LEAD INDUSTRIES ASSOCIATION, INC.

292 MADISON AVENUE
NEW YORK, N.Y. 10017

TELEPHONE - AREA CODE 212
OR 9-[illegible]

DON G. FOWLER
DIRECTOR OF HEALTH AND SAFETY

July 25, 1967

To: All Members of the Lead Health and Safety Committee

Attached for your information are copies of two recently issued articles that will be of interest to you.

First is the report from the July 3, 1967 issue of Chemical Engineering, reporting on the API study of the costs of removing lead from gasoline. You will remember that during the Muskie Hearings of June, 1966 the API promised definitive study would be made of the economics of removing lead from gasoline. The study was made for the API and first reported in May of this year at their Mid-Year Meeting.

Second is the report on the WHO study of lead in blood as it appeared in the official WHO Chronicle for May, 1967. You will notice that Professor Goldwater includes in his report the results of blood samples taken from New Guinea.

Very truly yours,

Don G. Fowler

Don G. Fowler
Director, Health and Safety

DGF/jv
Attachments (2)

Look Ahead with Lead

ETA122214

INDUSTRY & ECONOMIC NEWS . . .

JUL 24 1967

Unleaded gasoline—boon and burden

Lead compounds in gasoline may or may not pose health problems; but in any case, an industry-sponsored study points up the drastic effect on petroleum refining that would come from a decision to outlaw them.

Pity the future motorist who buys unleaded gasoline, and the refinery that makes such a product. It would mean staggering costs to both, according to a report presented at the 32nd Midyear Meeting of the American Petroleum Institute (API) Div. of Refining, held in Los Angeles in May. The API-sponsored study, conducted by Bonner and Moore Associates, Inc., Houston, tells what would happen if octane-boosting lead additives, long accused of being a source of atmospheric pollution, were banned from commercial motor gasolines.

Based on composite refinery studies aimed at providing a realistic countrywide picture, Bonner and Moore arrives at a figure of $1.3 billion/yr. in added fuel costs for U.S. motorists. The study also indicates that nationwide conversion to unleaded gasoline would require the construction of $4.24 billion of additional processing units capable of making high-octane gasoline without lead. This figure represents more than 42% of the current gross investment in refining equipment throughout the U.S., and is also 10 times higher than the average yearly capital outlay for refining equipment, says Bonner and Moore.

Here are other important facets of the switchover to unleaded fuel, as brought out by the study:

• More energy is needed to make the new gasoline—a blend high in aromatic components and low in olefins. This net energy requirement represents an increase of 5.5% in U.S. consumption of crude oil.

• The refinery processes that produce unleaded high-octane gasoline components are more costly than those currently employed. And the high per-barrel cost of small units restricts the use of these processes to large refineries, thereby putting the small refineries at a disadvantage.

• Higher amounts of platinum catalyst are needed to make unleaded gasoline.

Disquieting as these facts are, there is a good chance that they may never pose a real threat. Even though the old controversy of rising atmospheric-lead levels as a result of car exhaust emissions is far from dead, there is now no special urge on the part of governmental health agencies or industry to bring about a massive switch to unleaded fuels. The reason for this is that the parties involved in the controversy realize that a final word cannot be said until all aspects of the problem have been probed further.

At any rate, it seems certain that lead in gasoline does not contribute to smog formation. In a recent report to Congress on air pollution (*Chem. Eng.*, Sept. 12, 1966, p. 94), the U.S. Dept. of Health, Education, and Welfare (HEW) based that conclusion on year-long tests conducted by Du Pont on late-model passenger cars burning leaded and unleaded fuel. But because the tests were not concerned with all aspects of lead as an environmental hazard, leaded gasoline did not quite get a clean bill of health. The report itself carried some discrepancies between HEW and Du Pont over testing methods, and called for more research to settle the question.

▶ **A Massive Effort** — Since the early 1920s, when refiners started putting tetraethyl lead (TEL) into gasoline, much knowledge has been accumulated on the use of lead in fuels, and on lead's effect on the human environment. Variables such as the content of lead in city air, and in the blood and urine of people who work or live in urban areas, have been measured time and again in the search for meaningful trends.

One such study, published in 1965 by HEW, established that there was no consistent trend, up or down, in the lead content of the air of three cities (Cincinnati, Philadelphia, Los Angeles) during the previous five years. None of the concentrations found were thought capable of producing lead intoxication in individuals.

