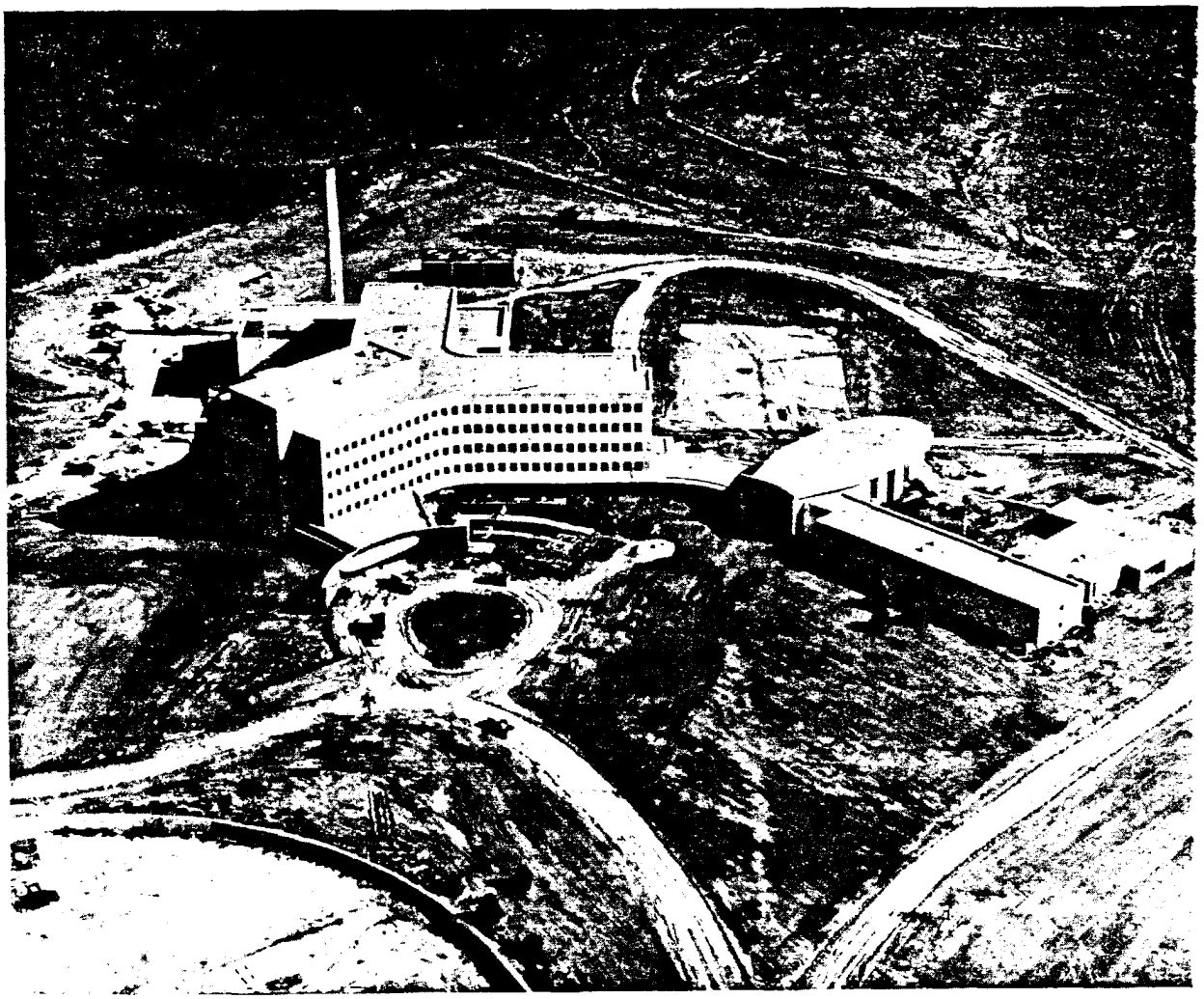
Lead

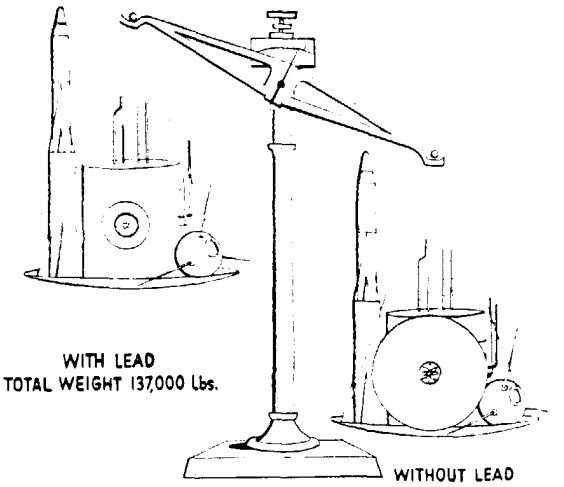
VOLUME TWENTY-FOUR 1960 NUMBER TWO



Aerial view of Tulsa's new St. Francis Hospital. Lead is extensively used for both sanitary plumbing and X-ray protection. (See page 7)

THE BALANCE OF NUCLEAR POWER

Two reactors identical in all respects except in the make-up, weight and volume of their equivalent shields. Shield at the left comprises ¾' lead and 3¾' water. Shield at the right comprises 11¾' water alone. Both envelop 5' diameter cores. The differences illustrate savings inherent in mobile polyshield configurations using lead. Weights were calculated using neutron removal cross sections and 3 Mev gamma build-up factors. More accurate analysis accounts for the energy and angular distribution of the source terms including secondaries i.e., capture gammas and gammas produced by inelastic neutron scattering.



