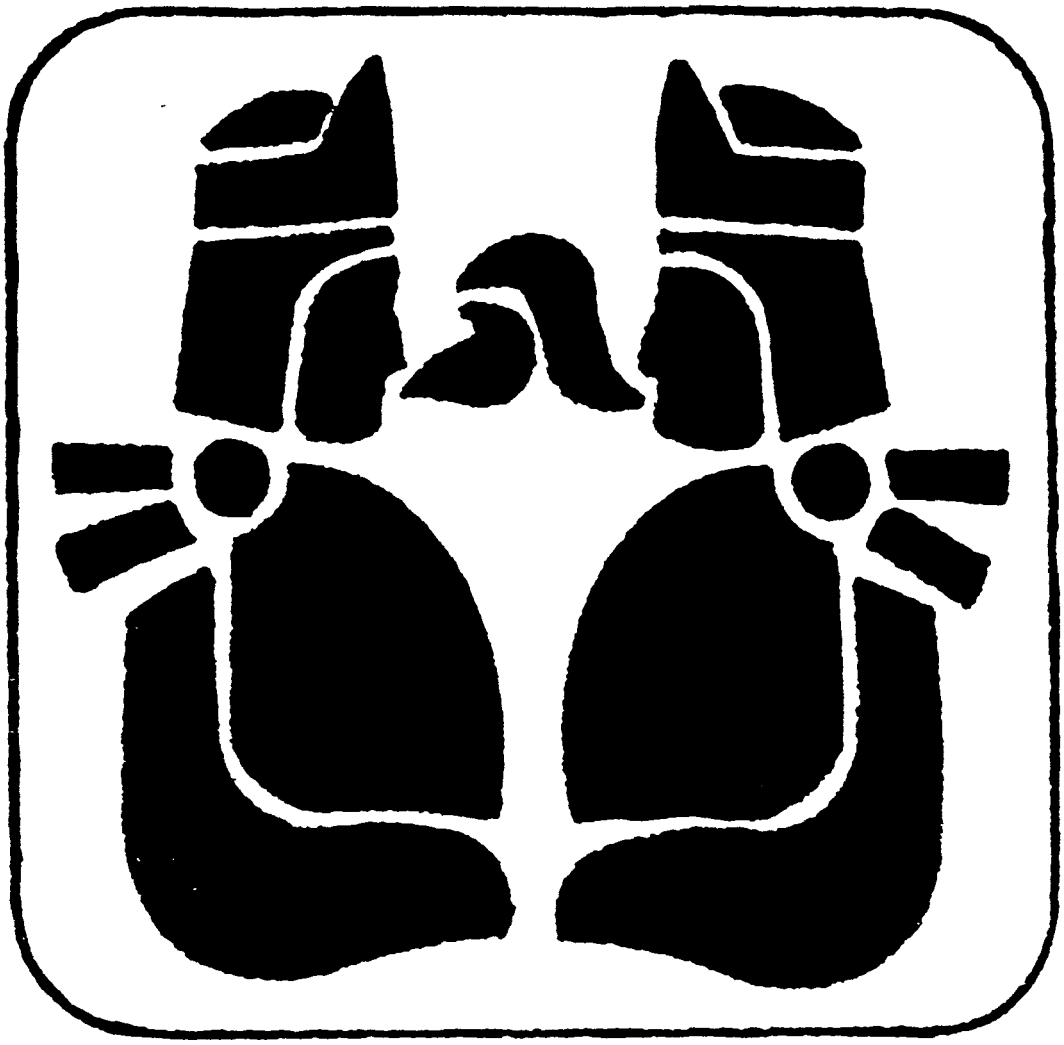
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PERSPECTIVE '77

PROCEEDINGS OF THE FIFTH ANNUAL
INDUSTRY CONFERENCE
A/C PIPE PRODUCERS ASSOCIATION
APRIL 18 - 19 , 1977
MEXICO CITY, MEXICO

DEFENDANT'S EXHIBIT
GtF 1

F O R E W A R D

The Fifth Annual Meeting and Industry Conference of the Association of Asbestos-Cement Pipe Producers was held April 17-21, 1977, in Mexico City, Mexico. The objective of the 1977 Industry Conference was to focus on the Association's commitment to unify the knowledge and resources of the international community of asbestos-cement pipe producers. "Perspective '77" captures the essence and importance of that commitment and provides the best available "perspectives" on critical factors affecting the future of the industry.

AACPP acknowledges with appreciation the participation of outstanding spokesmen from industry, academia and the regulatory community. Appreciation is also extended to all attendees for their obvious interest and active participation.

I. L. Taylor
Chairman of the Board of Directors

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A/C Pipe and Construction Practices - A Compliance Perspective
by
W. Clark Cooper, M.D.

Dr. Clark Cooper is the Senior Medical Scientist and Vice President of Equitable Environmental Health Incorporated, consultants in occupational medicine. Prior to joining EEH, Dr. Cooper was for nine years, Professor of Occupational Health at the University of California (Berkeley) School of Public Health.

Dr. Cooper was formerly Chief of Program Planning and Analysis for the United States Public Health Service, Division of Occupational Health and Chief of the Division of Occupational Health Field Headquarters in Cincinnati where his activities focused on occupational diseases of the lung. He has also served on the National Academy of Sciences Committee on Biological Effects of Atmospheric Pollutants (Chairman of the Panel on Asbestos), and Committee on Public Information and the Prevention of Occupational Cancer.

Thank you, Paul, very much. Dr. Kotin, ladies and gentlemen, I appreciate very much the opportunity provided by this association to begin the session on possible health risks associated with the installation and use of A/C pipe. My initial assignment is a relatively simple and limited one. It is to present and interpret data on airborne asbestos resulting from cutting and machining operations during the installation of pipe.

As most of you know, A/C pipe competes with metallic, clay pipe and a number of other materials in the United States for water and sewage lines. Different types of pipe are used for these two purposes. That for water, called pressure pipe, must meet requirements for internal pressure not required for sewer pipe. These differing requirements lead to differing composition, as shown in the first slide.

