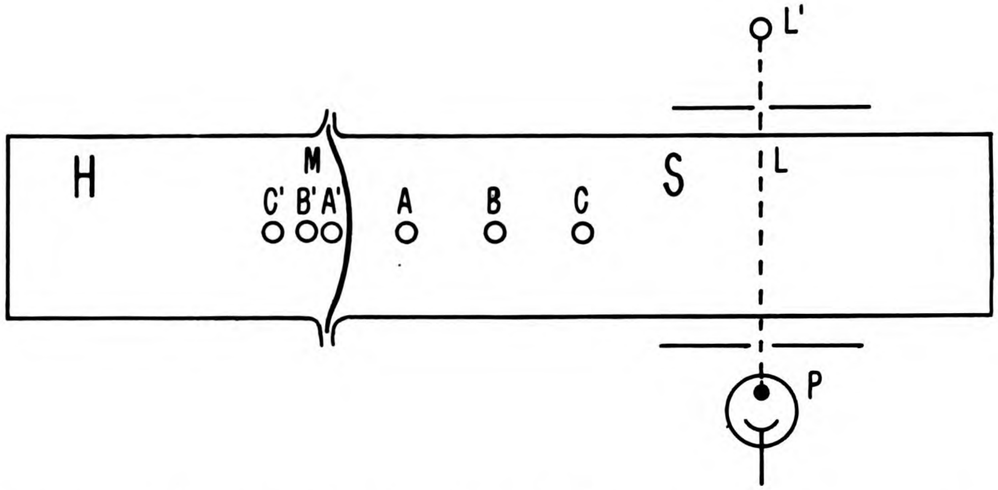
One other feature is shown in this shock tube. There is a light beam, L, that shines through the tube. As already described, the rate of a chemical reaction in a color change can be measured by photoelectric measurement of the change in the light transmission of the system. An example of this sort of investigation was recently completed in our laboratory by Dr. Tucker Carrington. The chemical reaction is

$$\underset{\text{colorless}}{N_2O_4} \rightarrow \underset{\text{brown}}{2\,NO_2}$$

Nitrogen dioxide, NO_2, is a brown gas—it absorbs blue light. Two NO_2 molecules stick together to form one N_2O_4 molecule, which is colorless. At low temperatures, the stable form is N_2O_4. When the temperature is raised, the molecules are broken apart into NO_2 molecules and the gas becomes more colored. The rate of this reaction has been measured

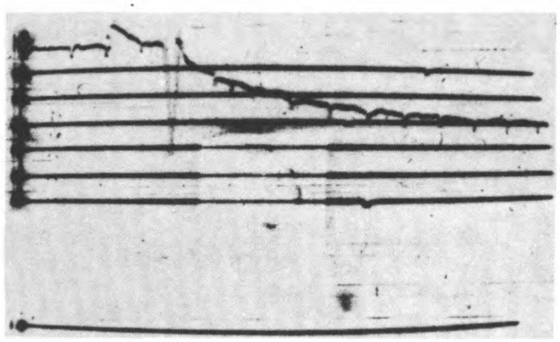


Graduate student Gary Schott and the author examine a shock tube now in use in their laboratory. The glass section to the right contains the low-pressure gas to be compressed and heated, and the steel pipe to the left contains the high-pressure "driving" gas.



Schematic diagram of a shock tube. Molecules A', B', C' are in the high-pressure (driving) section, H, separated by the membrane, M, from molecules A, B, C, in the low-pressure (driven) section, S. L is a beam of light from the lamp, L', shining through the tube, S, on the photocell, P.

by passing a shock wave through a gas containing N_2O_4 (nitrogen was present as an inert diluent gas). The shock wave heats up the N_2O_4 which then dissociates into NO_2 molecules. Depending on the temperature and nitrogen concentration, the reaction takes place in about 0.000010 to 0.000100 second. One of the measurements of the rate of this reaction is recorded below.