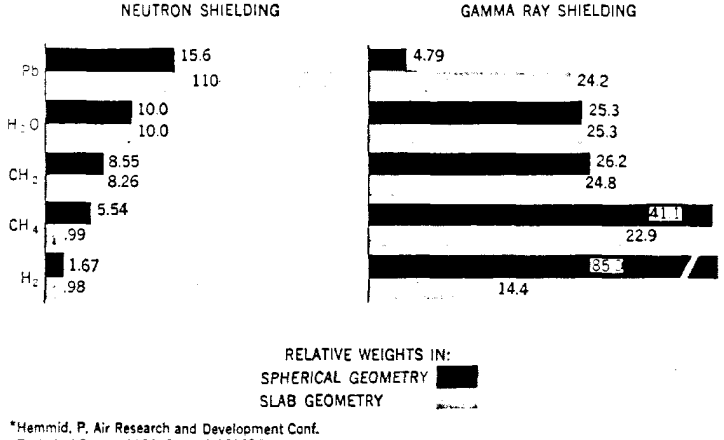
Lead is heavier than 81 other elements or roughly 80% of the periodic table. It follows that construction making use of lead will generally tend to be heavier than constructions making use of lighter elements. In the nuclear sense, for gamma attenuation, there is often little to choose between the light and the heavy in those instances where weight and volume restrictions are unimportant. In static structures, for example, concrete and water are comparatively cheap and are often used.

In mobile systems however, where weight and volume reductions are at a premium, the selection of such materials, admittedly low cost in themselves, would have quite the opposite effect to that intended. In practice lead is considerably "lighter" than materials normally considered as attenuators e.g., water, concrete and even air. Elements which are heavier than lead can contribute to even greater weight savings, although the cost of such candidates as depleted uranium and tungsten usually make their use prohibitive.

It is a simple matter to show that savings inherent in spherical shield structures containing lead are derived from surface area-radial thickness relationships, shield area increasing with radial thickness or distance of the shield from the core center. Compare lead and water as shielding. For a given dose constraint, so much less radial thickness of lead is required that it shows not only the lowest surface area, but also the lowest volume and weight.

From the comparison of shields, fig. 2, one can deduce that materials like lead make good light weight gamma shields, and that hydrogen is beneficial from the neutron standpoint. Happily some combination of the two, lead and hydrogenous materials, enable light dual purpose constructions as the degree of unbalance in the scale, fig. 1, indicates. As the artist's rendering suggests, the traditional concept of lead as heavy must be revised in terms of putting reactor payloads in the vicinity of the moon, in orbit around the earth, or even in transit from fabricator to user. Whether it be space probes or satellites in orbit with their prodigious appetites for unattended, uninterrupted power, or research and training reactors in transit or use where light weight and low volume have their apparent economies, lead is the lightest, most economical choice for gamma shield structures.

COMPARISON OF SHIELD MATERIALS*



*Hemmid, P. Air Research and Development Conf. Technical Symp., 1958, OTS PB 151627.

Comparison of mobile spherical shield configurations for various materials show great advantage of lead. Chart shows weight ratio of various materials having equal dose contraint.

LIA26205

LOOK AHEAD WITH LEAD

Bearings for Rocket Flight

— with built-in dry lubricant

— work fine at 1000°F.

Rocket propulsion and supersonic aircraft, cornerstones of our scheme of national defense, posed a pressing problem for materials scientists — the need for high-temperature lubricating materials. In answer, researchers at the NASA Lewis Research Center at Cleveland have developed bearing systems for high speeds and high temperatures which will never require lubrication.

Key to the development is a lubricating film of lead monoxide "fired on" to the bearing surface. These bonded lead monoxide coatings have better wear and a lower coefficient of friction at high temperatures than such standbys as molybdenum disulphide (see illustrations).