SLIDE (1) TYPES OF ASBESTOS/CEMENT PIPE

NAME	ASBESTOS CONTENT
SEWER	10 - 12% CHRYSOTILE PLUS 10 - 15% GROUND SCRAP ("FINES")
PRESSURE	17% CHRYSOTILE AND CROCIDOLITE

Tests were planned for both of these types. We were asked by the A/C Pipe Producers Association to obtain quantitative information on dust exposures during performance of several field operations, as shown in this slide for both sewer and pressure pipe.

SLIDE (2) OPERATIONS TO BE TESTED (BY ORIGINAL PROTOCOL)

MACHINING WITH A MANUAL FIELD LATHE

MACHINING WITH A POWER-DRIVEN FIELD LATHE

CUTTING HOLE WITH POWERED HOLE CUTTER

CUTTING WITH AN ABRASIVE DISC

CUTTING WITH CHISEL, USING HAMMER & RASP

These various operations will be illustrated and repeated as we get into the actual operations.

When possible, contractors avoid cutting and machining pipe in the field because of the added expense. The next few slides (photographs not included in transcript) show some typical field operations during the installation of six-inch pressure pipe in a new subdivision south of San Francisco.

The pipe is delivered precut in standard four-meter lengths, and pre-machined for assembly. Shorter lengths are provided, and whenever possible, special needs are anticipated. Nevertheless, there are always situations requiring odd lengths and custom work, so that some cutting and machining has to be on the job site. It was not feasible, however, for us to study all of the operations at an installation site. Instead, field conditions were simulated on the premises of a tool manufacturer. I will now show pictures of a few more field operations. This shows what a crew putting in a water line spends most of its day doing. Laying the pipe out, assembling, and putting lubricant and gaskets at the joints. Relatively little time is spent in cutting or machining.

This is six-inch pipe which can be handled manually. Eight-inch and larger pipe has to be laid mechanically by a hoist.

Now we will turn to the site where we simulated the various operations (Photograph of site).

A workman experienced in the use of all the tools performed individual operations with a helper provided by Equitable Environmental Health. EEH purchased eight-inch sewer type, Class 2400, and eight-inch pressure pipe, Class 150, from a local supply house. No special controls or ventilation were utilized since these are not usually available in the field. All operations were done dry.

Samples were collected as shown in slide (3)

SLIDE (3)

SAMPLES COLLECTED

* SHORT-TERM (4 - 20 MINUTE) BREATHING ZONE SAMPLES ON OPERATOR AND HELPER
* LONG-TERM (2 - 3 HOUR) BREATHING ZONE SAMPLES ON OPERATOR AND HELPER
* AREA SAMPLE 15 FEET DOWNWIND, FOR FIBERS
* AREA SAMPLE 5 - 10 FEET DOWNWIND, FOR TOTAL DUST
* BACKGROUND SAMPLE (1 - 2 HOURS) TWICE DAILY, FOR FIBERS

The short term samples were designed to measure so-called "peak" dust concentrations, for which a sampling period no longer than 15 minutes is usually recommended. Since it had been determined in advance that no single operation took as long as 15 minutes, and most were much less than that, several successive cuts or operations were usually made during each sampling period.

Three replicate short-term breathing zone samples were taken on the operator and his helper for each cutting operation. Longer term integrated samples over periods of two to three hours were also taken. Each of these included more than one type of operation. Area samples were taken to determine total dust concentrations, and background samples were collected before and after each day's work to determine the prevailing ambient asbestos air concentrations.

The methods of sampling and analysis are summarized in Slide (4)

SLIDE (4)

SAMPLING AND ANALYSIS
(ACCORDING TO OSHA & NIOSH STANDARDS)

* SAMPLES COLLECTED ON 37 MM, 0.8 MICRON PORE SIZE MILLIPORE FILTERS
* OPEN-FACED, i.e. NO SIZE SELECTION
* FLOW RATES 1.6 TO 2 LITERS/MINUTE
* PHASE CONTRAST MICROSCOPY AT 400x MAGNIFICATION

* ONLY FIBERS > 5 MICRON IN LENGTH COUNTED

* COUNTS BASED ON 100 FIBERS OR 100 FIELDS

These comply with OSHA and NIOSH regulations, and I must emphasize that for low fiber concentrations these are very imprecise methods. You will see fiber concentrations expressed to a second decimal place based on calculated values using area counted, volume of air and fibers observed. For anything below one fiber per cc. we are in an area of great uncertainity. One can say however, that such counts represent very low concentrations of asbestos.

The placement of personnel samplers is shown here (Slide). This is during a filter change. One sampler is for the peak sample, the other for the integrated sample. At the site you can see the placement of samplers for area sampling and for total dust sampling (Slide).

The first operation studied was with a manual lathe which is used for cutting and machining the end of the pipe. The next slide shows the airborne fiber concentrations.

SLIDE 5

AIRBORNE FIBER CONCENTRATIONS
DURING OPERATION OF MANUAL LATHE

TYPE OF PIPE	OPERATION TIME (MIN)	SAMPLING TIME (MIN)	OPERATIONS PER SAMPLE	FIBERS/CC (AVERAGE OF 3 SAMPLES) OPERATOR	HELPER
SEWER	4 - 5	9 - 12	2	0.15	0.13
PRESSURE	12 - 13	12 - 20	1	0.51	0.22

OSHA CEILING STANDARD: PRESENT 10 F/CC

PROPOSED 5 F/CC

You can see that for sewer pipe and for pressure pipe, the length of time each operation took, the sampling period, the number of operations per sample, and the average fiber concentrations during these operations.

I will go through these rather rapidly. You can compare the fiber

concentrations with the present OSHA ceiling standard of 10 fibers per cc., and the one that has been proposed, a ceiling of five fibers per cc.

The next operation was an electric-powered lathe, which does essentially the same operation with electric power. Here are the dust concentrations obtained during sampling periods of 13 to 20 minutes during the performance of these operations.

SLIDE (6)

AIRBORNE FIBER CONCENTRATIONS
DURING OPERATION OF POWER LATHE

TYPE OF PIPE	OPERATION TIME (MIN)	SAMPLING TIME (MIN)	OPERATIONS PER SAMPLE	FIBERS/CC (AVERAGE OF 3 SAMPLES) OPERATOR	HELPER
SEWER	5 - 6	13 - 14	2	0.08	0.09
PRESSURE	6 - 8	15 - 20	2	0.33	0.56

OSHA CEILING STANDARD: PRESENT 10 F/CC

PROPOSED 5 F/CC

The next operation studied was the cutting of a hole in pipe with a gasoline powered cutter. It took about one minute to cut a hole in sewer pipe, and one and a half to two minutes for pressure pipe. The next slide shows fiber counts during this operation.