Oscilloscope record of the rate of reaction, $N_2O_4 \rightarrow 2NO_2$. The line which starts at the top left is the photocurrent and the bottom line is zero photocurrent. The other horizontal lines are calibration marks. Time proceeds from left to right. The little downward pips on the photocurrent trace are timing markers 10 microseconds apart. The first small positive signal is a time marker from a delay circuit and is related to the measurement of the velocity of the shock wave. The large negative spike occurs as the shock wave intersects the light beam and is due to refraction of the light beam by the large refractive index gradient at the shock front. After this we are looking at heated gas in which the reaction $N_2O_4 \rightarrow 2NO_2$ is occurring. As NO_2 is formed over a period of 70 to 80 microseconds, the light transmission and photocurrent decrease. The initial conditions were: -27°C; nitrogen partial pressure: 1 atm; N_2O_4 partial pressure: 0.004 atm. The Mach number of the shock wave was 1.117, the final temperature was -8.5°C, and the final pressure, 1.33 atm.

A shock wave, generated in a shock tube, can be used to heat up a gas either by a few degrees or by a few thousand degrees. It requires 1 to 3 microseconds for such a shockwave to pass through a light beam 1 millimeter thick. This method can be used to study any reaction which is caused by the heating by the shock wave and in which there is a change of color that affects the transmission of the light beam, and which takes place in a time of from 10 microseconds to 1 millisecond. There will be many important and interesting applications of this new method of measuring the rates of very fast chemical reactions.

One particular problem deserves special mention. In the May, 1952 issue of this magazine, Dr. Joseph Kaye discusses the problem of "'Keeping Cool' at Mach 10." A highly supersonic projectile flying through air, by colliding with air molecules, will heat these molecules and the surface of the projectile to very high temperatures. Thus, for a Mach 10 projectile, the expected air temperature is about 5000°C. At this temperature, nitrogen and oxygen react to some extent to form nitric oxide molecules, and oxygen molecules are dissociated into oxygen atoms:

$$N_2 + O_2 \longrightarrow 2\,NO$$

$$O_2 \longrightarrow 2\,O$$

The aerodynamic characteristics of the projectile, as well as the cooling problem, depend on the rate of the chemical reactions. The study of these rates at high temperature is a problem that can be undertaken by the shock wave method.

Time Microscope Developed by NRL

Have you ever seen a spot of light travel faster than light? Scientists at the Naval Research Laboratory have. The Electricity Division has developed electronic equipment which will produce and record a voltage change of three million million volts a second. This voltage change appears on the face of a specially designed cathode-ray tube, somewhat similar to a television picture tube, as a spot of light that moves across the screen at a speed of 13,000 inches in a millionth of a second. In this time, light, which has a velocity of 186,000 miles a second, travels only 12,000 inches. In effect, then, here is a time microscope, which shows a voltage change occurring in a millionth of a millionth of a second. The equipment is shown on inside back cover.

Because it is relatively simple, easy-to-use, and inexpensive, the new recording system is expected to be of considerable use in the fields of electronics, electricity, and nucleonics. In these branches of science, there has grown an increasing need for producing, showing, and photographing such voltages. They may be produced naturally by the sparkling, or scintillating, of a radioactive substance, or they may be generated artificially, as by a gaseous switch tube in a radar or other electronic circuit.

On the Naval Research Reserve

Three New Companies Activated

Three new Companies have been added to the increasing ranks of the Research Reserve. During the past several weeks formal activation ceremonies have been held at Tullahoma, Tennessee; Charleston, West Virginia; and Louisville, Kentucky.

Naval Reserve Research Company 6-12, consisting primarily of men employed at the Arnold Engineering Development Center, was formally commissioned at Tullahoma on Wednesday, 29 April. CDR R. E. Carpenter, Assistant to the Reserve Coordinator, Sixth Naval District, delivered orders to the Commanding Officer, LCDR Burl Zimmerman, and members of the new Company. Also present was LCDR C. A. Buist, Jr., Research Program Officer in ComSIX, who outlined the District's function in supervising and supporting the Research Reserve Companies. He explained the procedures necessary to obtain training duty, record retirement points, etc.

CDR F. L. Edmondson, Director of the Research Reserve, attended a meeting of the Company the following week and presented the ONR program to the group.

Shown in the picture above (left to right), are: J. N. Herrmann, W. L. Chew, C. H. Partin, LCDR C. A. Buist, Jr., A. S. Huson, W. F. Pack, J. C. Eoff, Jr., LCDR Burl Zimmerman, J. M. Hart, D. E. Fults, O. D. Strawn, A. H. Hodges, CDR R. E. Carpenter, Joe B. Foster, E. W. Smartt, Jr., and W. J. Sanders III.