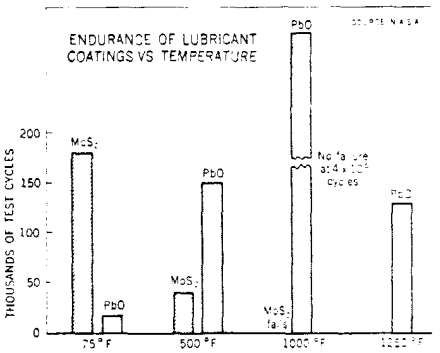
The reason for this lies with the nature of the film. NASA's coating lubricates best under conditions which produce high surface temperatures. Thus, up to a point, high ambient temperature, high load, and high speed improve the performance of such a bearing. In fact, at sliding velocities of 2,400 to 10,000 ft. per min. (highest speed studied) the coefficient of friction was 0.05 to 0.08 for all test temperatures. The explanation is that high speeds, loads, and temperatures produce a "glazed" or vitreous surface to the film. Sliding can then take place by plastic or viscous shear rather than shear along the crystal planes.

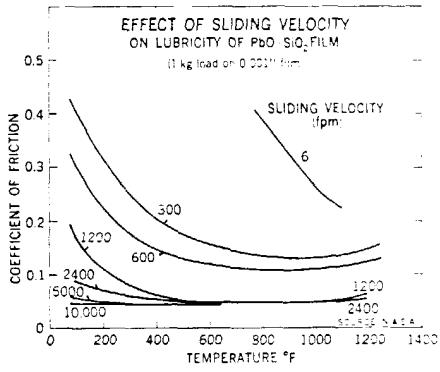
Bearing this out, life of the bearing has been found to be best when operating temperature is close to 1000°F. Though designed to operate in the 600 to 1200°F. range, the data shows that both life expectancy and friction coefficient for cool operation are good enough to recommend it even when it must be started or cycled through room temperature.

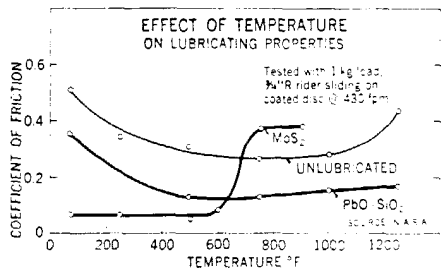
While there is some latitude in formulating such coatings, one of the best compositions to date contains about 5 per cent silicon dioxide and 5 per cent iron oxide (Fe_3O_4) formed in firing. The balance is lead monoxide. This and other formulations have been successfully applied to stainless steel (440C and 304) and Inconel X. They can be applied as a dry powder or sprayed on as a water slurry and fired at 1650 to 1800°F.

References:

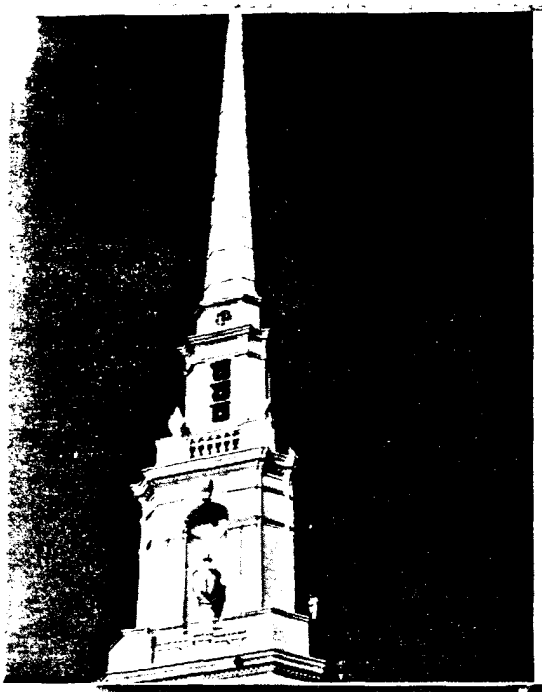
1. JOHNSON and SLINEY, "High-Temperature Friction and Wear Properties of Bonded Solid Lubricant Films Containing Lead Monoxide," *Lubrication Engineering*, December, 1959.
2. SLINEY, H. E. "Lubricating Properties of Lead-Monoxide-Base Coatings of Various Compositions at Temperatures to 1250°F," *NASA Memorandum* 3—2—59E.
3. PETERSON and JOHNSON, "Solid Lubricants for Temperatures to 1000°F." ibid. April. 1957.







