MUELLER Record

JULY - AUGUST • 1959

Recording Our Thoughts

Mr. Peter J. Russo has been named director of the Jefferson Parish (La.) water department, replacing the late Mr. John W. Hodgson, Sr. The April-May issue of the RECORD carried an item on P. 23 concerning Mr. Hodgson's appointment to this position, and we regret to announce his death on May 26.

We are pleased to bring you the story on Strategic Air Command in this issue. This writer was privileged to be one of a group of men from Illinois to tour this installation at Offutt Air Force Base, just outside Omaha, earlier this year. It was a most impressive trip, and the Air Force is certainly to be congratulated for its efforts at exhibiting, in the very best manner, the effectiveness of our defense posture.

Also within the pages of this issue is a story on the flow of natural gas into Florida. The extensive work done in so short a time to provide that state with natural gas is amazing.

Congratulations to the American Water Works Association on its record-breaking attendance at the recent annual convention in San Francisco. In excess of 3,200 members gathered for a week packed with technical sessions, tours, banquets, general meetings, and seeing the wondrous sights afforded by San Francisco. On the last night of the convention, July 16, delegates gathered to pay tribute to Harry E. Jordan, who will retire September 1 after many years in waterworks and association administration.

We feel that the following is worthy of passing on to you:

"Depending upon advertising and/or public relations to establish a personality for your company is like building the roof of a building before you pour the foundation and erect the walls. Advertising and public relations can be of assistance in this most important undertaking, but the foundation must be laid from within the organization."

—W. W. McCallum

"What exactly do you mean when you say you left your last place of employment because of illness?" asked the personnel manager.

"Well, it was a kind of mutual illness," replied the applicant. "I got sick of them, and they got sick of me."

In case you ever make a right turn from the left lane, you're probably just careless, and not at all what the driver behind called you.

There's no fool like an old fool—you just can't beat experience.

MUELLER RECORD

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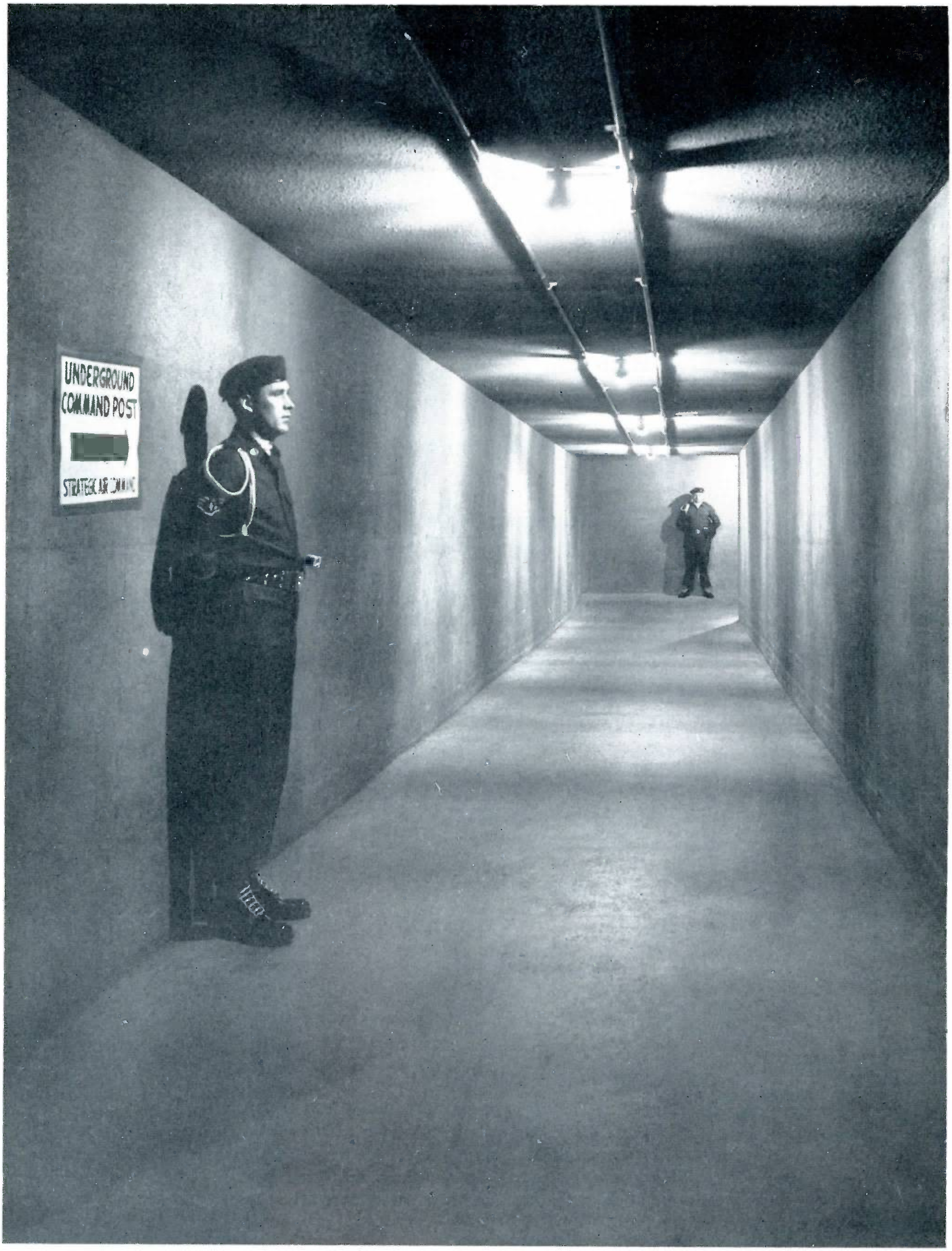
Our COVER this month is a dramatic presentation of the most important telephone in the world. Located in the underground SAC Command Post, this phone, which is bright red in color, will alert SAC bases around the world to retaliate against an aggressor.

Contents

Notice

This issue of your MUELLER RECORD contains a business reply card which we are using to bring our extensive mailing list up-to-date. We would appreciate its early return. Also if you wish others in your organization to receive the RECORD each month, please check the appropriate square, and we will send subscription data. There is no charge, of course!


UNDERGROUND
COMMAND POST
STRATEGIC AIR COMMAND

Representing some 250,000 men of SAC, Technical Sergeant Carl E. Ester, Clarksville, Ind., stands before the sign bearing the Command's motto.

They Take Profit Out Of War

THE deterrent concept—preventing an enemy from attacking by fear of consequences—is as old as man; but, the deterrent force concept—achieving security by continuously maintaining on combat alert a powerful striking force—is of fairly recent vintage. Nowhere is this latter concept so much in evidence as in the very existence of the Strategic Air Command.

This modern-day application of an ancient concept has been the result of technological progress in the development of more powerful weapons systems. The long-range bombers and intercontinental missiles—the names of which are on the tongues of millions of people today—coupled with nuclear weapons of many types, have made the cost of all-out global warfare unbearable to any participant.

From this reality has developed a deterrent force concept which, stated simply, is this: maintain a force so capable of quick, devastating retaliation that no nation will dare take the role of aggressor.

GENERAL THOMAS S. POWER
Commander-In-Chief
Strategic Air Command

It may be a force of manned bombers, of guided and ballistic missiles, or a combination of both systems; but it must possess two qualities: strength and readiness. It must be sufficiently powerful to guarantee complete destruction of the enemy's war-making capability, and it must be kept so alert that it could not possibly be totally destroyed by a surprise attack. Under these conditions, it is unlikely that any enemy would be foolish enough to attack the United States.

It must be remembered, however, that the deterrent effect of such a force as Strategic Air Command is relative to the strike capability of the enemy. If SAC's retaliatory force is sufficient in strength and readiness to prevent the enemy from attacking, then SAC is a deterrent force. This situation exists today.

But, if the Soviet Union should increase its strike capability, and if SAC neither improved its force nor made its combat force less vulnerable to attack, the advantage would be largely lost. It would be lost the very moment the enemy realized that a surprise nuclear attack would deprive SAC of sufficient retaliatory force to strike him a decisive blow.

To prevent this, SAC has undertaken two major steps: dispersal of the force and mounting a constant runway alert. Dispersal protects SAC's striking force by increasing the target system which the Soviets must plan to bring under attack. The maintenance of a segment of the force on constant alert insures that, despite a surprise attack, enough jet bombers to devastate a nation will be enroute to enemy targets only minutes after warning is received.

Robbed of the element of complete surpise, and faced with attacking many widely-dispersed targets, the enemy has no chance of destroying the bulk of SAC's forces with one blow.

THE DISPERSAL PROGRAM

The Strategic Air Command, since 1946, has been a military striking force so powerful that no enemy has dared attack the United States.

The dispersal program is designed to strengthen SAC's deterrent power and to weaken the enemy's strike potential by greatly complicating his attack problem.

The basic reasoning is this: if SAC's forces were bunched in a limited number of places, the enemy would stand an excellent chance of surprising and crushing them with one terrible blow. He could start a war and quickly emerge victorious. If, however, SAC's forces were dispersed to a greater number of locations, he would have to surprise and then destroy a large number of targets simultaneously.

This oversimplification points up some advantages of dispersal. For one thing, it will be costly for the enemy to build and maintain a larger striking force. Also, dispersal offers added protection to SAC's combat units. Another advantage is economy. The additional bases SAC needs will require only limited facilities. Many such bases—unused since World War II—are already in existence. SAC's present base complex would provide major support facilities required by these limited facility, or satellite bases.

Possibly the greatest advantage is that dispersal will increase the Command's strike capability. For instance, the maximum warning time SAC can anticipate under missile attack is 15 minutes. Within this time limit, it is possible to launch only a certain number of bombers from one runway. Thus, if SAC is operating fifty runways, it can put fifty elements of alert bombers in the air in 15 minutes.

SAC presently has two dispersal plans. Most medium bomber bases now support two combat wings of 45 B-47s each, and two tanker squadrons of 20 aircraft each. This is a massing of nearly 130 combat aircraft—much too lucrative a target for enemy bombs. SAC plans to cut in half the number of aircraft at each two-wing station by moving one wing and its tanker squadron to another base.