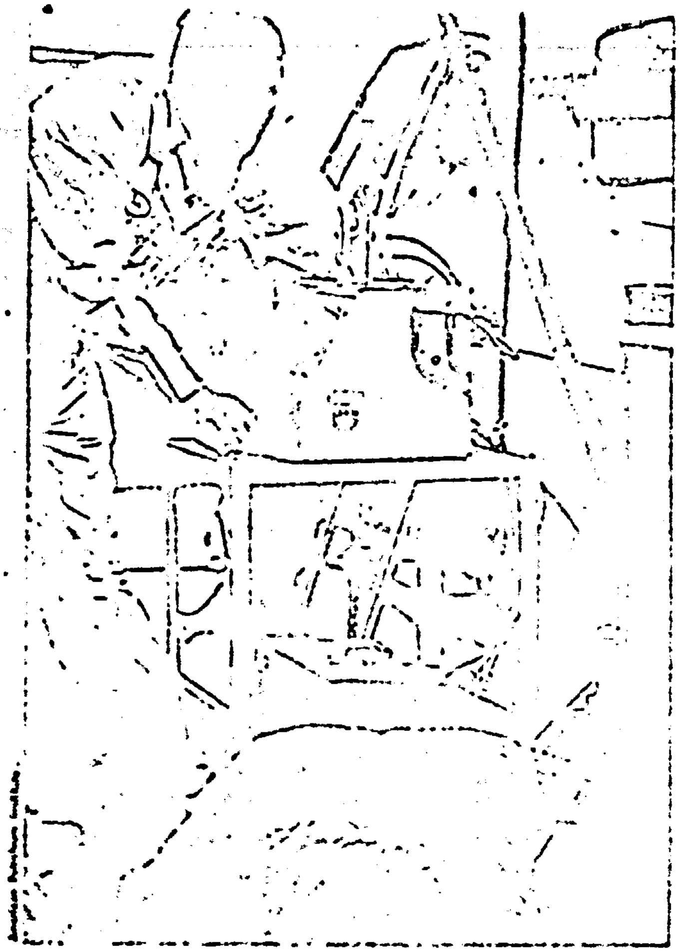
But controversy was raised again last year at Senate Public Works subcommittee hearings on air pollution (*Chem. Eng.*, Jan. 31, 1966, pp. 19, 20), which featured geophysicist Clair Patterson as a star witness. Patterson said his research studies showed that lead in the human environment was reaching critical levels.

Just how critical these levels were remains questionable, since a

Here's how refiners' costs would rise if gasoline had to be lead-free

(Above 1965 Operating Levels)

	Added Investment		Added Manufacturing Cost	
	Total $ Million	Per Barrel of Gasoline $/Bbl.	Total $ Million/Yr.	Per Gallon of Gasoline ¢/Gal.
East Coast	520	950	120	2.0
Mid-Continent	1,470	900	310	2.2
Gulf Coast	1,160	810	450	2.1
West Coast	690	1,140	230	2.6
Other	400	....	140	...
Total U.S.	4,240	940	1,440	2.2



TEST PROGRAMS, such as this U.S. Bureau of Mines project have long tried to establish the precise effects of lead (and other elements) entering the atmosphere.

major area of dissension at the hearings lay in determining the so-called normal blood/lead level. A report issued by the U.S. Public Health Service put the limit level at between 0.05 and 0.08 mg. of lead/100 g. of blood, while Patterson claimed the normal lead level was 0.002 ppm.

The wide disagreement over this and other aspects of lead pollution was still unresolved when the Public Works subcommittee held its last hearing, in mid-1966. The only unanimous action was to urge a continued quest for meaningful data. In this vein, API is one of the major sponsors of lead-and-health research today.

At the Midyear Meeting, API made a progress report on several projects that are concerned with: establishing a reasonable air-quality standard for lead (an API-PHS joint program); evaluating the potential toxicity of lead through animal tests; determining the lead burdens of laboratory animals exposed to heavy doses of automotive emissions; and comparing the present-day environment (food, air and water) with the ancient environment to determine whether lead levels have risen significantly, and if so, at what rate.

▶ Industry Steps In—The Bonner and Moore study was made as part of the overall lead-research effort, but it also represents the oil industry's first thorough investigation into the economics of unleaded fuel. The basic study plan was to determine representative refinery configurations that reflected desired variations in geographic location and size.

These representative refineries were the bases for mathematical models that simulated the manufacture of gasoline using lead antiknock additives. When modified, the same models showed the increase in costs when lead additives were eliminated. Linear programming was used to obtain the results.

The researchers developed two or more refinery simulations for each geographic region (West Coast, Mid-Continent area, East Coast and Gulf Coast), and twelve refinery cases were selected for study. Altogether, about half of all U.S. refineries were included in the groupings that resulted in the refinery simulations.

Some of the processes that were considered for making the unleaded gasoline are in only limited service today. However, the researchers made certain that they were in commercial operation in at least one facility. Among these were: high-severity reforming, aromatic extraction, isomerization, olefin disproportionation, hydrocracking, and naphtha steam-cracking.—AB

Chemical Industry Draws on More and More Engineers

For every ten engineers in the U.S. chemical industry now, there will be eleven in 1970. What's more, the 1970 total will be more than one and a half times the number of engineers that the chemical industry employed at the beginning of this decade.

These comparisons are based on estimates by CHEMICAL ENGINEERING market researchers, who in turn worked with data from the U.S. Bureau of Labor Statistics and from the Engineers' Joint Council's Engineering Manpower Commission. The estimates show 33,500 engineers for 1960, 50,300 for 1967, and 55,400 for 1970. The biggest year-to-year rise came between 1962 and 1963, when the ranks swelled from 33,800 to 44,300. The figure predicted for 1968 is 52,600.