LIA26206



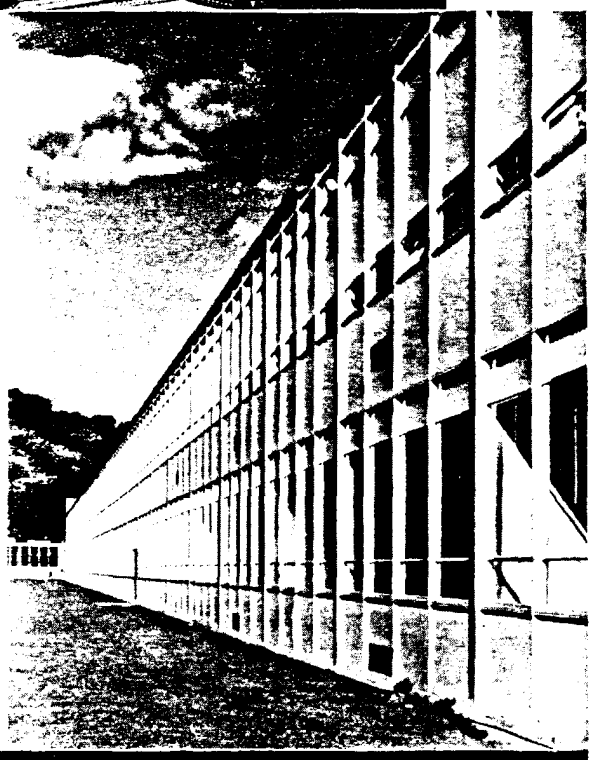
The varied world of

LEADED PORCELAIN ENAMELED ALUMINUM

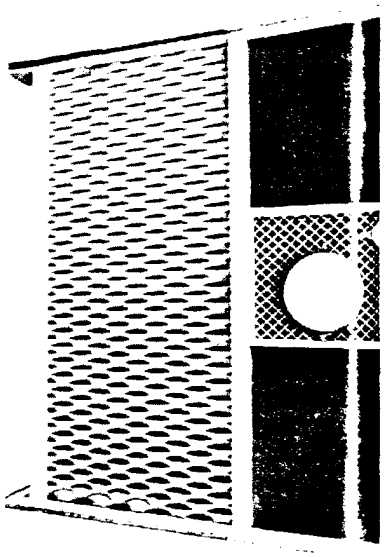
The durable beauty of leaded porcelain enamels for aluminum provides a flexible medium for the talents of renowned porcelain enamel artist Edward Winter.

Architects, too, have found that these colorful permanent finishes on light aluminum offer unlimited and economical scope in the design of churches, schools, industrial and office buildings, and, in fact, any type of structure.

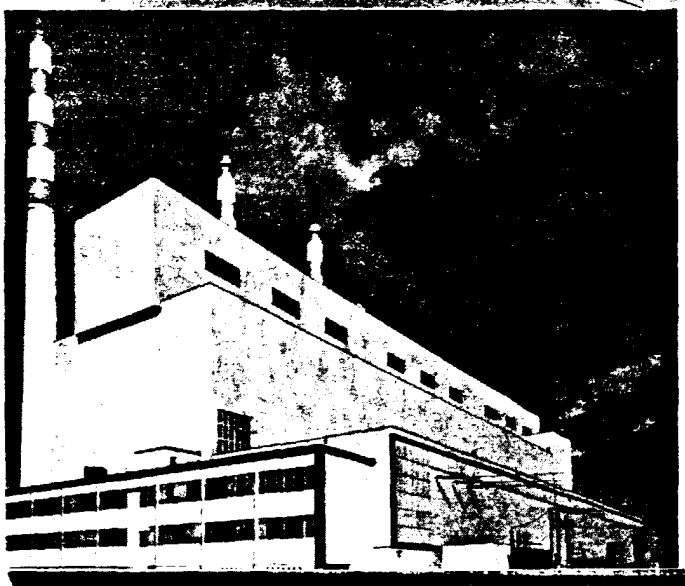
Westminster Presbyterian Church Steeple, Upper St. Clair Township — Ingram-Richardson Manufacturing Company



New Kensington High School — Ingram-Richardson Manufacturing Company



Expanded metal room divider by Ingram-Richardson Manufacturing Company.



Thos. H. Allen Generating Station (lower left) — H. H. Robertson Co.

Bowls and plates designed and executed in leaded porcelain enamel finishes by Edward Winter of Cleveland.

LIA26207

OPTICAL COLORS OPTICAL COLORS OPTICAL COLORS

Conventional pearlescent lead pigments ("Lead," Vol. 23, No. 1) produce a pearly luster which resembles that of the oyster pearl or mother-of-pearl. Although simulated pearl objects may equal or surpass the natural product in brilliance, they ordinarily lack the play of colors which is apparent in natural mother-of-pearl. It now becomes possible to produce a play of colors in conjunction with pearly luster in all types of applications *through the use of* Murano Colors.* While these do not produce a full spectrum of colors in any particular case, they do provide a multiple color effect which cannot be achieved with conventional colorants.

The colors are synthetic nacreous pigments consisting of a lead compound in the form of thin plate-like crystals which behave like a conventional pearl pigment in all respects except that they have twin inherent colors: one being observed by reflected light, the second seen by transmitted light.

These colors are produced by an optical effect rather than by the absorption of a particular band of wave lengths as occurs with ordinary dyes and pigments. The colors are rather subtle and of moderate intensity, but the two-color play inherent in each pigment makes possible effects which cannot be achieved in any other way.

Optical properties are readily demonstrated in transparent plastic sheets or films. For example, a polyester cast sheet containing the "red" pigment BD appears red when held against a dark background and examined by reflected light. When viewed by transmitted light however, the complementary green color is observed. These properties are illustrated in the table where each color combination is represented by one relatively large-grained and one relatively fine-grained material.