For the B-52 heavy bombers, SAC wants only one unit of 15 bombers with a complement of ten tankers at any one base, and this will be called a strategic wing. The B-52 has a much greater range and load-carrying capability than the B-47. Maximum security for the B-52s is imperative.

REFLEX

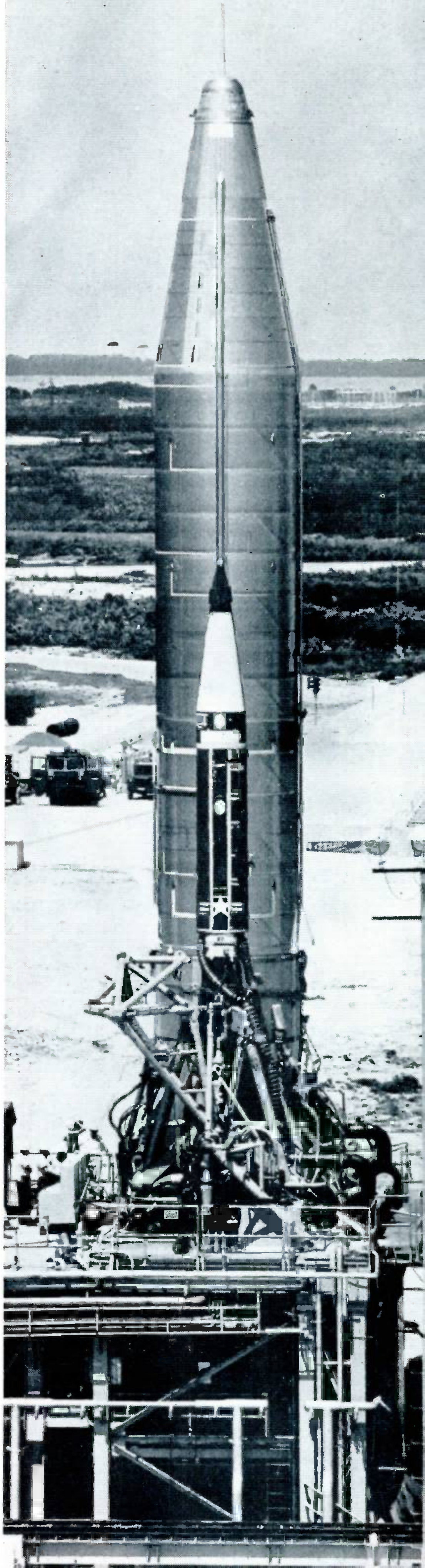
The Strategic Air Command recognized several years ago that, eventually, it must be able to launch its strike force within minutes—or die on the ground. The moment this capability would become vital would depend on technological progress in weapon system development by the enemy.

Plans for an immediate launch capability were begun in SAC's earliest days, and were implemented for the first time on October 1, 1957, when a limited number of SAC aircraft went on a 24-hour-a-day alert at U. S. and overseas bases. The ultimate goal is one-third of the bomber force on runway alert.

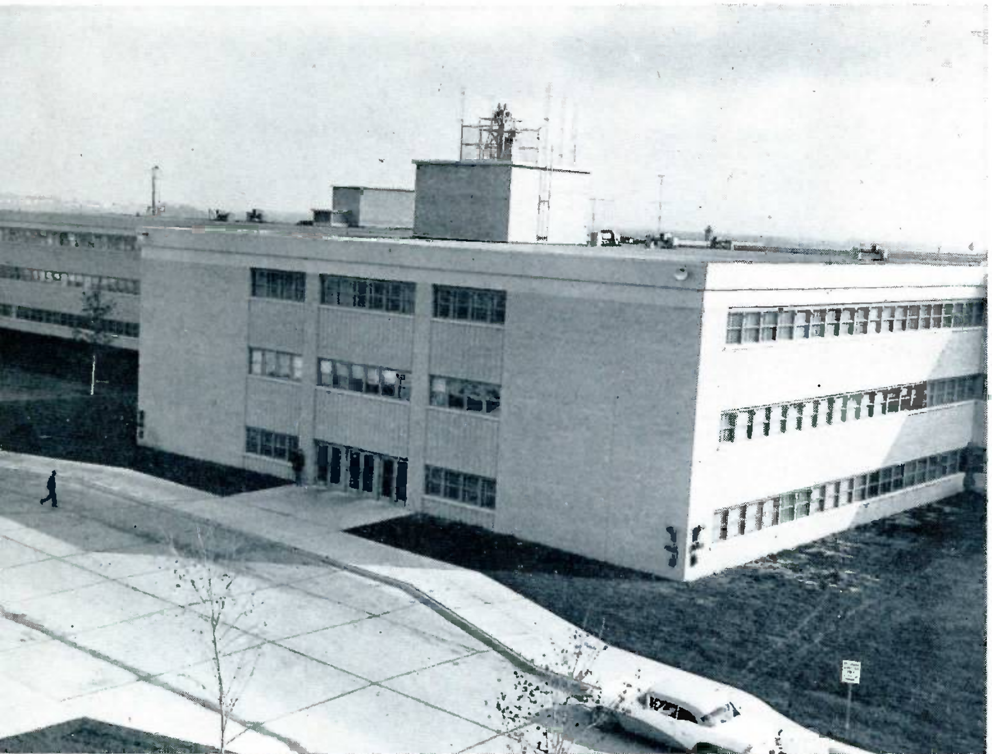
Although operation of alert forces requires a tremendous amount of hard work, it presented a particularly challenging problem in the overseas areas where units previously were away from their home station for two to three months.

As a result, numerous studies were made to develop the most efficient method of establishing such an alert force in overseas areas. Three main factors were considered. First, bomber crews should remain overseas for only a short period of time, but most of their time would be devoted to alert duty while there. Second, training requirements would still have to be met. Third, establish a system that would be the most palatable to the crews.

The old system of 45-90 day overseas rotation for the entire wing did not seem compatible with the above requirements for a 15-minute alert capability. In the fall of 1957, several wings started to maintain a small alert force in North Africa and other forward areas. This was accomplished by sending only small numbers of aircraft overseas for short periods of temporary duty. During this time, the crews would be on actual alert and return to their home stations



Right: Symbolic of future roles SAC will play in space operations is this mighty intercontinental ballistic missile, the SM-65 Atlas.



Nerve center of SAC's global strike force is its headquarters at Offutt Air Force Base near Omaha. The three-story administration building shown at left is connected by underground ramps to a three-story control center buried 45 feet beneath the earth.

immediately after this short period of time.

SAC found that this system known as "reflex" gave us a truly effective alert force in overseas areas since crews devoted their entire time to maintaining this posture, training requirements were met flying over and back, and just as important, the crews and their family definitely preferred "reflex" over the 45-90 day rotation period.

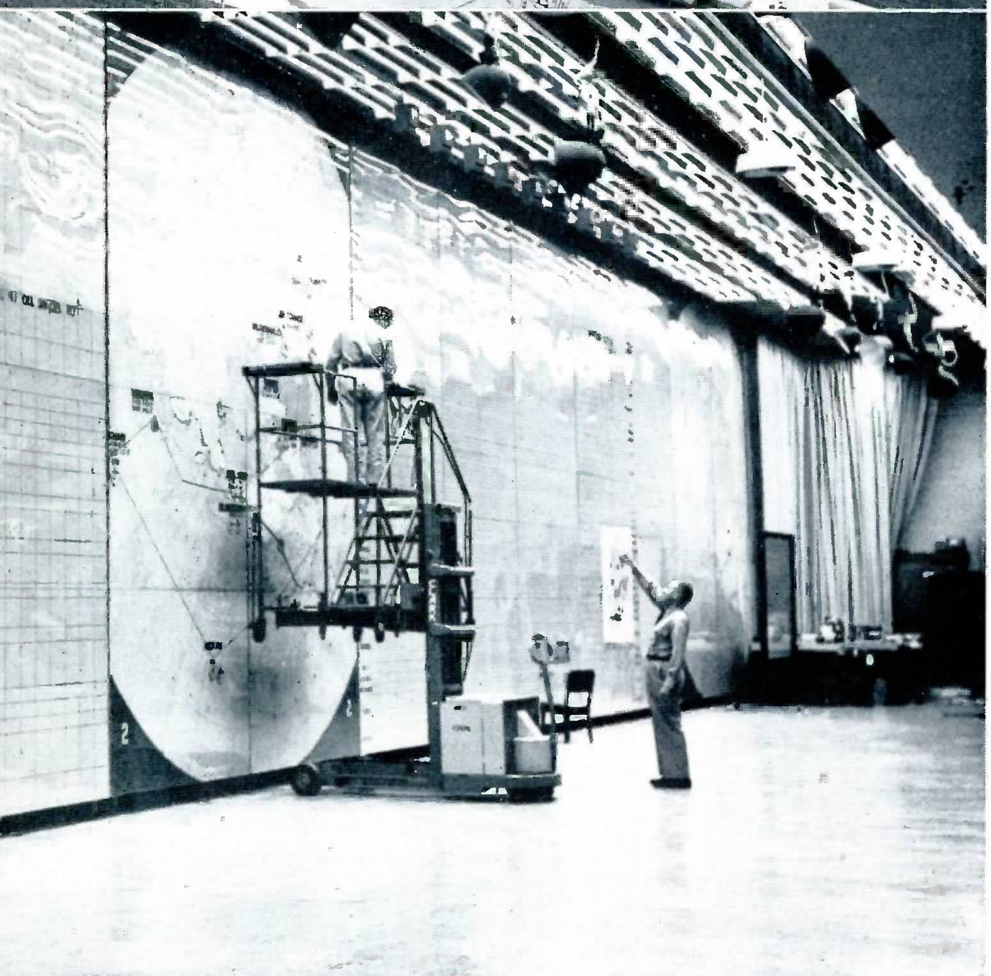
Reflex rotation now applies to their entire bomber force; refueling units are also rapidly implementing the system.

DIRECTED FROM HEADQUARTERS

Now that we have briefly discussed the capability of SAC, measured in terms of strength and readiness, we might well wonder what kind of massive personnel installation is necessary to handle such a global operation.