SLIDE (7)

AIRBORNE FIBER CONCENTRATIONS
DURING OPERATION OF POWER HOLE CUTTER

TYPE OF PIPE	OPERATION TIME (MIN)	SAMPLING TIME (MIN)	OPERATIONS PER SAMPLE	FIBERS/CC (AVERAGE OF 3 SAMPLES) OPERATOR	HELPER
SEWER	1	11 - 15	4	0.44	0.23
PRESSURE	1 1/2 - 2	14 - 19	4	1.65	0.38

OSHA CEILING STANDARD: PRESENT 10 F/CC

PROPOSED 5 F/CC

The next piece of equipment studied was an abrasive disc, a gasoline powered disc saw with a 10 inch diameter carbide blade. Each cut took 30 to 45

SLIDE (10)

AIRBORNE FIBER CONCENTRATIONS
DURING CUTTING WITH WHEELER CHAIN CUTTER

TYPE OF PIPE	OPERATION TIME (MIN)	SAMPLING TIME (MIN)	OPERATIONS PER SAMPLE	FIBERS/CC (AVERAGE OF 3 SAMPLES) OPERATOR	HELPER
SEWER	2 - 3	13 - 14	3	<0.06	<0.06
PRESSURE	2 - 3	4 - 5	1	0.85	0.87

OSHA CEILING STANDARD: PRESENT 10 F/CC

PROPOSED 5 F/CC

I can't explain why there's a great difference in the two types of pipe, since the operator is so far from the operation you wouldn't expect there to be much of a fiber concentration. But these were the results. They were relatively low.

We carried out a single test of another cutting device in which there is a circumferential cutting action from the pressure of rotating sharpened discs operated manually. We did only one trial of this during three operations and found a relatively low dust concentration.

SLIDE (11)

AIRBORNE FIBER CONCENTRATIONS
DURING CUTTING WITH PILOT PIPE CUTTER

TYPE OF PIPE	OPERATION TIME (MIN)	SAMPLING TIME (MIN)	OPERATIONS PER SAMPLE	FIBERS/CC (ONE SAMPLE) OPERATOR
SEWER	2 - 3	10	3	0.09

OSHA CEILING STANDARD: PRESENT 10 F/CC

PROPOSED 5 F/CC

The next slide (12) summarizes all of the short term or peak concentrations during the cutting and machining with these various pieces of equipment with sewer pipe.

SLIDE (12) SUMMARY OF SHORT TERM ("PEAK") CONCENTRATIONS OF AIRBORNE FIBERS DURING CUTTING AND MACHINING OF A/C SEWER PIPE

OPERATION	AVERAGE (FIBERS/CC) OPERATOR	HELPER
MANUAL LATHE	0.15	0.13
POWER LATHE	0.08	0.09
POWER HOLE CUTTER	0.44	0.23
ABRASIVE DISC	35.55	64.00
CHISEL-RASP CUT	0.30	0.25
WHEELER CUTTER	<0.06	<0.06

OSHA CEILING STANDARD: PRESENT 10 F/CC

PROPOSED 5 F/CC

I have copies of all of the numbers of these slides with me, so if anyone who's particularly interested in the numbers, I can supply them.

This Slide (13) summarizes for the same operations with pressure pipe.

SLIDE (13) SUMMARY OF SHORT TERM ("PEAK") CONCENTRATIONS OF AIRBORNE FIBERS DURING CUTTING AND MACHINING OF A/C PRESSURE PIPE

OPERATION	AVERAGE (FIBERS/CC) OPERATOR	HELPER
MANUAL LATHE	0.51	0.22
POWER LATHE	0.33	0.56
POWER HOLE CUTTER	1.65	0.38
ABRASIVE DISC	20.30	59.70
CHISEL-RASP CUT	1.99	0.90
WHEELER CUTTER	0.85	0.87

OSHA CEILING STANDARD: PRESENT 10 F/CC

PROPOSED 5 F/CC

Again, the abrasive disc was rather dramatically high. The helper appeared to have a higher count because of his position with respect to the action of the saw and the disc, which was driving a great deal of the dust in his direction.

The next slide (14) is a little detailed; it represents integrated samples over periods of 112 to 194 minutes, which covered a number of different operations.

SLIDE (14) FIBER CONCENTRATIONS DURING CUTTING AND MACHINING OF A/C PIPE
-LONG TERM (INTEGRATED) SAMPLES OF 112 - 194 MINUTES-

OPERATIONS	TYPE OF PIPE	FIBERS/CC OPERATOR	HELPER	AREA
POWER LATHE	SEWER			
HOLE CUTTER	"			
MANUAL LATHE	"	0.09	0.10	0.04
WHEELER CUTTER	"			
CHISEL-RASP CUT	"			
CHISEL-RASP CUT	SEWER			
ABRASIVE DISC	"			
ABRASIVE DISC	PRESSURE	3.94	7.07	4.90
CHISEL-RASP CUT	"			
POWER LATHE	PRESSURE			
HOLE CUTTER	"			
MANUAL LATHE	"	0.75	0.17	0.44
WHEELER CUTTER	"			

OSHA TIME-WEIGHTED AVERAGE STANDARD: PRESENT 2 FIBERS/CC
PROPOSED 0.5 FIBERS/CC

As you can see, the group above the first dotted line represents a period of roughly two hours in which power lathe, hole cutters, manual lathe, Wheeler cutter , and chisel-rasp cuts were carried out. The integrated sample showed a concentration of fibers less than 0.1 fiber per c.c.

The next group includes the operations in which the abrasive disc was used on sewer and for pressure pipe. You can see during that two to three hour period the concentrations were of the order of four to seven fibers per c.c. for the operator's helper, and the area sample several feet away was approaching five fibers per c.c.

Later, when we carried out the power lathe, hole cutter, manual lathe, and Wheeler cutter operation on pressure pipe, the concentrations were below 1 fiber/cc but were somewhat higher than with the sewer pipe.

The standards that have to be considered when you look at these numbers if they were carried out over an entire day, that is, the time-weighted-average of two fibers per cc as currently in effect, or 0.5 fibers per cc as proposed or 0.1 fibers per cc as suggested by NIOSH.