While the individual pigments produce an essentially two-color effect, minor variations in shade may appear as the angle of observation changes. Intimate mixing of two or more of the pigments does not increase the color play, but instead, diminishes the color intensity, and with some combinations, neutralizes the color entirely. For example, BA (gold) mixed with BD (red) produces a pink gold at a color intensity somewhat lower than that of the individual pigments; BA blended with an equal quantity of BF (blue) is entirely free of color. Thus colors can be modified with some loss of intensity by mixing pigments which are not of complementary color. Color is lost altogether when complementary colors are combined. The pigments can enhance each other however, when "marble-cake" mixtures or laminates are made. In this type of non-intimate combination, the use of complementary colors is particularly effective.

MURANO COLORS

Series I large grain	Series II fine grain	Reflection color	Transmission color
BA	BK	Gold	Blue
BD	BN	Red	Green
BF	BQ	Blue	Orange
BH	BS	Green	Red

Surface coatings: A Murano Color coated on a black object shows the reflection color only. On application of the pigment to a white object, or over a white undercoat, the transmission color appears: light passes through the layer of pigment crystals to the white undercoat, is reflected, and is then transmitted back through the nacreous layer once more. However, even with a white undercoat, the reflection color is still seen at the gloss angle or highlight, where specular reflection occurs directly from the crystal layer. Curved objects always show a highlight, and therefore demonstrate the two-color play more readily than flat objects.

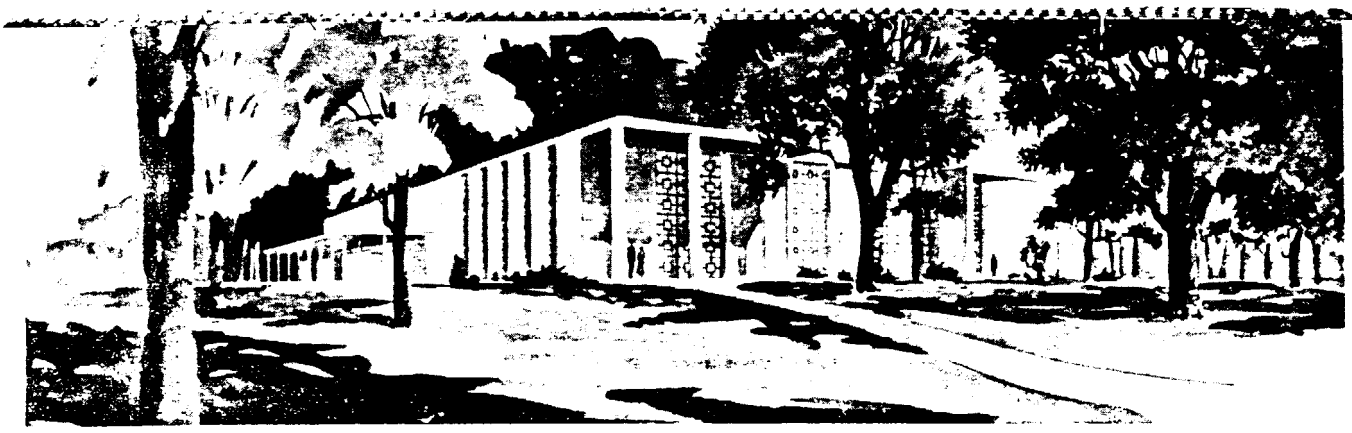
The two-color play shows effectively on any curved surface from furniture legs to automobile fenders. The colors may be modified and intensified somewhat by using a light gray background instead of white. Care must be taken in darkening the background, however, since too dark an undercoat suppresses the transmission color.

Plastics: The color effects obtained on incorporation of Murano Colors in plastics depend on the orientation of the crystals. If the orientation is uniform and parallel to the surface of the plastic sheet or film, the reflection color appears when the film is placed against a dark background, the transmission color when placed against a white background. This is very similar to the surface coating application.

If, however, the crystals are oriented in a mottled or variable pattern, and the plastic sheet or other object is then placed against a white background, the reflection color will be seen in the highlights, and the transmission color at all other points. A two-color play is readily available even in flat objects, so long as a mottled orientation can be achieved.

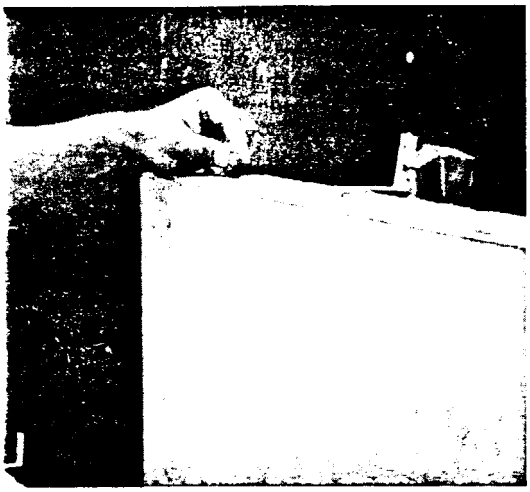
Color effects can be enhanced by laminating two sheets containing complementary pigments in mottled orientation. Suitable combinations are BA and BF, or BD and BH. In each case the transmission color of one pigment is intensified by the reflection color of the other.