Naval Reserve Research Company 5-6 was activated officially at Charleston, W. Va. on 7 May. LCDR Elbert S. Churchill, Training Officer, Research Reserve, representing the Office of Naval Research, described ONR's program for the Reservists. The Fifth Naval District was represented by CDR C. H. Walker, Jr., Inspector-Instructor at South Charleston, who delivered the orders to the new Company. Guest speaker was Dr. Raymond W. McNamee, Superintendent of Research and Development of the Carbide and Carbon Chemical Company.

Members of the Company are: LCDR B. W. Stonestreet, Commanding Officer, LCDR Irving H. Bowman, CAPT Vincent T. Churchman, LTJG Harold Latourette, LTJG James L. Prince, LT Charles Lemkuhl, Jr., LT Herman G. Wilhelm, LT George W. Unangst, LTJG Thomas B. Wheelock, and LT Walker H. Urling.

The third new company is 5-7 activated in Louisville, Kentucky, on 16 May. CAPT A. B. Cook, Director of the Military Services Division, ONR, represented the Office of Naval Research. The District was represented by CDR B. F. Porkuska, Inspector-Instructor, Louisville, and by LT R. E. Holland, Assistant Inspector-Instructor.

CDR Rohrman Heads Massachusetts Reserve Officers

CDR H. Wray Rohrman, USNR, Program Officer for the Boston area, was recently elected president of the Reserve Officers' Association of Massachusetts, which represents the Army, Navy, Air Force, Marines, and Coast Guard. Congratulating him, above, at the annual banquet-ball of the Association, is RADM John L. McCrea (center), Commandant of the First Naval District and guest speaker of the occasion. At the right is Major Ray Palmer, USAFR, the outgoing president.

Successful Meeting of Psychological Warfare Course

The second meeting of NRRC 11-4 (San Pedro, Calif.) Psychological Warfare Course was successfully carried out on 15 April. CAPT Charles H. Smith, USN, Director of Psychological Warfare Programs Division in the Office of the Chief of Naval Operations, ably presented the organizational structure of his Division and pointed out the responsibilities of the Navy in this field. Shown above with CAPT Smith (second from left) are (left to right) LT L. L. Whiteneck, USNR, Commanding Officer of Company 11-4; CAPT C. E. Coffin, USN, Chief of Staff, Long Beach Naval Station; and LCDR M. S. Allen, USNR, Publicity Officer, Company 11-4.

The meeting was attended by more than 100 officers from the Army, Navy, Marines, Coast Guard, and Air Force. Members of several Naval Reserve units are making the Psychological Warfare Course their fourth quarter drill schedule.

CAPT Smith illustrated his address with appropriate slides. The attentiveness and keen interest of the audience was indicated by the great number of questions asked and the long discussion which followed. In addition to providing enriched understanding of psychological warfare, the course is proving a very effective method of increasing the appreciation of the various military services for the problems and responsibilities of one another. The informal dinner held after each meeting provides a fine opportunity for the officers to meet each other and the speaker, who is the guest of honor at the dinner.

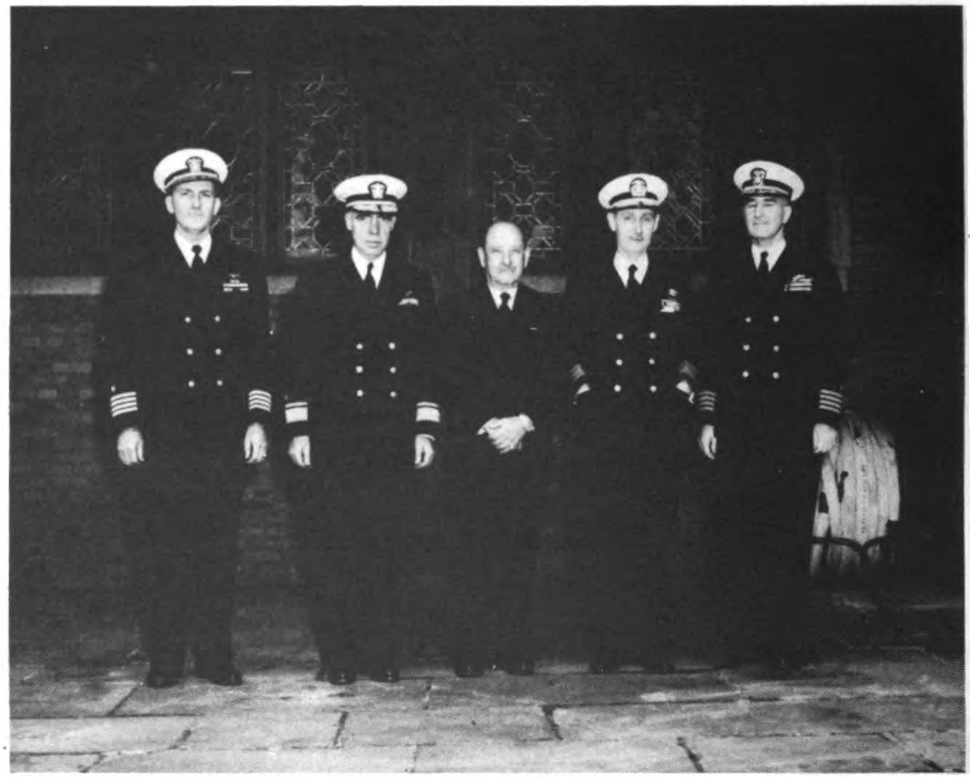
The Commanding Officer of the U. S. Naval Station, Long Beach, has extended every cooperation possible to assist Company 11-4 in developing and carrying out this course.