This slide does show the influence of the abrasive disc operations on long-term exposures. An operator carrying out such work for over four hours a day would exceed the current of two fibers per cc. One hour a day would exceed the 0.5 fibers. The helper would exceed the 0.5 fiber standard with slightly over half an hour's exposure a day, even if his remaining work day involved zero exposures It is obvious that the abrasive disc cutter produces unacceptable concentrations of airborne asbestos. Its use in cutting A/C pipe or sewer pipe would appear to be in violation of current OSHA standards which require that all hand-operated and power-operated tools which may produce or release asbestos fibers in excess of prescribed OSHA limits shall be provided with local exhaust ventilation.

I will not spend much time on the next slide (15) which shows the total dust.

SLIDE (15)

CONCENTRATIONS OF TOTAL AIRBORNE DUST
COLLECTED 5 TO 10 FEET FROM A/C PIPE OPERATIONS

	TOTAL DUST IN MG/M^3	
OPERATION	SEWER PIPE	PRESSURE PIPE
MANUAL LATHE	51.5	8.13
POWER LATHE	5.74	2.99
POWER HOLE CUTTER	1.8	0.2
ABRASIVE DISC	37.5	24.0
CHISEL-RASP CUT	$\leq$0.1	2.9
WHEELER CUTTER	29.0	$\leq$0.1

SLIDE (15) CONTINUED

OSHA STANDARD DEPENDS UPON QUARTZ CONTENT, E.G.,

IF NO QUARTZ, TWA = 15 MG/M^3

IF 10% QUARTZ, TWA = 2.5 MG/M^3

This was not size-selected, but was total dust. We did not have estimates of the quartz content, since this was not part of the study plan. There are several operations which produce concentrations of total dust, which if long continued would exceed the silica standard of the airborne quartz content was sufficiently high.

The following general conclusions can therefore be made: (1) That the abrasive disc saw leads to unacceptable airborne fiber concentrations; (2) That the use of the other tools tested would appear acceptable under the current asbestos standard, but sustained use with pressure pipe would exceed the proposed TWA of 0.5 fibers per cc; (3) Actual field operations would probably not involve the continuous or frequently repeated cutting or machining, which would reduce the time weighted average exposures; (5) Good housekeeping and proper disposal of asbestos waste is essential. I think you could see all during those operations piles of scrap and dust all over the area, and this would clearly be unacceptable practice; (6) Furthermore, continuous exposures to the dust from cutting and machining could involve a silica hazard if the quartz exceeded roughly five percent. An additional point not shown on the slide is that the pipe that we saw in our operations had no indication on its label that it contained asbestos, so that the workers would have no way of knowing that special precautions should be taken.

It should be stressed often that it is improbable that field personnel would be exposed during a full working day to the intensive cutting and machining operations which we set up for the purpose of this study. We believe, therefore, that the current and proposed occupational standards could be met with available equipment, if the abrasive disc saws were eliminated.

In final conclusion, I want to stress the need for good housekeeping and proper waste disposal, and my concern at the lack of labeling to indicate asbestos.

A/C Pipe and Water Supply - A Regulatory Perspective
by
Gordon G. Robeck

Gordon Robeck is Director of the Water Supply Research Division of the Municipal Environmental Health Research Laboratory of the United States Environmental Protection Agency (EPA). Mr. Robeck joined EPA in 1974 after serving 30 years as a Commissioned Officer (Sanitary Engineer) in the United States Public Health Service. During this period, he had a number of geographic and program assignments, primarily in water supply research.

Mr. Robeck is the recipient of six awards from the American Water Works Association including the 1970 Research Award. He has also received the Huber Research Prize from the American Society of Civil Engineers.

Thank you, Dr. Kotin, and good morning, ladies and gentlemen. I've been asked to discuss the regulatory rationale and philosophy that started our agency research. EPA as well as many other agencies have a basic approach to establishing regulations. We have to follow criteria to help select constituents that should be included in drinking water standards. These criteria include occurrence, that is, just how abundant and how frequently does the constituent appear in the drinking water and how widespread is it nationally. In other words, if molybdenum is found downstream from Climax, Colorado but not in high concentrations in other watersheds, we might suggest to Colorado that they have a limit for that, but we wouldn't make it a national limit and expect all the utilities to measure for molybdenum from now on. So, it has to be there in fairly high concentrations and in several places before we would consider it.

Of course, assuming that we do know it's there means that we must have a good analytical capability. Thus, another criterion is the ability to be able to measure a contaminant quantitatively.

The most important criterion of course, is the human health effect, demonstrated through either epidemiology or toxicology.

One other major aspect is the availability of a reasonable and cost effective treatment technique. We have much controversy going on, for example, about sodium in drinking water. There are many people who feel that it is related to hypertension and even cardiovascular problems, but we don't know how prevelant it is. Secondly, we certainly don't have a way of economically reducing it. Therefore, we recommend that local physicians know the concentration of sodium in the local water and use some common sense in discussing it with their patients.

The fifth criterion is that we must understand and appreciate that there has to be some feasibility of implementing this standard. That is to say, if we immediately ask for everyone to use granular activated carbon to reduce organics and manufacturers in the country were not prepared to produce enough of this

material or the furnaces for regeneration were not readily available, well then, we certainly wouldn't be in a position to push for such a standard immediately. However, this in general would be considered a temporal thing.

And then, of course, tying these all together, we must make a risk-benefit analysis. We present this, along with the national costs, to the Price and Wage Council and we do the usual presenting of information to advisory groups made up of practitioners in the waterworks field as well as health officials. But more importantly, nowadays we have to submit it to the public. This is when we get the advice of the citizenry, particularly the usual vocal environmental groups.

In the case of asbestos, we were asked to look at A/C pipe by Dr. Hutchinson, Health Commissioner in Tennessee, back in the mid-60's as a possible source of fibers. Working with Johns-Manville in New Jersey at that time, we finally concluded that it wasn't a problem as best we could measure it. We, therefore, did not include it in our review of the 1962 Drinking Water Standards during the period of '69 to '73. We, in other words, felt that two of the usual criteria for picking constituents could not be met. We had no way of measuring it quantitatively, and we certainly didn't see any obvious health effects in the communities using the pipe at that time.