*A product of The Mearl Corporation, 4 East 42nd Street, New York



The White Chapel Funeral Home, Montgomery, Alabama, where lead pellets protect a cast stone wall's symmetry.

PILLS TO KEEP A WALL STRAIGHT



The mason's hand gives the scale of both the pellet and the blocks of which the wall is built.

Utter simplicity of style often demands refined engineering and construction techniques. The unadorned expanse of cast stone wall of the new White Chapel Funeral Home in Montgomery, Alabama, for example, conveys a feeling of symmetry and serenity. Think how differently it would strike the viewer if its only feature — the mortar joints between blocks — were to wander, even slightly, from the true horizontal and vertical.

And, of course, a cracked block caused by settling of the structure would be glaringly evident.

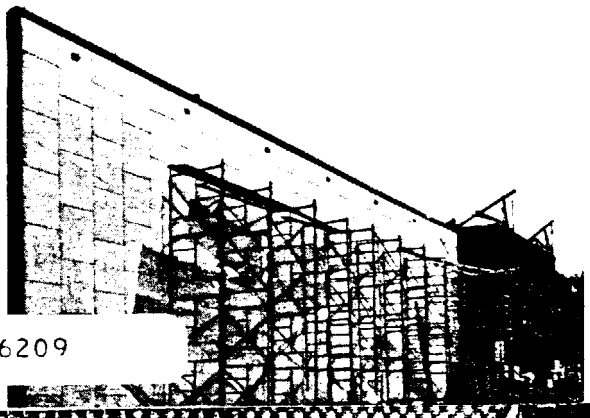
While a form of corrugated sheet lead is sometimes used between polished granite blocks to prevent either of these situations from spoiling the elegance of a wall, another form of lead solved the problem here. Architects Pearson, Tittle & Narrows agreed with the contractor, W. K. Upchurch, on the use of novel lead pellets to space the cast stone blocks and equalize bearing stresses between blocks throughout the wall.

Approximately 7,000 pellets of lead ¼" thick x ½" in diameter were used in the 16,177 square feet of cast stone wall of the building.

Set in place after the mortar had been applied to a block, these pellets (two to four of them, depending on location and bearing stress) take the weight of the masonry above and deform just enough to bring them all into bearing. Should slight foundation movements shift the balance of the load the pellets will flow a bit more so that local stress concentrations will not crack the wall.

About 2,000 of the pellets were used to wedge stone anchors tight into the reglet cast into the top edge of the stone. The reglet is ½ inch wide. Anchors ⅛ inch thick allow for any adjustment needed in anchoring the blocks to the wall behind them. Lead pellets offered a quick and permanent way of adjusting the anchor position — this cut the time needed by skilled masons on the job and turned in a creditable time saving.

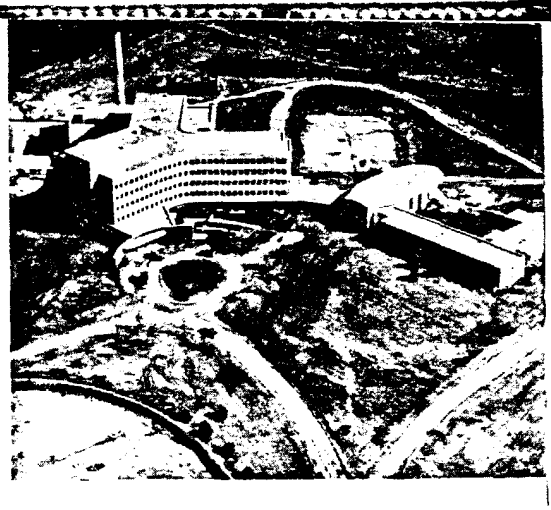
aying the wall, mor- is first trowelled into joint, then two or e lead pellets are itioned . . . the next b is lowered into ce and the process is eated . . .



. . . until the finished wall has been completed. Note the perfect trueness of horizontal and vertical joints.

LIA26209

No Leaks Here — Water or X-ray



These lead wastes and vents will be connections for 4 lavatories in the hospital.

Tulsa's new St. Francis Hospital relies heavily on lead for sanitary and laboratory plumbing, X-ray shielding

A spanking new 300-bed hospital built by the Wm. K. Warren Foundation is now nearing completion at Tulsa, Oklahoma. Tons of lead products are being installed. It takes a heap of plumbing to keep today's complex hospital functioning. Lead has been specified by Schmidt, Garden & Erikson, Architects and Engineers, of Chicago and its installation by Watt Plumbing Company of Tulsa has been overseen by a resident architect of the firm of Schmidt, Garden & Erikson.