Informative Special Devices Seminar Held

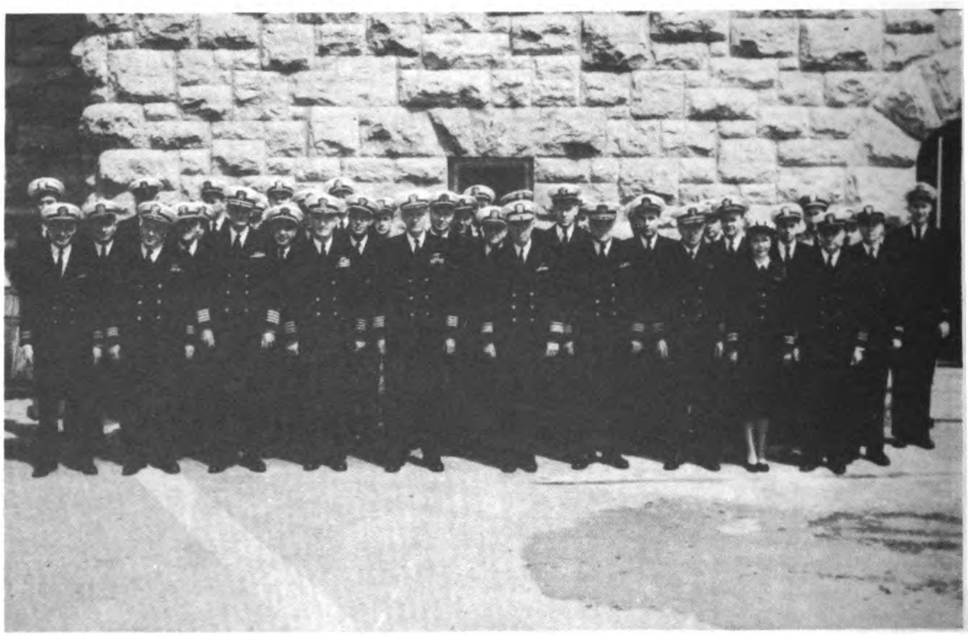
This year's Research Reserve Seminar opened at the Special Devices Center, Port Washington, New York, on April 20 with an address by the Chief of Naval Research, RADM C. M. Bolster, USN. The Seminar, attended by about 35 Reservists, extended through May 2. Field trips to the United Nations, Fairchild Guided Missiles Division, and the Naval Material Laboratory at the New York Naval Shipyard were highly informative.

Among the distinguished speakers were: Former Commander of the Eastern Sea Frontier, VADM Oscar C. Badger, USN (Ret.), who discussed the latest developments in fire control; RADM Luis de Florez, USNR (Ret.), founder of the Special Devices Center; RADM Gordon McLintock, USMS, Superintendent of the Merchant Marine Academy; RADM K. M. McManes, Assistant Chief of Naval Operations for Naval Reserve, who discussed the Reserve program; and CAPT T. B. Haley, Commanding Officer and Director of SDC. The speakers and the officers who attended the Seminar are shown below and on next page.

VADM Badger discusses the latest developments in fire control.