In the early 70's, various developments took place that caused us to review the asbestos-cement pipe situation again. Naturally, we fell back on our five criteria and decided to review it within that framework. Well, as many of you know, a lot of the trouble started when it became apparent to some people, at least, that the filtering of beer with asbestos fiber filters contributed fibers to the beer. Others, however, felt that it might be in the water used in the processing of the product.

So, we were forced to look at both ground and surface waters as a possible source. I believe the Food and Drug Administration in this country, as well as in Canada, was doing likewise. Others decided about that time, that there

were sources of fibers from many places, particularly as a result of mining or milling operations and most spectacularly in the Lake Superior area. Pipe also came in for more scrutiny.

It was at that time that the AWWA Research Foundation along with your Association decided to summarize all the knowledge that we had on the subject and put out a report from a committee chaired by Dr. George Wright. This was published in September of 1974 as a separate addition in the American Water Works Association Journal. The general conclusion, as most of you recall, was that there was no obvious health problem.

On the other hand, there was insufficient information to convince all of the people who reviewed the literature that there was a complete absence of adverse effects, so the committee recommended further research on 11 points. At that time, we worked with the waterworks and your industry to design and carry out the necessary field work and laboratory research to try to be as responsive to these 11 points as possible.

The first thing we did was go back over our criteria to make sure that each one was met before we advocated including this constituent in the drinking water standards, at least in the Primary Drinking Water Standards. Any gaps would reveal where further research was necessary. For example, we didn't have precise knowledge about its presence in drinking water although there was some speculation that there was a little bit of it all over -- in the air, on the ground, in water -- and if we did not find it, this simply meant we didn't have a very sensitive way of measuring it.

So, we went to work with the analytical contractors that we fortunately happen to have in the United States, along with some of the industrial analysts in your industry, and we developed the appropriate electron microscopic methods -- some using the transmission approach rather than scanning. And, of course, we also used X-ray energy dispersion techniques to help verify the composition.

These methods were then able to measure fibers as long as 60 micrometers and as short as two-tenths micrometer and those with diameters down to .02 micrometers which was the distinctive measurement that forced us to use such expensive instrumentation.

The actual reporting of quantitative results depends upon the unique capability of this instrument, plus the amount of material in the sample. That is to say, the sensitivity relates to the volume and number of grids viewed in the microscope. Thus, the detectable limit is generally 20,000 to 40,000 fibers per liter when using a fairly large volume. We can generally do that with well treated water. However, with turbid raw waters you can only use a few millileters of sample, and thus the sensitivity may be a million (fibers per liter).

In the case of the pipe loop study that you've heard us discuss before, we filtered the recirculated water each time so that in the next pass of about 90 feet, there were not many fibers or other debris picked up. Therefore, we can filter quite a bit of water, far more than the usual 500 milliliters, and consequently we have a sensitivity that is down into the range of a few fibers per liter.

Now, we had the methods. We had the instrumentation. We had a few skilled people and we had several contractors who were able to follow through and do surveys of ambient levels and representative drinking water supplies. McCrone Associates did most of this survey contract for the EPA Office of Toxic Substances (OTS). OTS was asked to handle the survey because it involved sampling all media, not just drinking water.

Since then, the survey has been completed; we think it fair to say that the results indicate nothing too unusual or unexpected. That is to say, in those areas that have rock containing asbestos, we found millions of fibers per liter. The counts were related very much to the seasons, and thus, rainfall and runoff. In California, for example, in the Trinity River area above Redding, we had

100 million fibers of amphiboles during the spring but not very much later on. In Montana, it got as high as 140 million in June, but not much in August. In Chattanooga, we found as high as 22,000.

I must hasten to say that water treatment when conventionally applied, reduced the fibers 90 to 99 percent. In Redding, the fibers were reduced 99% while in Chattanooga a little less than 90 percent were removed. This is not too different than what the Canadians have reported from Ottawa and other places where there is a considerable amount in the raw water. New England had the same variations. We didn't find too much in the midwest, as you might expect.

The other factor that influenced the Agency considerably on the matter of asbestos was the Reserve Mining Company's discharges into Lake Superior and the fact that the Court suggested strongly that the best available technology be used in Duluth (in the North Shore communities) to reduce the fiber count in their waters, a consequence of the discharge of 67,000 tons of taconite per day.

We found that it was rather simple, through at least pilot plant studies, to reduce the fiber count below detectable limits, particularly with amosite which, as most of you know, is rather short and stubby and we feared would not be easy to remove. But it has a charge that allows it to be reduced with the right combination of coagulating chemicals and by simply using direct filtration, we predict it wouldn't cost any more than about seven cents extra per thousand gallons.

The Senate and the House passed a special appropriation of $4 million to help build a full-scale demonstration water treatment plant. Minnesota supplied $2 million which eventually will come indirectly from Reserve Mining via a tax on ore. That plant has been built and is now working successfully. The sludge produced in this direct filtration process is very modest and we hope that it will permit easy and secure confinement of fibers.

Extrapolation of data from this rather expensive demonstration may not be as fruitful as you might expect because there were not many chrysotile fibers

in that particular water. The few found were troublesome to remove. Therefore, we have started another pilot study, this time in Seattle, Washington. We are finding with our pilot plant there that direct filtration again works quite well, and we're pleased with that. We may be going into Philadelphia, but with the results that we have obtained at Duluth and Seattle, and the results that the OTS survey by McCrone showed in various conventional plants (ones, in other words, that didn't use any polymers to improve the conventional) suggests that we may have a process right now.

Incidentally, this court case concerned with Lake Superior created some other actions that may have implications regarding future regulations. The court ruled that before the treatment plant at Duluth would be finished, the citizens were entitled to some water free of fibers. So, the Federal government presented a program, and it was finally agreed that bottled water (obviously water free of fibers) would be provided to those who wanted it and small filters were also installed in various places where people could go with their bottles and get water.

This practice was stopped a couple of weeks ago when it was demonstrated that the new central filtration plant could provide basically fiber-free water or certainly "below detectable limit" water regularly. We have a standby agreement, however, that if they're unable to do that for a day or two in a row, the cylinders that hold the cartridges in the filters will remain in place and people can once again go back to that as a stopgap procedure.