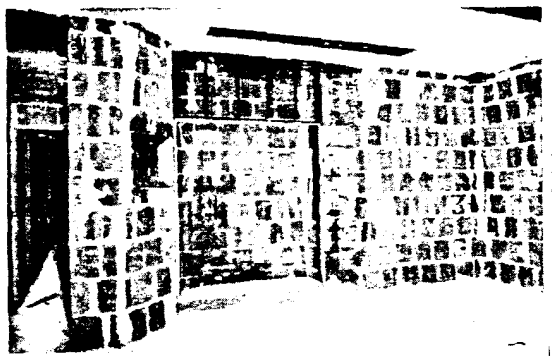
Some idea of the complexity of the plumbing system for the new hospital can be gained by looking through the list of lead and lead plumbing fixture connections required: there are 254 water closets, 3 urinals with 4" XH. lead bends or stubs, two dozen shower pans of 4 lb. sheet lead, and three lead bathtubs with lead waste lines and traps. In the category of sinks and lavatories alone there are 260 standard lavatories, 10 more special lavatories for surgeons' wash up, 76 sinks, 31 janitor's sinks, 20 more hospital clean up sinks, 4 clinic flush rim sinks, 4 autopsy trays, an autopsy sink, 29 scullery sinks, 10 laboratory sinks, and a photographic developing sink all with lead fixture waste connections. Twenty pounds of caulking lead alone were used for the C.I.S.P. drainage and vent system. All vent pipes through the roof were flashed with 4 lb. sheet lead vent pipe flashings.

Long life and dependability argue for the use of lead plumbing in a system like this. Freedom from leaks and low maintenance requirements are expected from it. But plumbing leaks are not the only sort that concern those connected with St. Francis. Eight X-ray rooms in the hospital have to be stopped from leaking invisible radiations. Here, too, lead has been used liberally. Two and one half tons of it in sheet form for partitions, ceilings, and floors. This sheet lead varies from 2 to 32 lbs. per sq. ft.

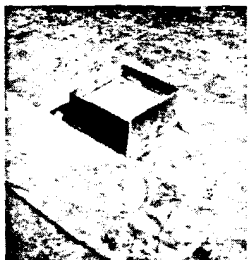
The walls of these X-ray rooms must also block the radiation to protect people outside as well as inside the building. Lead is used here, too, in the form of sandwich-like cement blocks with lead centers.

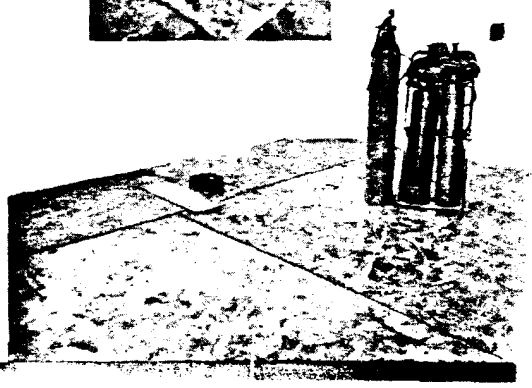
Another feature of the X-ray rooms is the use of leaded glass viewing windows to permit operators to observe the patient without exposure to the radiation. The sheet lead frame for one of these windows can be seen in the photo of the X-ray room under construction. It is in the projecting wall at the left.

X-ray rooms (below) are built with interleaving lead block walls for radiation protection. Note lead frame of viewing window at left.



Floor of the room above the X-ray room is lead covered with (inset) lead baffled electrical connection box.





A Ton of Lead Aids Fine Tuning

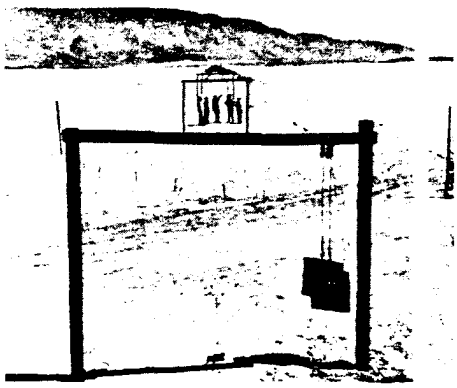
THE FOUNTAINS OF TIME-LIFE

In describing the new Time & Life Building in its last issue, LEAD omitted mentioning the fountains which will complement the eight lead-lined reflecting pools. These pools extend the graceful vertical lines of the building and the prospect is further augmented by the vertical jets of the fountains. Design of the fountain system, as well as the mechanical design of the pools and their linings was by Syska and Hennessy, Inc., Consulting Engineers, of New York.

The world's largest radio telescope, pictured here in part, requires perfect alignment for critical measurements. Two miles of transmission lines connect up eight parallel rows of north-south dipole elements in the California desert. To keep these transmission lines straight and parallel, two 1000-pound lead weights have been hung from their suspension to take up slack.