WHO Chronicle Vol. 21, No. 5 May 1967

"NORMAL" CONCENTRATIONS OF METALS IN URINE AND BLOOD

*by Professor Leonard J. Goldwater**

In response to public concern about the effect on man of poisonous substances in the environment, WHO initiated an international study of the normal values of toxic substances in the human body. A meeting of the investigators[1] was held in Geneva, and this article has been specially written by the Chairman of the meeting, who organized the international study.

The chemical contamination of man's environment has caused growing concern in recent years. The reasons for this include the use of new methods of producing, processing, preserving, and packaging foodstuffs. As regards possible harmful effects, antibiotics and synthetic pesticides have been commanding more attention than have certain of the older chemicals, but the latter cannot be overlooked.

Recognizing the importance of establishing some sort of base line for the quantities of heavy metals in the human body, WHO, in collaboration with Columbia University, New York, initiated in 1961 a study of the normal amounts of lead, mercury, and arsenic in urine and blood. For the purposes of the study, "normal" was defined as the concentrations of those metals present in the urine and blood of individuals who had had no occupational, therapeutic, or other demonstrable exposure to them.

The Director-General of WHO designated the laboratory of the Division of Occupational Medicine, School of Public Health and Administrative Medicine, Columbia University, as a reference laboratory for studies of this kind. Financial support was obtained principally from the US Public Health Service and partly from WHO.

Arrangements were made with collaborating laboratories in 14 countries[1] to collect samples of urine and blood and send them by air to Columbia University, where the analyses were performed. The subjects from whom the samples were obtained did not constitute a random sample of the populations in the different countries, but they included members of both sexes and rural and urban residents.

Lead

To obtain an idea of the amount of lead present in human urine, 300 samples were analysed. The amounts present ranged from less than 3 µg to 118 µg per litre of urine. The mean values at various places ranged from a maximum of 45 µg/l in Finland to a minimum of 22 µg/l at Lima, Peru. The mean for the entire series was 33 µg/l. Urban dwellers in general had slightly higher levels than people from rural areas, but there was little difference between males and females.

* Professor of Occupational Medicine, School of Public Health and Administrative Medicine, Columbia University, New York.

[1] [illegible]

[1] [illegible]

The concentration of lead in the blood was found from a study of 816 samples. The values ranged from less than 5 μg up to 100 μg of lead per 100 ml of blood. The highest mean blood level, 26 μg/100 ml, was found in samples from Helsinki, Finland, and the lowest, 7 μg/100 ml, in the Peruvian samples, while the mean for all samples was 17 μg/100 ml. As with the urine samples, urban levels tended to be slightly higher than rural, and there was no appreciable difference between the sexes.

Not included in the study were 38 blood samples obtained from inhabitants of a mountainous area in New Guinea. This group was selected because of its complete absence of contact with motor vehicles or other possible man-made sources of lead. It is of considerable interest that the levels of lead in the blood lay between 10 and 40 μg/100 ml, with a mean of 22 μg/100 ml. Higher mean values than this were found only in England, Finland, and Yugoslavia.

These studies confirm previous reports on the ubiquity of lead. When the results are compared with those of similar studies in individual countries made during the past three decades, there is remarkable agreement in the ranges and means for the concentration of lead in both urine and blood.

Mercury

Analyses for mercury were performed by a very sensitive method capable of measuring as little as 0.5 μg per litre of urine or per 100 ml of blood. Concentrations below these figures are recorded as "zero".

The urine specimens tested for mercury numbered 1107. Of these, 77% had zero concentration, and a further 17% contained less than 25 μg/l. This figure might reasonably be accepted as the upper limit of normal concentrations, and higher values would suggest an unusual exposure. There were no important differences between males and females or between urban and rural dwellers.

With regard to mercury in the blood, the present study—based on an analysis of 812 blood samples—is the first large-scale effort to establish a normal level. A zero reading was obtained for 74% of the samples, and a further 20% contained less than 5 μg/100 ml, which figure may be taken as a reasonable upper limit for mercury in the blood. Again, there were no important differences according to sex or degree of urbanization.

Arsenic

Owing to difficulties in analytical techniques, reliable results for arsenic in the blood were not obtained, but arsenic in the urine was determined in 631 specimens, with a sensitivity of 1 μg/l.

In 76% of the samples no arsenic could be detected, and in a further 17% the level was less than 40 μg/l. This latter figure may thus be considered as the upper limit of normal concentration. However, it is known that the ingestion of shellfish may result in high levels of arsenic in urine without producing any adverse effects. There were, in fact, six samples that contained more than 100 μg of arsenic per litre, the highest being 630 μg.

* * *

Since the population samples were not selected on a statistically random basis, the results cannot be said necessarily to represent the normal values of absorbed metals for the different countries. But they probably give an approximate idea of those values.

The studies reviewed here are but the beginning of a larger effort to evaluate the extent to which humans may be absorbing metallic elements present in the environment. It is desirable to have some sort of base line with which to compare future observations. Such factual data may serve to limit sensational speculative notions on the amount of toxic metals ingested by man in urban and industrial communities, and they may be of value in a variety of epidemiological investigations.