This matter of "best available (treatment) technology" in a regulatory sense, is something that the Safe Drinking Water Act, of course, also permits. This, in other words, is a recourse you can use if use of a maximum contaminant level (MCL) is inappropriate. The MCL is only "inappropriate" when you have a situation such that the measuring of the constituent is so difficult and expensive at each site where you have a public water system it might be better to simply recommend

a certain treatment.

In a sense, we do that with virus particles now. We don't say that you have to measure the various types of viruses that might be in the water down to a certain limit. Instead, we say you have to clarify and disinfect the water, and remove the coliform bacteria. When you do that, we know from experience that you have inactivated the virus particles.

So, in this case it's conceivable that we may be forced to go to some treatment technique that is easily monitored, say through gross turbidity. Right now at Lake Superior sites, we are going below one-tenth turbidity unit. In fact, if you go to .05, this seems to correlate with the absence of fibers. Of you go much above that, fibers begin to break through.

We have a turbidity limit in our present Primary Drinking Water Regulation of one turbidity unit which is, of course, ten times higher. The AWWA water quality goals are one-tenth. So, one of these days, in certain spots at least, we may find ourselves justifying a much lower turbidity limit as a practical way of showing that you have operated your plant properly to reduce fibers. I'm not saying that we necessarily are going to do this for the sake of asbestos fibers, because we have these other criteria that we have to meet before we would pursue an actual Primary Drinking Water Regulation on asbestos.

Back to the survey, which was done in six different towns with the advice of the A/C Pipe Producers Association, certain manufacturers who installed the pipes, and the health departments. In Pensacola, as I told you in Williamsburg, we are getting quite high counts because the pH was low and the Aggressive Index was about 5.34. Your Association was recommending something about 10.2 or above and we found that was not quite good enough to reduce the corrosion and release of fibers. In King County, Washington we also have some problems where the Index falls below 10. In four other towns, the Aggressive Index was above the level of

12, and all the fiber counts were below detectable limits. One of these was in a hard water area of Ohio, two in Texas, and one in Connecticut. The Aggressive Index seemed to go up as the water flows through several miles of the pipe, showing that it's actually being stabilized by taking cement from the pipe itself.

Our loop study, as I explained to you at Hilton Head,was simply designed to show what various changes in water chemistry would do to the inside of the pipe, and thus the release of fibers. This, you may recall, was done with four- and six-inch diameter pipe in a 95 foot long loop. Our first run showed that we could make mistakes like everybody else, and we considered that kind of a "dry" wet run. We had problems, in other words, with corrosion in the pump. This deposited iron onto the pipe and protected it very nicely, even though the water was designed to be aggressive.

We fixed that and then made another run and found that there certainly were considerable fibers released when we had an AI of 10.4. The last test, which covered about nine months, was made with an Aggressive Index of over 12, and we found very little release of fibers. We recently tapped that pipe with the best available device to see what that interruption of the pipe surface would create in the way of release of fibers. If it's not too bad, we'll continue testing with that same pipe. If it is bad, we'll put a new section in and reduce the Index down and down noting what changes this creates. When fibers start to be released, we'll try to use corrective measures to suppress release.

We have several places in the United States, South Carolina, Pennsylvania, and Massachusetts, where we're checking out these results (corrective measures).

The fiber length is of concern to the health effects researchers. We found that the chrysotile fibers ranged from 0.3 to 40 microns in length, and .02 to .5 microns in diameter. Most of them, 75 percent of them, were less than 5. In the case of Seattle, we only found chrysotile fibers as long as 10, and the diameter was 0.02 to 0.06 micrometers.

On the matter of health effects, we decided that we would have to spend some money on research now that we found that asbestos was present in the environment. We joined with HEW to do one large experiment, and we have several others of our own. The joint EPA-HEW project is finally showing some progress. That is to say after a long controversy about the test protocol, we are now proceeding at the usual animal testing rate. The animals seem to be surviving and seem in normal health. The work at Hazelton Laboratories and the IIT labs are proceeding as anticipated. The current protocol as you may recall, is to study two forms of chrysotile, one which will represent a range of fibers less than 10 microns in length, and the second which has a normal broad range of fiber lengths. In addition to the two chrysotile samples, two forms of amphiboles, tremolite and crocidolite, will also be evaluated.

Laboratory studies to determine the appropriate chemical to be used in assessing the interactive effects of asbestos and a chemical known to produce intestinal tumors have also been completed. The chemical selected is dimethylhydrazine. The doses selected for this agent are those that will produce a low tumor incidence in reproducible fashion. The same agent will be used for both the rat and the hamster interactive studies. In the lifetime study on biological effects of both short-range and intermediate-range chrysotile, each at one percent in the diet have been started.

We also have some of our own EPA projects underway. One is determining whether or not asbestos is mutagenic or carcinogenic, using cell cultures. This is being done at the Naylor-Dana Institute for Disease Prevention of the American Health Foundation. We are not too comfortable with the methodology yet, so the current effort is to improve these methods. Some of the other ongoing studies will help determine the toxic effects in colon organ cultures and determine the mutagenic properties of asbestos fibers in the I-407 human colon derived cells.

Further, we are preparing synthetically labeled asbestos fibers with the help of the University of Cincinnati. We hope with the tritium attachment,

we'll be able to feed known size ranges and follow the movement of it in the test animal.

A draft paper on an investigation of the use of A/C pipe for public water supply and the incidence of gastrointestinal cancer in Connecticut during the period 1935 to '73 has been prepared, is now undergoing review and will be presented at the Anaheim meeting of AWWA. In this study, Connecticut townships were ranked according to population served by A/C pipe, the age and the length of the pipe, and the aggressiveness of the water transported. The towns studied contained from less than one to over 100 miles of A/C pipe. The majority had A/C pipe that was at least 25 years old and most had water which would be considered highly aggressive. The preliminary findings of the epidemiology study did not show any excess in cancer incidence for stomach, colon, or rectum in Connecticut township during 1935-1973 that could be related to the use of asbestos-cement pipe for drinking water.

On the basis of analytical results from 31 samples collected at water sources prior to entering the distribution system, it was concluded that the population served by the public water systems not using A/C pipe, were not exposed to significant amounts of naturally occurring asbestos in water. Chrysotile fibers from the samples collected after water had passed through various lengths of A/C pipe range from below detectable limits which at that point was about 10,000, to 700,000 fibers per liter. None of them, in other words, very high. The lengths of the chrysotile fibers ranged from two-tenths to 60 micrometers and from .02 to .5 micrometers in diameter. I'll skip over some of this health effects work because we'll be able to discuss some of it this afternoon.