Strategic Air Command headquarters moved, in January of 1957, into its new $10 million Control Center, which consists of a three-story administraion building and a three-floor command post—the latter 45 feet beneath the earth. The installation is located at Offutt Air Force Base, just outside Omaha, Nebraska.

The command post gives SAC Commander - in - Chief, General Thomas S. Power, complete control of SAC's global operations and the



Glistening under the batteries of lights mounted in the ceiling of the operations control room, map panels reflect the status of the SAC force throughout the world.

ability to order his strike force of bombers and missiles into action within seconds, if directed to do so by the President.

Facilities in the underground command post include a communications center, a global weather center, connections to a world-wide communications system, and a special long-distance telephone system connecting the center to each SAC base in the U. S. and overseas.

In the event of attack, the command post would automatically be sealed off and would become self-sustaining. It has its own air-conditioning system, an independent water supply, an emergency electrical power system, complete communications systems for teletype and voice transmission, and a 30-day supply of emergency rations.

The most impressive facility in the underground command post is the control room—140 feet long, 39 feet wide and 21 feet high. Lining one wall, the length of the room, are giant panels, each eight feet wide and 20 feet high, mounted on trolley rails for ease in handling. The panels reflect all information needed to direct the global force in peace or war—world maps 16-feet across, weather maps, charts showing deployment of force, operational status of aircraft and missiles, current training exercises, and other important data.

SAC's emergency war plan, constantly changed as new information is gathered, is maintained on panels generally covered by drapes at one end of the room. At any moment war should start, the drapes would be pulled and the panels rolled into position within seconds to put the command post in fighting configuration.

Adjacent to the command post are two additional rooms, housing the Intelligence Air Room and the Operations Plans Room. Both rooms are serviced by the same trolley rails as above, so that information can be quickly rolled from one room to another as required.

The command post is a fascinating operation, with its maps and charts, direct phone connections and closed circuit television facilities, and its intensive security measures. It could well become this country's most important single structure in the event of enemy attack.

TO WHAT END?

Volumes have been written about Strategic Air Command and its role in preserving peace. Yet, not enough can be said to impress us with its importance and vitality. The very idea of SAC is perhaps best expressed in these words by General Thomas S. Power, its Commander-in-Chief.

"SAC's strength does not lie solely in its intercontinental bombers and the power of its bombs. Its strength lies in an unmatched combination of the most advanced weapons systems, a nucleus of highly-skilled and dedicated men, and a global organization which is flexible enough to be adaptable to any new weapon system or technique, no matter how revolutionary, including the most advanced missiles

"But the real strength of SAC's effort to take the profit out of war is rooted in its people. They are dedicated to their vital task—to prevent war or, should war be forced upon us, to retaliate with decisive results. That is the basis on which SAC was formed and the principle by which its people work and live."

Television technicians scan the monitors of SAC's closed circuit color TV system in the Command Post. The TV system enables key staff members to obtain information on SAC without leaving their offices.

. . . . Around the Gas Industry . . . .

Gas Industry Plans Meeting in September

The gas industry's 11th annual **Accident Prevention Conference** will be held Sept. 15-16 in Atlanta, co-sponsored by the Accident Prevention Committee of the American Gas Association and the Southern Gas Association's Accident Prevention Council.

A special feature of the two-day conference at the Dinkler Plaza Hotel will be a workshop for corporate officers on the theme "Top Management Looks at Accident Prevention." Discussions will be moderated by L. T. Potter, chairman of A.G.A.'s Executive Safety Committee. Mr. Potter is president of Lone Star Gas Co. and a vice-president of A.G.A.

R. G. Taber, president of Atlanta Gas Light Co., will welcome conference delegates at the first general session on Sept. 15. The keynote speaker will be J. M. Wilson, vice-president of United Gas Corp. Program chairman for the 1959 conference will be William J. Easton, director of accident prevention, The Cincinnati Gas & Electric Co.

Record Amount for Construction

The nation's gas utilities and pipeline companies will spend **a record $1,859 million for construction** during 1959, the American Gas Association estimates. This year's construction expenditures will be 4.9% higher than the industry's all-time peak of $1,772 million set in 1957. They also will exceed 1958's outlays of $1,618 million by 14.9%. Construction during the years 1959-62 is expected to cost $7.9 billion, according to current A.G.A. forecasts. This will represent a 25.7% increase over the $6.3 billion spent in the previous four-year period.

A.G.A. Chooses PR Judges

The presidents of two national public relations societies and the publisher of a leading gas industry magazine have been named judges in the third annual **Public Relations Achievement Awards** contest of the American Gas Association.

The gas industry's outstanding public relations programs will be selected by H. Walton Cloke, president of the American Public Relations Association; Carroll R. West, president of the Public Relations Society of America; and Frank Chapman, publisher of GAS MAGAZINE, Los Angeles.

Awards will be made October 5 at the A.G.A. annual convention in Chicago.

Record Number of Customers Added

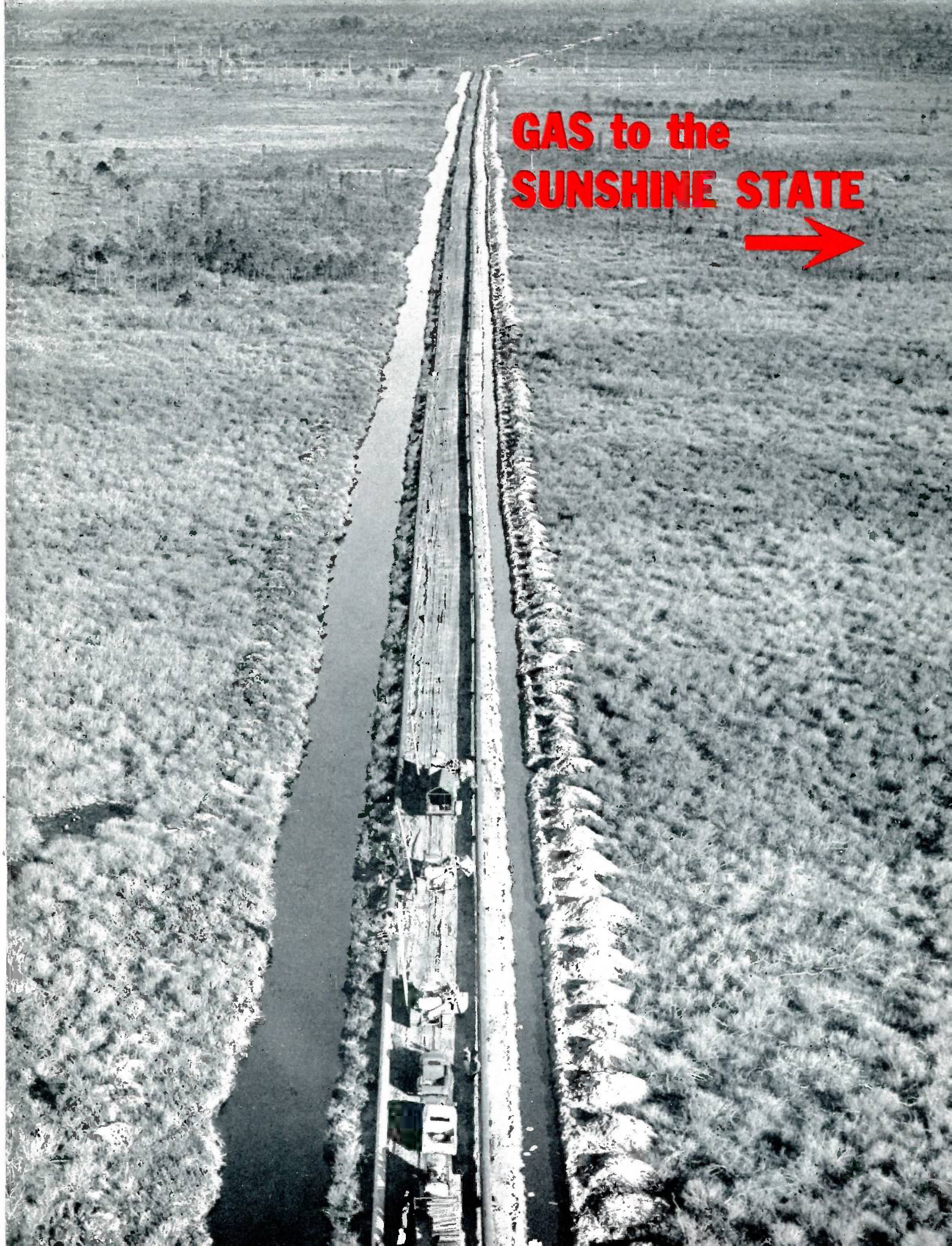
The nation's gas utility companies **added 1,079,000 new residential heating customers during 1958,** and increased the number of gas-heated homes by six percent to establish a record total of 19,003,000, according to recent A.G.A. figures. Nearly 65 percent of all residential gas customers now heat their home with gas, a gain of 2.3 percent over a year ago.

The gas trade association estimates that four million new gas house-heating customers will be added during the next three heating seasons.

GAMA President Reveals Progress

During the past twelve months the American gas industry has " . . . run the economic gamut . . . . " from recession levels to spectacular sales increases, Edward A. Norman, president of the Gas Appliance Manufacturers Association, declared in an address delivered on his behalf at the annual meeting of the Canadian Gas Association. Mr. Norman was prevented at the last moment from attending the meeting, which was conducted June 22-24 at Victoria, B. C., and his speech was presented by Harold Massey, GAMA managing director.

Norman's text revealed that the industry's appliance and equipment shipments during the first five months of this year, as compared to the same period in 1958, showed **sales of gas ranges up 12.5 percent,** water heaters up 10.7 percent, central heating equipment up 29.3 percent, and vented recessed wall heaters up 28.9 percent.


GAS to the
SUNSHINE STATE

Texas to Florida

Last Major Market Tapped

Houston Corp. Builds 2,654-mile line

THE nation's last major untapped natural - gas market was opened when a 2,654-mile pipeline system from the Rio Grande Valley to Miami, Fla., started operating June 1.