Some of the distinguished guests at SDC's Third Annual Seminar: CAPT T. B. Haley, CO and Director, Special Devices Center; RADM C. M. Bolster, Chief of Naval Research; RADM L. de Florez, USNR (Ret.); RADM G. McClintock, USMS; CAPT B. Matthews, ONR, New York.



Members of the Special Devices Seminar

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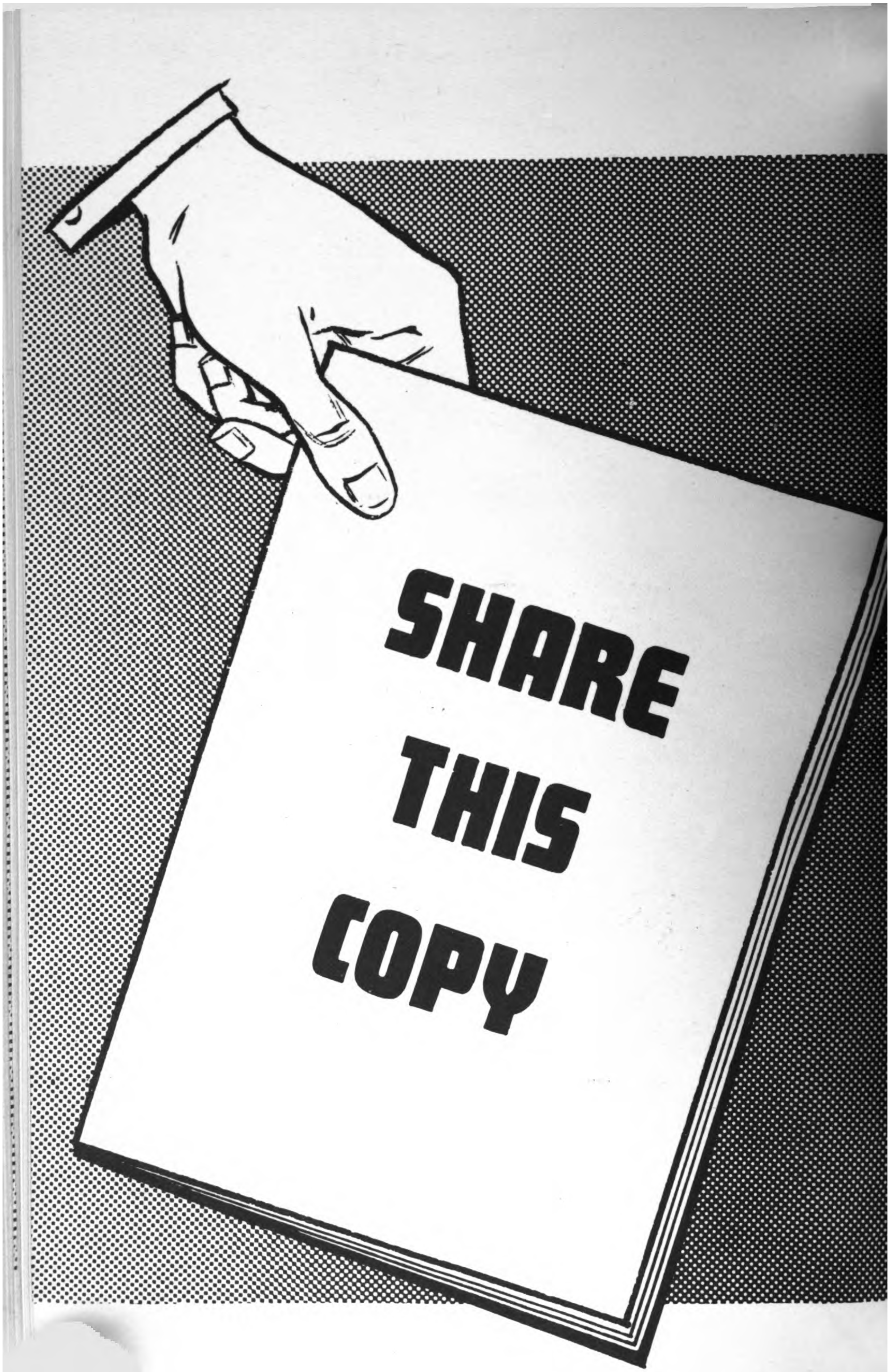
NRL's Time Microscope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