On the asbestos study in domestic water supplies and cancer incidence in five California counties, to date 154 water samples have been analyzed for asbestos content by our grantee. Thus far, samples taken before and after flow through the A/C pipe indicate no significant contribution of asbestos from this source.

A word was supposed to have been said about the National Academy of Sciences report due in December, 1976 in which a Subcommittee on Particulates was to make recommendations to EPA regarding health goals that pertain to asbestos fibers. This report is not officially out yet and therefore, I'd rather not comment on what little that I know about it unofficially. However, I think we can expect one of three possible recommendations from them. Either it is a carcinogen when ingested with water, and perhaps we should, therefore, minimize it. Or it is not a carcinogen when ingested in such low doses. Or thirdly, evidence is not sufficient to be conclusive, and hence more research is needed.

The Environmental Defense Fund may, incidentally, push for immediate corrective action. This is a constant reminder to us that we have another constituency to be responsive to besides you, and invariably they're like this. And here we are in the middle. We had a court case with all arguments presented on April 5th; EDF made a case for saying that we didn't have stringent enough standards on organics, sodium and fluoride and didn't ask for enough samples from the distribution system for lead and cadmium. Fortunately, they did not pinpoint asbestos specifically in their petition. But I don't think that they meant to neglect you, instead they may have assumed that the National Academy of Science report would strongly state asbestos fibers are carcinogenic and thus the agency, would have to do something about it.

So, it's up in the air. I just wanted you to know that we are under pressure from both sides. The National Drinking Water Advisory Council has been very skeptical about regulating carcinogens particularly chloroform, although we are going to proceed with that soon... To summarize, I say the National Academy of Science report obviously will have some influence, but so will other government agency actions -- NIOSH, FDA, NCI, NIEHS. We want to be together on this, although generally we in EPA have to perhaps be a little more stringent since we're applying these things to the total population.

When we look at our five criteria, we notice that we really haven't satisfied or resolved all of them for asbestos. That's particularly true of the health effects. Thus, the Office of Water Supply, EPA, in Washington at this time is not currently pushing for any asbestos standard limit in the Interim Drinking Water Regulations. I know of no specific schedule for setting an MCL or treatment regulation.

So, it will have to be considered along with all the other contaminants that the National Academy of Science reviewed for possible inclusion in the Revised Primary Drinking Water Regulations. We have 10 days after NAS gives us the report to publish it, and then 90 days to prepare a revised regulation. I don't know how we're going to do all that in 90 days, so don't be surprised if there's a little slippage. At any rate, that's the Congressional target. We have to allow some time for people to read the Federal Register and make their comments. Twelve to 10 months after we actually announced new regulations, compliance is expected. The industry is entitled to that period to get their treatment hardware and analytical instruments purchased and operating. Hence, compliance would not be expected until sometime in 1979 at the earliest. Additionally, there are opportunities for variances or exemptions which could allow considerable time for the water utility to prepare to comply.

In the meantime, we might consider some form of corrosion control index to help with the post-treatment plant changes that affect the pipe. As Joe Jackson says, maybe we should keep the asbestos fibers locked in once the pipe is manufactured. Unfortunately, thus far there has not been too much sympathy for this approach even in the Secondary Standards, which came out on March 31st, although a pious statement is made that "the water shouldn't be corrosive," whatever that means. It's going to be difficult to measure that corrosiveness.

Well, there we are. We will continue our water supply search, be it analytical, health effects or treatment. We certainly promise to work closely with

all the interested parties on both sides including your Association. With that I want to thank you for the invitation, and thank you for your attention.

Ingested Asbestos and Evidence of Hazard - An Experimental and Epidemiological Perspective

by

Marvin Kuschner, M.D.

Dr. Kuschner is Dean of the School of Medicine of the State University of New York, Health Sciences Center, Stony Brook, New York. Prior to his appointment as Dean, Dr. Kuschner was Chairman of the Department of Pathology. Before joining the faculty of the State University, he was Director of Pathology of Belleview Hospital and University Hospital in New York City and Director of the Experimental Oncology Laboratory of New York University.

Dr. Kuschner served on the American Water Works Association Research Foundation's Study Committee on the Problem of Asbestos in Water, has been a consultant to the National Cancer Institute, the Surgeon General's Committee on Smoking and Health, and the Division of Environmental Health Sciences of the United States Department of Health, Education and Welfare. He is a member of the National Research Council Study Group on Environmental Monitoring and member of the National Cancer Institute Clearinghouse on Environmental Carcinogens.

I am about to offer you some thoughts on the nature, extent and significance of chemical contamination of the environment which some might consider exculpatory and therefore biased or even tainted with forgiveness. I should therefore like to establish my credentials as more than a disinterested commentator. The laboratory in which Professor Sidney Laskin and I collaborated was among the first to develop animal models which demonstrated that polycyclic aromatic hydrocarbons produced the human type of lung cancer and did it in dose related fashion. We also showed that ionizing radiation could produce lung cancer in experimental animals and developed techniques by which dose and dose-rate effects could be accurately evaluated. We were able to isolate, by means of animal experimentation, the particular offender, calcium chromate, in the induction of a high lung cancer incidence in workers processing chrome ores. We have shown that inhalation of benzo(a)pyrene becomes of particular significance when coupled with inhalation of SO_2. We have suggested on the basis of animal experimentation that the inhalation of freshly generated polyurethane dust may be hazardous. Our laboratory has demonstrated the rapid production of lung cancer by his chloromethyl ether, a devastating occupational hazard, and more recently, we have been able to show that two other alkylating agents in industrial use, dimethylcarbamoyl chloride and epichlorhydrin, must be considered potential hazards since, for example, the former produces nasal cancer in almost 100% of rats exposed to 1 ppm. With Dr. George Wright we have demonstrated the potential fibrogenicity of long fibers of glass.

Now, this long recitation of seeming triumph is not designed to overly impress you but to indicate that I approach this subject with an interest in identifying and tracking down environmental hazards to human health.