Coastal Transmission Corp. constructed a gathering system from near McAllen, Tex., to Baton Rouge, La., where gas is delivered to Houston Texas Gas & Oil Corp. for transportation to Florida markets. Both companies are wholly owned subsidiaries of Houston Corp. Coastal's McAllen - Baton Rouge line and Houston's Baton Rouge-Miami line will be operated as one system dispatched from Houston's St. Petersburg, Fla. headquarters.

This is a different pipeline. Because of the nature of the market, its conception is different. There are design and construction innovations, too.

This $163,757,000 project was born in the mind of the late J. O. Mack in 1954, when a survey revealed Florida to be a sleeper market for a gas pipeline because of postwar industrial expansion. Late that year, F. E. Stanley, Tulsa pipeline contractor and promoter, joined Mack in the venture. With the aid of associates and the Clint Murchison interests on gas supply, he steered the project through the Federal Power Commission, which granted a certificate in December, 1956.

Competing fuel interests' opposition further delayed the project. It wasn't until May, 1958, that the U. S. Supreme Court cleared the way for financing and construction by denying the last appeals aimed at keeping natural gas out of Florida. Construction began in October, 1958, and the line was installed by May 1.

Initial throughput is 282,000,000 cu. ft. daily, with a maximum capacity of 287,000,000 cu. ft. A $41,000,000 compressor-station expansion planned for completion by January, 1960 will increase capacity to 418,000,000 cu. ft. daily.

The line, at first, will be based primarily on an industrial load, because Florida's semitropical climate does not offer the big space-heating market that exists in most of the United States. Some 100,000,000 cu. ft. daily go to Florida Power & Light Co. plants at Cutler, Miami, Ft. Lauderdale, Riviera Beach, Sanford, Palatka, and Sarasota; 50,000,000 cu. ft. daily go to Florida Power Corp. plants at Inglis, Avon Park, Sanford, St. Petersburg and Oldsmar. The power companies purchase gas directly from producers in Texas and Louisiana and pay the pipeline a transportation charge.

Gas purchased by the pipeline for resale to commercial and residential users will comprise a gradually increasing percentage of the load as this market grows. Houston Corp. has accelerated development by purchasing manufactured-gas distribution systems in Jacksonville, Orlando, Miami, Lakeland and Daytona Beach. Small LPG systems have been purchased in other cities. The company plans to spend $23,000,000 in the next 3 years expanding distribution systems to be converted to natural gas.

Here are the principal design and construction features:

. . . Four-cycle engines are directly connected to pancake-type compressors on the Baton Rouge-Miami line, which is the first to use this combination throughout its system. The reason is maximum fuel economy.

. . . Polyethylene tape is used for all the Baton Rouge-Miami line for another "first" in the industry, while coal tar is specified for the McAllen-Baton Rouge line.

. . . All auxiliaries are run off the compressor engine, and hydraulic water power drives the cooling fans at each station on both lines. Both these features are unique for an entire system.

. . . Double jointing is employed extensively on both lines to cut laying costs.

Original compressor stations will be located at Wiggins, Miss.; Munson, Fla.; Quincy, Fla.; and Brooker, Fla. The first expansion will involve additional horsepower at existing stations and installing intermediate stations. When expanded, Houston will have eight 10,000-h.p. stations and one 6,000-h.p. station. Houston will receive gas from Coastal at 975 psig. Suction pressure at the stations will be 650-700 psig. and pressure will be boosted to 975 psig.

Nine personnel will be assigned to each station. A superintendent and chief mechanic will live on the site. There will be five operators (one per tour) and two laborers.

The stations were designed for attended operation at the beginning and in the future. The operator starts the station by pressing a series of buttons on the control panel. Automation design is used only to the extent that safety and reliability are enhanced. Engineers proceeded on the theory that as long as personnel are needed for housekeeping and repair, then local control is best.

The company believes that safety and continuity of operation demand that an operator be on shift at all times. If anything goes wrong, they reason, nothing can replace a man on the scene. The stations are 100% pneumatically controlled, event to engine alarms.

Houston Construction

The Baton Rouge-Miami main line was constructed by three spreads of Midwestern-Walco Contractors, a joint venture of Midwestern Constructors, Inc., and Walco Engineering & Construction Co. Harbert Construction Corp. has the contract for sales laterals in Florida, part of which has been subbed to Mid-States Construction Corp.

The Baton Rouge-Miami main line consists of 679.4 miles of 24-inch, 97.1 miles of 20-inch, and 137.7 miles of 18-inch, for a total of 914.2 miles of main line. With 707.7 miles of 2½ to 18-inch sales laterals, the system totals 1,616.9 miles. Specifications for main-line pipe called for 5LX Grade X54.312-inch wall for most overland construction, .375 wall in populated areas and for highway and road crossings, .438 wall for minor river crossings, and .500 for major river crossings.

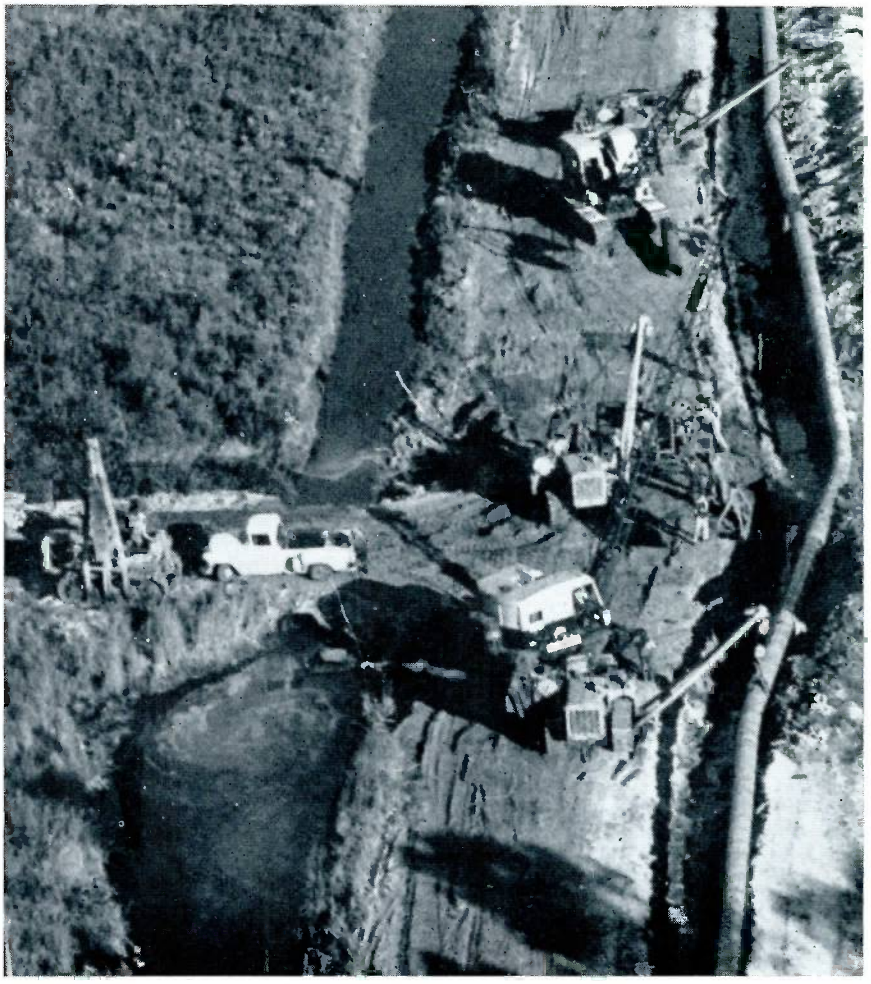
Spreads laid from 1 to more than 3 miles of pipe per day. The key to exceptional speed was the use of 60-ft. joints (two 30-ft. joints welded by automatic submerged-arc welding at the mill) instead of standard 40-ft. joints for almost all of the main line. The double joints delivered by Republic Steel Corp. amounted to 124,000 tons, the largest single order of line pipe ever placed with the Gadsden, Ala. mill.

The day that Spread 3, under Supt. John Work, was visited, 14,100 ft. was laid in swampy terrain. The spread had been laying 12,000 to 13,000 ft. regularly in northern Florida, and hit a high of 18,000 ft. on the pipe gang using three stringer-bead welders and four on hot pass. There were nine firing-line welders. All welding equipment was contractor owned. Line-up crews found 60-ft. joints as easy to handle as 40-ft. joints.

On .312-inch wall 24-inch diameter main-line pipe, a field weld cost $27.50, according to estimates by Houston. A weld made automatically at the mill costs $13.50. Using 30-ft. joints instead of 40-ft., the number of welds was increased by one-third but the cost of welds made at the mill was only half that of field welds. So the net savings on welding was estimated at one-sixth.

The pipeline hugs the Gulf Coast all the way, and encounters timbered swamp for about 25% of the route. Swamp is more prevalent in Florida, which has been described as 650 miles long, 150 miles wide, and one foot high. Unfortunately for pipeliners, there is much truth in the description. For several miles the water table is only a few inches below the surface.

Giant cranes maneuver the lengths of pipe into position somewhere in Florida as the pipeline construction moves forward at a rapid pace.



These "before-and-after" shots show the pipe lying alongside the ditch, and then show it wrapped and in place.

In the San Pedro basin in northern Florida, the route traversed by the pipeline for 23 miles often is under 3 to 4 ft. of water. But unusually dry weather came to the rescue of the contractor. The water table was 8 in. below the surface during construction in the winter.

Progress was maintained through San Pedro and other swampy areas by constructing rip-rap mats to support sideboom tractors and other heavy equipment. Where the right-of-way was inaccessible to pipe-laying equipment, the line was continuously coated with concrete and pushed.

The line was hydrostatically tested throughout to 1,170 psi. by Walnesco, Inc., Dallas. Right-of-way, purchase by E. H. Schmidt & Associates, Inc., Tulsa, was 75 ft. wide in some sections, but much of the work was done on 50 ft. or less. Clearing was subcontracted to local contractors. Commonwealth Services, Inc., New York, is the certifying engineer which inspects construction and reports to bondholders as to progress, quality, and economy of the installation.