Built by the Scientific Research Department of Convair, the huge telescope uses the earth's rotation plus electronic "aiming" to scan the skies. It has already led to new solar radiation data.

Covering four square miles, the network uses 12 500-lb. and 9 1,000-lb. lead weights.



THE Lead LIBRARY of Technical Information

The following articles and reprints contain information, drawings and specifications on the use of lead products helpful to architects, engineers and others interested. They are available free of charge except where otherwise indicated, upon request to the LEAD INDUSTRIES ASSOCIATION, 292 MADISON AVE., NEW YORK 17, N. Y.

THE MATERIALS YOU BUY — LEAD
Descriptive information about lead from mine to finished products. Reprinted from "New York Purchasing Review," January, 1959.

USE LEAD TO CONTROL CORROSION
Latest practices in lead construction for the pertoleum refining industry are described. How to avoid the difficulties sometimes experienced with lead-lined equipment. Reprinted from "Petroleum Refiner," April, 1958.

MATERIALS of CONSTRUCTION REVIEWS
Lead and lead alloys in design and construction research, engineering and technological applications. With bibliography, 1959, 1958, 1957 and 1956 reviews (editions are not cumulative) are available. Reprinted from "Industrial and Engineering Chemistry," September, 1959, 1958, 1957 and 1956.

CORROSION DATA — LEAD & ALLOYS
Chart form presentation of the corrosion resistance of lead and its alloys to 188 common chemical materials over the normal temperature range. Reprinted from "Chemical Engineering." February 1953.

LEAD DOME'S SILVER ANNIVERSARY
The excellent maintenance and service records of the lead dome at New Jersey's penitentiary in Rahway are reviewed after 25 years. Shows construction method. Reprinted from "Heating & Air Conditioning Contractor," January 1960.

ULTRA LOW LOSS CERAMICS
Technical discussion of new formulations for ultra low loss ceramics together with possible mechanisms of behavior. Reprinted from "Jour. Amer. Ceramic Soc.," September 1959.

LEAD-ASBESTOS ANTI-VIBRATION PADS
Gives specification, drawings, and reviews recent applications of lead-asbestos anti-vibration pads for buildings.

LEAD WORK FOR MODERN PLUMBING
$2.00 Postpaid, $1.50 per copy in quantities of 10 or more.
Profusely illustrated with over 140 photographs and drawings, the textbook presents clearly to the plumbing student the necessary tools, procedures and the methods required for lead work.

LEAD IN MODERN INDUSTRY
$1.00 Postpaid
A fully illustrated 230 page, cloth bound book describing all phases of the production and use of lead, lead alloys and lead compounds.

ANODES FOR SHIP PROTECTION
Results of a detailed examination of lead-silver anodes for corrosion protection of ships. Operating efficiency and behavior are given. Other anodes are compared. Reprinted from "Corrosion," November 1959.

RED LEAD TECHNICAL LETTERS
No. 12 Seven formulations and schedules for painting highway structural steel.

No. 13 L.I.A. Formula 9-2. A single Red Lead Primer for Rusted, Weathered or New Galvanized Steel.

No. 14 Describes the formulation of red lead-coumarone primer for seawater immersion — ship hulls, fixed marine installations.

TRUCK COSTS IN A JIFFY
Three nomographs permit estimation of costs for gas or battery powered industrial trucks in two or three minutes. Depreciation, operating costs, and maintenance are appraised separately for all unusual types of operation.

BUILDING CONSTRUCTION BULLETINS
A series of specifications for the use of lead in building construction. (Available separately.)

No. 1 Specification for Lead Waste Connections for Plumbing Fixtures with Integral Traps (Water Closets — Pedestal Urinals — Service Sinks).

No. 2 Specification for Lead Shower and Safe Pans.

No. 3 Specification for Lead Chemical Laboratory Drainage Systems.

NEW LISTINGS

ISOLATE COOLING TOWER VIBRATION
An installation of lead-asbestos anti-vibration pads to isolate a roof-top cooling tower on a new office building is reviewed. Sectional drawing and loadings are given. Reprinted from "Plant & Power Services Engineer." March 1960.

NEW CLASS OF LEAD-BASE ALLOYS
A new set of alloys made by dispersing metal powders in lead show superior tensile strengths. Test data and formulations of seven of these are given. Reprinted from "Metal Progress," February 1960.

SEAMLESS TERNE FOR ROOFING
Illustrated four-page architectural specification also provides data on strength and weight characteristics and color advantages of terne-plate as roofing.

UPON REQUEST, THE LEAD INDUSTRIES ASSOCIATION WILL BE GLAD TO MAIL "LEAD" REGULARLY, FREE OF CHARGE, TO THOSE INTERESTED, AND WILL COOPERATE WITHOUT OBLIGATION IN THE SOLUTION OF YOUR LEAD PROBLEMS.

188

LIA26211

RINTED IN U.S.A.
NTING — ROGERS KELLOGG CORP.
ISLAND CITY 1, N. Y.