Laying Along the Turnpike

Alongside the Sunshine Parkway turnpike, 18-inch pipe was laid under unusual conditions for 108 miles. In this stretch, pipe has been strung directly from trucks on the highway to the right-of-way on turnpike land closely paralleling the road.

From Fort Pierce for 52 miles to a point south of West Palm Beach, the sugary sand is difficult for ditching. In some places the ditch was 10 ft. wide. South of Palm Beach to the end of the line, the ground is swampy with patches of coral. Most of the ditch there is under the water table.

This 18-inch line extends 132 miles from Fort Pierce to Cutler, at the end of the whole Florida gas line system terminating south of Miami. The 108-mile turnpike section is the northern part of this 132-mile line. Pipe for it is made with .250-inch wall in 50-ft. random joints.

Along the turnpike, pipe was welded at a distance of 3 to 4 miles ahead of ditching operations; therefore the dope gang engaged in cleaning and wrapping the pipe with polyethylene tape, followed with the ditching operations. When the ditch caved rapidly, it was sometimes necessary to have the dope gang crowd up close to the ditching.

Between the start of the job, about October 10, and January 15, when work was still following the turnpike, pipe laying averaged 8,000 ft. per day. Some days of 12,000 to 15,000 footage were reported. X-raying was done on 30% of the main-line welds and 100% of the tie-in welds.

An electronic holiday detector ran directly behind the taping machine. Care was taken to change crawler wheels before wear occurred which might affect the wrapping of the tape. The spreader bar on the wrapping machine proved effective in applying tape smoothly.

Taping operations easily kept up with the ditch. On one day 17,000 ft. of tape was applied.

Houston Tape Coating

The Baton Rouge-Miami line is the first to be wrapped with a polyethylene tape for corrosion protection for its entire length. Tape was attractive to the company because of its low application cost.

No primer coat is required, and cleaning and spiral wrapping are done in one operation. Two operations—cleaning and priming, and coating and wrapping—are required for the hot enamel which is the standard proven protection on almost all pipelines. Combination cleaning-wrapping machines were developed for this project, with hand-operated machines for wrapping compressor - station piping. Pipe which has been stored in a yard for several months was double cleaned — first by a conventional cleaning machine followed by the cleaning and wrapping machine.

Taping was especially convenient for construction along the Sunshine State Parkway for 108 miles from Fort Pierce to Miami. The line was laid a minimum of 40 ft. from the concrete slab of the turnpike.

Houston officials reported that their studies indicated the three mainline spreads saved an average of $500 per mile of installed pipe by using tape. The higher cost of tape materials (about one - third more than coal tar, which is specified for most pipelines) was more than offset by savings in application, Houston said.

Houston estimated savings of 25 cents per ft., or $1,310 per mile, in tape applications, due to reduced labor and machinery. Subtract from this figure the $798 difference in materials costs, and you have $512 which the company reported it was able to save per mile of installation by using plastic tape.

Houston Aerial Crossings

Five of the 25 major rivers crossed by the Houston line were spanned by aerial crossings. They were designed by Clear Span Engineering Co., Houston, and built by Clear Span and Midwestern-Walco as a joint venture. Each crossing was custom designed.

The aerial crossings include a 520-ft. span over the Pearl River, a 640-ft. span over the Escambia River, a 660-ft. span over the Pascagoula and Suwanee, and a 960-ft. span over the Apalachicola River, all carrying a 24-inch line.

The method of erection developed by Clear Span incorporates precision prefabrication sections and pivoted towers enabling the assembled towers to be hoisted erect, pulling the cable system and the line pipe aloft with it. The bridges are considered safe, competitive in cost with submarine crossings, and can be erected in one day using standard equipment on a pipeline spread.

After foundations have been installed, each tower is assembled face down toward the river. Line pipe is welded on one bank and the entire cable system connected to it. The pipe is then towed and floated across the river until the terminal of the main cable has been connected with the opposite side tower head. When the main cable has been connected at both ends, the towers are then pulled erect singly or simultaneously.

The rear leg is then welded to a foundation insert. This procedure generally takes from 4 to 8 hours. Wind booms and wind cables are then attached. The wind cables are designed for direct lateral support of wind loads.

Coastal Construction

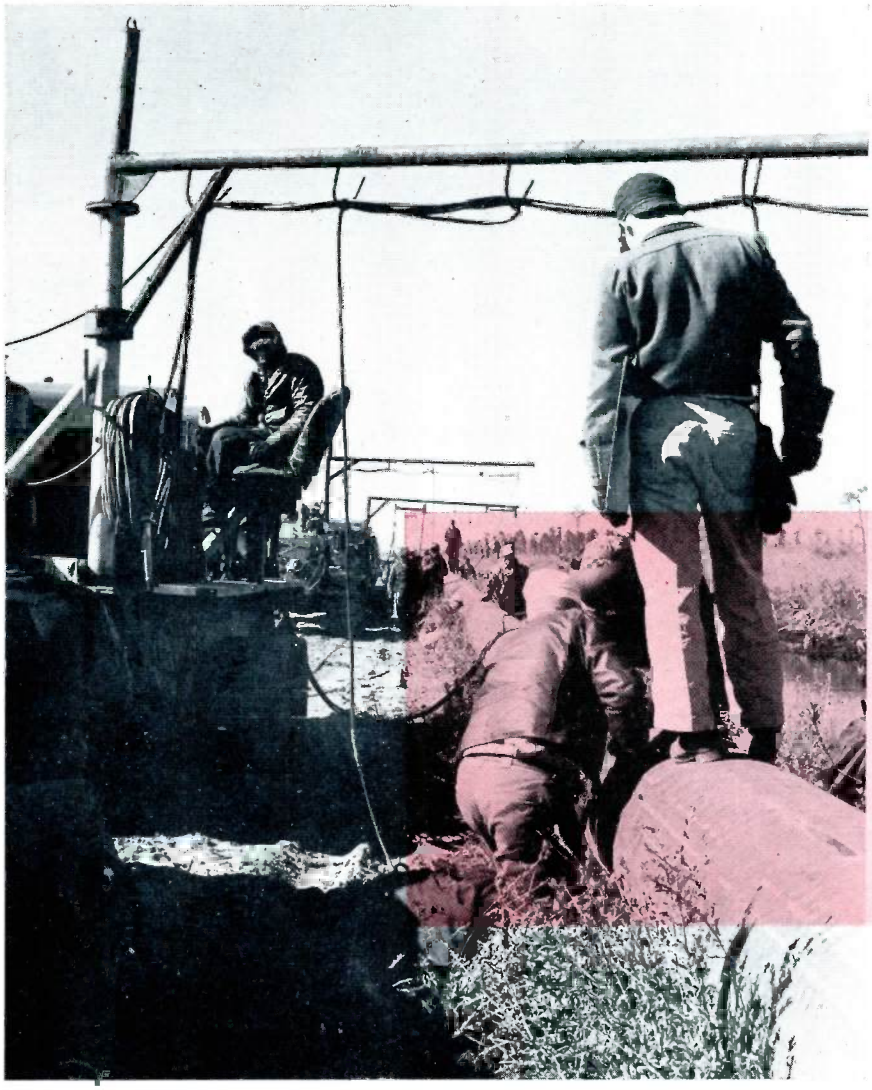
The main line consists of 192.6 miles of 24-inch, 101.9 miles of 22-inch, 174.9 miles of 20-inch, and 94.4 miles of 12-inch. There are 365.4 miles of 3 to 14-inch supply laterals on the Texas and Louisiana Gulf Coast. Pipe specifications were similar to the Baton Rouge-Miami line.

The entire system was coated with coal-tar enamel with a 15-lb. asbestos felt outer wrap. Coal tar was reinforced with glass for 5 miles of the discharge side of each compressor station. The protective coating will be supplemented by cathodic protection with rectifiers and, in certain isolated areas with magnesium anodes.

Major water crossings—all submarine—made by Coastal were the Mississippi, Atchafalaya and Neches rivers, the Houston Ship Channel and Galveston Bay. From header to header, the Mississippi crossing was 9,900 ft., including an island in the river. At the crossing point near Baton Rouge, the river is 80 ft. deep. The concrete-coated pipe was triple joined and laid off a barge. The ditch was backfilled hydraulically to provide for minimum cover of 12 feet.

The Atchafalaya and Neches crossings were pulled. Dual lines were laid across the Mississippi and Atchafalaya rivers; automatic valve operations will function to block off a line in the event of a break. The 11-mile 22-inch crossing of Galveston Bay was jetted in from a barge.

Main-line valves are of the full-opening type and scraper traps are installed at each compressor station to permit on-stream pigging. Pigs will be run regularly to remove any water that is picked up with gas from supply laterals.



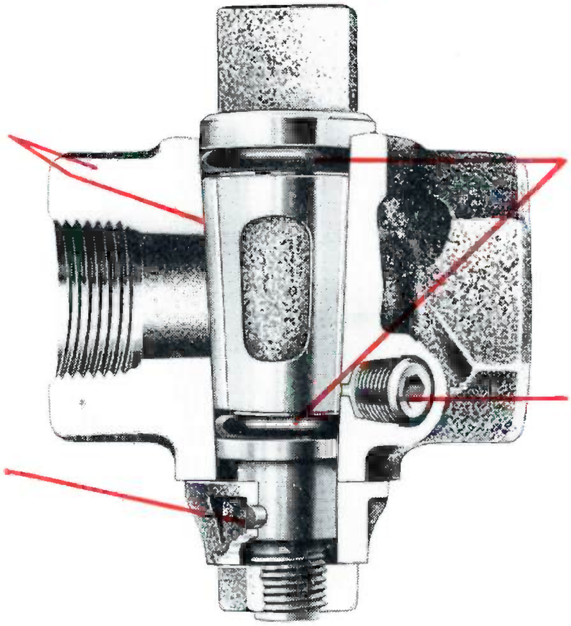
Welders are hard at work joining two more lengths of the line.

Now . . . a full line!

MUELLER® 125 pound LubOseal® stops

Iron body and bronze key—ground and lapped to perfect fit prevents leakage through the port.

Heavy bronze washer secured to key by steel drive-lock pin in blind hole to permanently maintain perfect adjustment between key and body and to prevent tampering. Stop safely operable without nut.

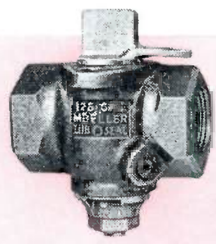


"O" rings at top and bottom of key provide dependable seal to prevent leakage to the atmosphere.

Entire sealing surface and both "O" rings quickly and easily re-lubricated through independent port in body. Assures continuous easy turning.

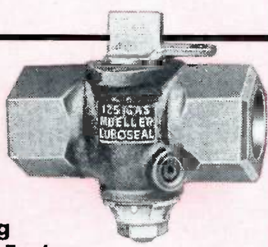
iron body, bronze key—working pressures to 125 psi

H-11170
Plain Head
Inlet: Inside I.P. Thread
Outlet: Inside I.P. Thread
Finish: Black or Galvanized
Sizes: ¾", 1", 1¼", 1½", 2", 2½"

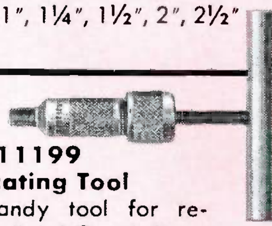


H-11175
Lock Wing
Inlet: Inside I.P. Thread
Outlet: Inside I.P. Thread
Finish: Black or Galvanized
Sizes: ¾", 1", 1¼", 1½", 2", 2½"

H-11173
Plain Head
Recessed Ends
Inlet: Recessed Inside I.P. Thread
Outlet: Recessed Inside I.P. Thread
Finish: Black
Sizes: ¾", 1", 1¼", 1½", 2"



H-11178
Lock Wing
Recessed Ends
Inlet: Recessed Inside I.P. Thread
Outlet: Recessed Inside I.P. Thread
Finish Black
Sizes: ¾", 1", 1¼", 2"



New! H-11199
Re-lubricating Tool
Simple, handy tool for re-greasing all LubOseal Stops to restore original turning ease. Tool is screwed into grease port of stop and handle turned — that's all there is to it! Convenient H-853 Grease Sticks just fit tool to eliminate waste.

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The features of these products are typical of the attention to detail in research, design and engineering that becomes a part of every Mueller No-Blo product manufactured for the gas industry. Write for complete information.

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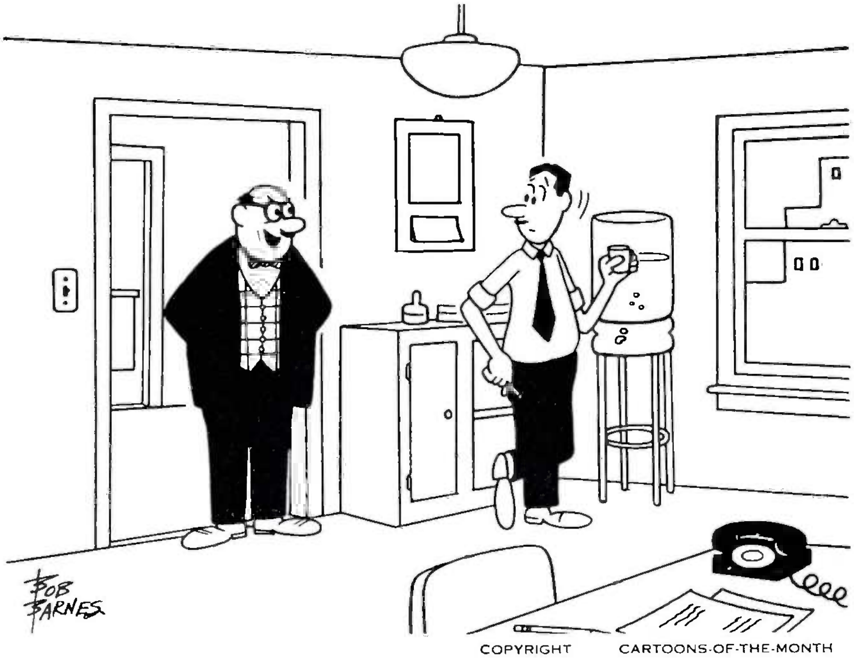


"I'm having them make up your pay in travelers cheques, Gibson"

If you would stand well with a great mind, leave him with a favorable impression of yourself. If you would stand well with a little mind, leave him with a favorable impression of himself.

All the finest things we have today were discovered, fashioned or conceived by those who kept constantly in sight of the motto: "I may be wrong."

The hard part about making good is that you have to do it again every day.

The scoffers said it couldn't be done,
And the odds were so great, who wouldn't?
But I tackled the job that couldn't be done
And what do you know? It couldn't!

Don't forget that people will judge you by your actions and not by your intentions. You may have a heart of gold, but so has a hard-boiled egg.

Sign in a barber shop: Parking for longhairs only.

Have you heard about the cannibal who got fed up with the human race?

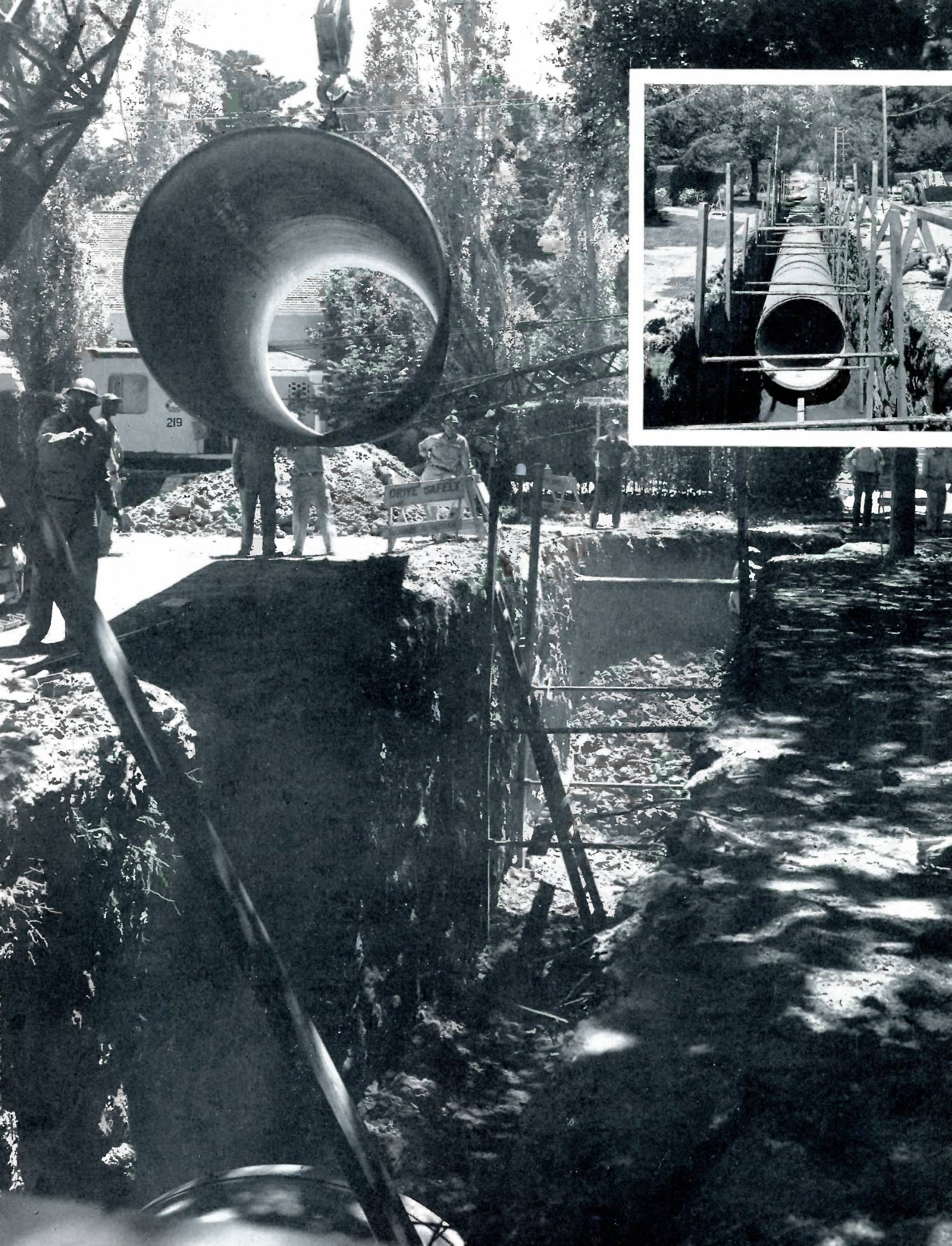
Hostess: "I have a lonesome bachelor I'd like you girls to meet."
Athletic Girl: "What can he do?"
Chorus Girl: "How rich is he?"
Society Girl: "Who are his parents?"
Secretary: "Where is he?"

"My wife has been nursing a grouch all week."
"Do you feel better now?"

A tourist visiting northern New England stopped to talk with an old farmer beside the road. "I understand you have a very short summer up here," he said.
"Yep," the farmer replied, "last year 'twuz on a Wednesday."

THORNDYKE

"What do you mean, 'Is it clinically proven'?"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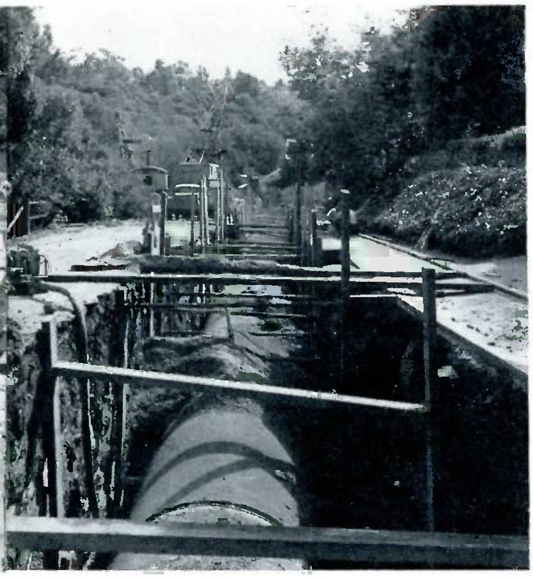
DRIVE SAFELY

In the large photo at left, the 79-inch Sunset Supply Line is being laid in Hillsborough, Calif. The inset photo shows a 78-inch section of the same line. Above left: A 78-inch section of the Sunset line is ready to be covered.

Above center: A 60-inch pipe on a 40-foot right-of-way traverses the back yards of a subdivision in South San Francisco. Above right: A 60-inch section of the Sunset Line snakes its way under a street in San Bruno.

San Francisco, Calif.

Ten Year Program Completed

by
J. H. Turner, General Manager and Chief Engineer
San Francisco Water Department

EARLY in 1958, the San Francisco Water Department completed a 7,300 foot long section of 78″ pipe through the Town of Hillsborough, San Mateo County, some 15 miles south of San Francisco, at a cost of $950,000. This was the final link in a program started in 1948 to bring additional water from the 22.6-billion gallon Crystal Springs reservoir in San Mateo County to the Sunset Reservoir in San Francisco, a distance of nearly 20 miles. A second basin of 87.3 m.g. capacity, now being constructed at Sunset Reservoir at a cost of nearly $3,000,000 will, upon completion in the fall of 1959, increase the existing 89.4 m.g. capacity, making a total of 176.7 m.g. storage at this site.

Prior to completion of the Sunset Supply Line, the delivery capacity of the existing lines from Crystal Springs reservoir to San Francisco and other consumers in route was approximately 67 m.g.d. Under present conditions, more than 152 m.g.d. can be delivered for these purposes, or an increase of 85 m.g.d.

This 20 mile long aqueduct, known as the Sunset Supply Line, was constructed over a period of 10 years under eight separate contracts, at a cost of nearly $7,600,000. It consists of 83,300 feet of 60" and 61" pipe, 14,600 feet of 78" and 79" pipe, and 5,200 feet of 91" pipe. By developing in this manner, the San Francisco Water Department was able to finance most of the work out of current revenue, while providing increased capacity in increments as needed. $2,232,000 of the total cost was financed from a $25,000,000 bond issue for water system improvements voted in 1947.

The need for this new aqueduct became apparent during World War II when San Francisco and, in particular, the San Mateo Peninsula area to the south of San Francisco, began to grow very rapidly. Nine communities and 4 water districts in San Mateo County are supplied from transmission mains originating at the storage reservoirs on this peninsula. Some of these customers purchase supplemental water from San Francisco at wholesale rates and distribute the water for resale, and some obtain their entire water supply in this manner.

San Francisco's water supply system consists of three principal sources: (1) The Hetch Hetchy Water Supply, which impounds waters of the Tuolumne River and tributaries, and with the delivery system as presently constructed, is capable of delivering 163 m.g.d. of water by gravity to Crystal Springs reservoir, a distance of 150 miles. From this source San Francisco can ultimately develop more than 400 m.g.d.; (2) The Alameda sources, consisting principally of Calaveras reservoir, Sunol underground galleries and the Pleasanton Well Field. From these sources water is conveyed into the Bay crossing aqueducts, and thence delivered by gravity to Crystal Springs reservoir, as well as to consumers en route. The average yield of which these sources are capable is about 46 m.g.d.; (3) the Peninsula reservoirs, which consist of Crystal Springs, San Andreas and Pilarcitos, all located within 20 miles of the City and County of San Francisco. These sources have an average yield of about 15 m.g.d.

The San Francisco Water Department supplies water to about 40 communities, water districts and other large users within its service area, which includes the City and County of San Francisco, the major developed areas in San Mateo County, the northerly portion of Santa Clara County and portions of southern Alameda County.

Table No. 1 illustrates the rapid growth of the areas served outside of San Francisco. The suburban consumption shown below in m.g.d. is for all areas outside of San Francisco, but is also indicative of the rate of growth of the areas in San Mateo County supplied by the transmission mains from the Peninsula reservoirs, of which Crystal Springs reservoir is the largest.

TABLE 1
Average Daily Consumption in M.G.D.

Year	San Francisco	Suburban	Total System
1940-41	60.7	7.3	68.0
1945-46	83.7	17.2	100.9
1950-51	82.8	23.0	105.8
1955-56	91.3	47.8	139.1
1957-58	94.0	46.5	140.5
1958-59	98*	57*	155*

**The last month of this year is estimated.*

Due to the location of the master meters the consumption for the inhabited portion of the northerly 47 sq. mi. of San Mateo County is included in San Francisco consumption.

Without the Sunset supply line the capacity of the transmission mains delivering water to San Francisco would have been overtaxed, since the Peninsula communities grew rapidly. By constructing this new aqueduct from San Francisco progressively toward Crystal Springs reservoir, and by cross-connecting to exiting mains, additional capacity was made available every few years.

With completion of the Sunset Supply line, over 200 m.g.d. can be withdrawn from the three Peninsula reservoirs to serve San Francisco and the consumers along the transmission mains. With the new basin at Sunset reservoir, the storage capacity in the City's distribution reservoirs and tanks will exceed 404 m.g. The maximum day's consumption within the City and County of San Francisco was 121.7 m.g.d. for the fiscal year 1957-58 and 211.3 m.g.d. for the entire system. The maximum monthly consumption for these areas was 107.0 m.g.d. and 185.8 m.g.d respectively.

In addition to the distribution reservoir and tank storage within San Francisco referred to above, Lake Merced reservoir has a capacity of 2.5 billion gallons, and Lake Honda has 44 m.g. which can be used in emergencies.

The earthwork for another dual-basin reservoir in San Francisco, known as Balboa reservoir, has been recently completed. One of these basins is scheduled for completion within a few years and will add 75 m.g. to storage within San Francisco. The second basin, scheduled for completion when the storage is required, will add an additional 75 m.g. of storage within the limits of San Francisco. Upon completion of these 2 basins and the new basin at Sunset reservoir, the available storage in San Francisco

This section of 79-inch pipe is shown in place in the canyon below Crystal Springs Dam.

will exceed 550 m.g. without including the emergency storage mentioned before.

Table No. 2 shows the date of construction, type and size of pipe, length of pipe constructed and the total project cost for the 8 contracts involved, listed progressively from San Francisco southerly.

The 79" and larger sections were built to serve the dual capacity of forming part of the Sunset Supply line as well as part of the future Crystal Springs Pipeline No. 3.

Pipe for the first 3 contracts listed above was secured from the War Assets Corporation, being surplus pipe available at Stockton, California. The pipe was of heavier plate than needed, it being ¾" and ⅝" thick, as compared to the $\frac{7}{16}$" and ⅜" required, but since the price was right and it was available, the City of San Francisco purchased it and furnished it to the contractors to be coal-tar lined, coated, and installed.

For other sections of the line, alternate bids were permitted for furnishing and laying either steel pipe with coal-tar lining, coating and felt wrapping, steel pipe with cement lining and coating or steel cylinder reinforced concrete pipe.

In its course to San Francisco, this 20 mile line traverses the cities of Hillsborough, Burlingame, Millbrae, San Bruno, South San Francisco and Daly City before entering the southerly limits of San Francisco. It also crosses State Highways in various locations; traverses the Golden Gate National Cemetery as well as several private cemeteries, and the U. S. Naval Depot at San Bruno. Many problems were encountered in securing rights of ways and permits from these individual property owners.

This photo shows a section of 79-inch pipe running alongside the state highway near Crystal Springs Dam. This is part of the Sunset Supply Line.

The recently completed 78" pipeline through the Town of Hillsborough was one of the most difficult and costly sections due to its size and location in a street only 22' wide through a highly developed residential area. It was planned to construct this section in the summer and fall to avoid difficulties of winter weather. Work started late in July and was progressing very satisfactorily when heavy rains in mid-October caused trench cave-ins and a considerable delay. Persistent heavy rains throughout the winter months of 1957-58, which was the wettest winter in 68 years, further delayed the project, so that it was not completed until early in 1958.

In city streets, the minimum depth of cover was 3 feet, but averaged close to 4 feet. All excavated material was hauled away and the entire trench backfilled with imported dune sand thoroughly jetted. In this manner, the ditch was filled as soon after pipe-laying as practicable, and cross-traffic and driveway entrances to homes were provided for over the loose fill. All pavement was repaired to the original grade, and a 1½" "plant-mix" wearing surface placed over the entire roadway in accordance with the terms of the permit from the

TABLE 2

Section	Year Completed	Steel Pipe I.D.	Lining and Coating	Total Length	Project Cost
1. Sunset Res. to Colma	1948	60"	Coal Tar	25,495	
2. Across Lake Merced	1948	60"	" "	409	$2,313,000
3. Colma to Baden	1949	60"	" "	18,644	
4. Baden to Millbrae	1954	61"	" "	18,739	955,000
5. Millbrae to Burlingame	1954	61"	" "	19,112	1,153,000
6. Hillsborough Section	1958	78"	Cement	7,300	965,000
7. Hillsborough Tunnel	1957	90"	"	5,198	1,487,000
8. Crystal Springs Dam to	1954	79"	Coal Tar	7,343	717,000
Hillsborough	1954	60"-36"	" "	382	
				102,622	$7,590,000

Crystal Springs Reservoir stores 22.6 b.g. within 20 miles of San Francisco. Productivity of the 22.5 square mile watershed is 7.5 m.g.d.

Town of Hillsborough. The heavy equipment and the 8.5-foot wide ditch in this narrow street would have, in any event, necessitated the repaving of practically the entire street.

From an engineering standpoint, the Hillsborough Tunnel was the most interesting part of this project. In order to avoid construction of two 60" aqueducts, each more than 25,000 feet long, through narrow streets and in a canyon with limited room, it proved economically feasible to construct the one larger aqueduct, consisting of 15,000 feet of 78" and 79" pipe and 5,200 feet of 90" I.D. tunnel. The larger tunnel section was selected so that it could also serve a third 60" pipeline if needed in the future.

Geological investigations indicated that there would be no unusual problems, such as large quantities of ground water, fault lines or formations containing gas, to contend with. Borings were made in 5 locations and, as a result, it was anticipated that considerable sandstone would be encountered, and the balance would be in shale formations with a few serpentine seams. Final results showed the shales to predominate, making timbering necessary througout the entire tunnel—in fact, only 60 feet was untimbered in hard sandstone.

The tunnel was excavated to a horseshoe shape, approximately 10' at springline, with a ½ circle upper section, 9' high, and a bottom width at invert of 8'. Excavation was carried on in a conventional manner by drilling 25 to 30 holes 6' deep, blasting, and then excavating with an air-operated mucking machine. 4" steel H-Beam ribs were then placed at 3' to 6' intervals, depending upon general conditions, and the necessary timbering, lagging and bracing installed. Generally, this work was carried out in a 2-shift operation from one or the other heading, and for a 6-week period from both headings at the same time.

In order to avoid undue disturbance to the residents in the area and above the tunnel, no blasting was permitted prior to 8:00 A.M. or after 9:00 P.M. In the 14-month period of tunnel excavation there were not more than 4 or 5 days when this restriction caused any delay.

Through the highly-developed residential areas, the tunnel is from 140' to 250' below ground. No serious damage was done to any structure, but there were numerous complaints regarding noise and minor damage.

The average rate of progress was 10 feet of driven tunnel per shift, and the maximum was 20 feet. January, 1957, was the month of best progress, with an average of 27 feet of tunnel driven per day by 2 shifts. The tunnel was started on December 5, 1955 and holed through on February 8, 1957; meeting within 0.1 ft. for line and grade.

After driving nearly 2,200 feet from the southerly portal, operations were shifted to the northerly portal, which had, at that time, progressed only to the extent of making a portal and getting underground. This change in operations was due to a cave-in, at 900' from the southerly portal, which required re-excavating, re-timbering and guniting to hold the ground. No further driving was done from this heading.

While driving continued from the northerly portal, and after necessary repairs had been made, the 91" I.D. x ⅜" plate-welded steel pipe was installed in the southerly 2,200 feet of tunnel. Pipe in place has 8" minimum clearance between the steel ribs at top and on springline, and 6" minimum clearance at the invert. Two or three sections of pipe, each 30' long, were installed each day by the "swing" shift, welded on the inside by the "graveyard" shift, and concreted by means of a pneumatic gun by the day shift. The 2,200 feet of pipe was installed and concreted in place in 34 working days, with the 3 shifts mentioned. Pipe was installed and concreted in place for a distance of 2,900 feet from the southerly portal in a similar manner, 35 days being required for this operation. The concrete mix was 6 sacks, 4"-6" slump and 1¼" max. aggregate, giving a strength of 3,000 p.s.i.

During the tunnel driving, accurate records were kept of places which would later need grouting. These were generally in the arch section and sides where considerable overbreak occurred or where excessive timbering, which could not all be removed, was necessary. Upon completion of the pipe and concreting operation, the grouting started.

Grout holes were drilled at predetermined locations, so that the hole would go 6" into original ground. In addition to this "normal" grouting, thirteen "cut-off rings," consisting of 8 holes 15 feet deep, spaced at 45° intervals around the 91" pipe, were drilled and grouted. These "cut-off rings," located at 500' intervals, were to prevent seepage of water along the tunnel bore. A total of 299 grout holes were drilled and 259 grouted; forty holes being filled while grouting from adjacent holes. Grout varied from 1 cu. ft. per hole to 550 cu. ft. per hole; the average for the entire job was 36 cubic feet per hole.

The next operation was to line the 91" steel pipe with ½" concrete centrifugally applied by the "Centriline" process. This was done in 14 working days. Upon completion, there remained only miscellaneous work of piping at portals, cleaning-up and testing the tunnel section for tightness. A 24 hour leakage test at 96 p.s.i. showed a loss of only 54 gallons, which was 27% of the allowable. All work was completed in a 21 month period.

In addition to the third Crystal Springs pipe line estimated to cost nearly $9,000,000, and completion of the Balboa reservoir at an estimated cost of about $6,000,000, San Francisco must, in the near future, construct a third pipe line across the San Joaquin Valley and a fourth bay crossing pipe line at a cost of nearly $50,000,000, as well as other works, in order to provide for the increasing demands for water. These are some of the major developments for the future, and will necessitate financing by a bond issue.

The San Francisco Water Department is one of several utilities controlled by the San Francisco Public Utilities Commission, a five man body appointed by Mayor George Christopher. Mr. Robert J. Kirkwood, Manager of Utilities, is the executive head of this commission and Mr. J. H. Turner, General Manager and Chief Engineer, is the executive head of the San Francisco Water Department. Mr. George D. Burr is Assistant General Manager and Chief Engineer. Mr. H. C. Medbery is head of the Engineering Division, and Mr. C. A. Lauenstein is the Construction Engineer who was in charge of the Sunset Supply pipe line location, right of way acquistion, and construction.

. . . Water Bulletin . . .

A patent has been issued on a device for automatically reading meters by telephone. The utility would simply insert a coded card into a sending machine at its central office, and then energize a special telephone circuit. The house phone would not ring, but the meter would be automatically "read" and the service charge punched on the customer's office record—all in ten seconds!

* * * *

The largest water system in the world will be developed in California under provisions of a $1.75 billion program approved in mid-June by the State Legislature. Billions of gallons of water annually are to be moved 500 miles or more from the moist northern counties of California to arid regions in the southern counties. The program must be ratified by the voters in the November, 1960, elections—and will be financed by bond issues and revenues from off-shore oil operations.

* * * *

The sea will provide cheap water for Southern California within five years, predicts A. L. Miller, Chief of the Interior Dept.'s Office of Saline Water. Dr. Miller believes that conversion costs will ultimately drop to *$0.60 per 1000 gallons,* particularly if inexpensive atomic power is available. The first saline conversion demonstration plant will be built on the Gulf Coast—probably Texas—and will produce fresh water for about $1.00 per 1000 gallons, exclusive of distribution costs.

The largest salt-water conversion plant in the world—supplying up to 2.7 million gallons of fresh water daily—has recently been completed on the island of Arruba in the Caribbean. The plant is of the *evaporation type,* and will deliver water at an estimated $1.75 per gallons, exclusive of distribution costs.

* * * *

Weather modification will be the basis of a new research program announced by the National Science Foundation, Washington, D.C. The program has the objective of studying more intensively than has ever been attempted before the scientific basis of weather modification. Among the field and laboratory projects covered by the program are *cloud-seeding,* changing of the *heat balance* of clouds through introduction of lampblack and other agents, and artificial modification of atmospheric electricity.

* * * *

The Army Engineers have begun a study of plans for the Rampart Canyon Dam in Alaska, which would be built on the Yukon River, 90 miles northwest of Fairbanks. The completed structure would be the nation's largest hydro-electric power plant, and would create a reservoir covering an area larger than the state of New Jersey. Meteorologists say that the reservoir might modify the climate to such an extent that much of inland Alaska would be warmed considerably.

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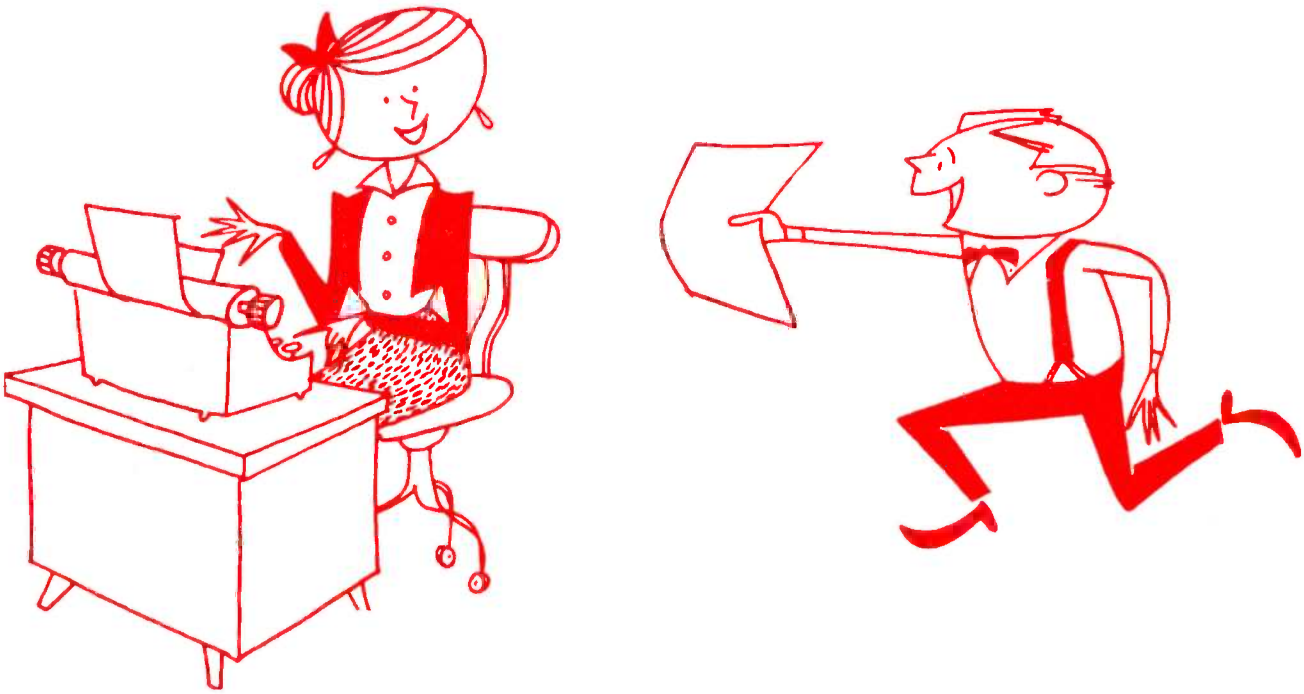

"Quick, Miss Jones! Send my new title and address change to the Mueller Record editor so I won't miss next month's issue!"