Experimental approaches to human cancer causation such as I have described above have, in large part, received their impetus from observation of

occupational clusters of disease. With the notorious exception of cigarette smoking, chemicals introduced into the environment by man, or classes of such chemicals, have been identified as cancer producers by virtue of the high incidence of tumors resulting from occupational or paraoccupational exposure. Indeed, one might even consider the hazard of cigarette smoking to have announced itself in Percivall Potts' description of cancer of the scrotum in chimneysweeps since the initiator of malignant transformation is, in all likelihood, the same class of compounds for both exposures.

So it has been with asbestos. The initial asbestos-related disease recognized around the turn of the century was the massive pulmonary fibrosis that followed on working in heavily contaminated atmospheres. As exposures lessened, as exposed individuals survived with lungs scarred but not lethally so, and as we now know from Dr. Selikoff's studies, as cigarette smoking became prevalent, lung cancer was observed to develop in asbestotic lungs by the mid 30's of this century. This was followed by the startling 1960 observation by Wagner, in South Africa, that the malignant consequences of asbestos inhalation included malignant mesothelioma. Burgeoning interest in asbestos-related disease led then to a number of studies in a variety of countries, among them the cohort studies of Selikoff which have become epidemiologic classics. Of particular interest to us today are the multiple observations that indicate a higher incidence of tumors of the gastrointestinal tract in occupationally exposed populations than in a comparable group of the general public not so exposed. In none of these studies has the data established unequivocally that employment in asbestos producing or asbestos using occupations poses a higher than usual risk of developing gastrointestinal cancer. Nevertheless, considering the consistency of the findings in multiple studies, the data taken in aggregate, justify the presumption that a causal relationship does exist.

The multiple studies of health effects of occupational asbestos exposure further revealed that peritoneal mesothelioma was an undoubted consequence to such exposure. Although it is not certain that asbestos fiber reaches the peritoneal mesothelioma by penetrating the wall of the stomach or intestine, such a possibility does exist and, even though other routes of translocation can be postulated, to my mind direct movement of fiber from gastrointestinal tract into the peritoneal cavity seems entirely reasonable.

The disease entities that might be related to ingestion of asbestos fiber that immediately concern us then are cancer of the esophagus, stomach, and intestine and peritoneal mesothelioma.

It is important to point out that occupational exposure to asbestos is inhalational but by virtue of the fact that fibers deposited on the nasopharyngeal, tracheal, and bronchial surfaces are cleared by muco-ciliary action (the "mucous escalator" bringing them to the back of the mouth) the bulk of such fiber is swallowed. There is an additional contribution to ingestion in occupational situations made by contamination of food consumed on the job.

We must conclude, then, that ingested fiber poses a risk of cancer in those occupationally exposed. Everything we know about cancer causation by specific agents leads us to believe that the response is dose related. Although quantification of human dose in the past is at best crude, studies that have examined the relationship between intensity and duration of occupational exposure to asbestos and the incidence of gastrointestinal cancer have produced data that can be interpreted as demonstrating a dose effect. At least one study in which rough quantification of dose was attempted in relation to mesothelioma showed a dose relationship with risk lessening as dose decreased. In this regard, it should be stated that the evidence, both epidemiologic and morphologic, indicates that an excess of mesothelioma occurs in occupationally exposed groups at doses

below those that produce pulmonary fibrosis or lung cancer. The occurrence of mesothelioma in paraoccupational, that is neighborhood or familial exposure, is often cited as evidence that significant exposure may be very slight. It would appear that many of these exposures are actually fairly substantial. Thus, Bohlig describes the conditions around a plant in Hamburg where the neighborhood incidence of mesothelioma was 17X that of the rest of the city as follows: The patients who lived within the vicinity of the plant before the Second World War reported that a severe,visible, snowfall-like air pollution was emitted from this factory, which blew dust-laden air into the atmosphere." It is extremely important then that in any risk assessment we carefully consider the matter of dose. I shall return to it.

I shall dismiss the issue of type of asbestos for we have no evidence to suggest that difference in type is a determinant of the diseases under discussion today. We have no information on fiber size in relation to gastrointestinal cancer, a particularly deplorable deficiency since we have no real insight into the mechanism of epithelial cell malignant transformation by asbestos. Malignant potential of asbestos fiber in inducing mesothelioma seems to be size dependent and especially dependent on long (larger than 20 micrometer) and thin (less than 1 micrometer) fibers. At least this is true when fibers are introduced directly into mesothelial lined cavities.

To return to dose - how does the dose that might be ingested by way of water compare with the dose ingested by workers inhaling asbestos and subject to higher cancer risks?

Using a certain number of reasonable assumptions, it has been calculated that the amount of asbestos ingested during a working lifetime by workers in McDonald's group (one of the studies with attempted quantification of dose) would

range from 2 to 168 grams and by workers in Enterline's group (the other semi-quantitative study) 42 to 336 grams, with half of this in light microscope visible fiber and half in electron microscope visible fiber, the latter of course being far more numerous. This is to be compared with drinking of water with an asbestos content of the order of micrograms per liter and a consequent lifetime ingestion of 3 orders of magnitude less than the lowest estimate for workers.

Animal experiments have thus far been uninformative except to indicate the need for more determined and better designed experiments than have been carried out in the past. Feeding experiments with as much as 1% of the diet being asbestos fiber have been negative. Inhalation exposure of rats may have provided ingestion doses of the order of 1/10 to 1/2 gram for life but have not produced gastrointestinal tumors. To my knowledge several extensive feeding experiments have been undertaken within the past year, one of which has in part been described to you by Mr. Robeck.

In terms of the general population, what we are faced with again is an evaluation of the potential of long term, very low level exposure for producing malignant disease. I think this can best be discussed in the context of, and as part of, the general problem of environmental chemical carcinogenesis.

The causes of perhaps most cancers are not understood. Epidemiologists analyzing the geographic, social and ethnic variations in incidences of a number of important cancers such as breast, stomach, and large intestine have concluded that 60-90% of all cancers are due to environmental factors if one adds lung cancer as a tumor unquestionably of environmental origin. Dr. Merril Eisenbud has commented as follows: "This estimate has been widely popularized in the press and in the environmental literature and is frequently misunderstood to imply that 60-90% of cancer is due to man-made environmental factors such as air and

water pollution or food additives. This conclusion is simply not warranted and was not suggested by the original authors of the estimates." Here are some examples of statements I consider misleading and potentially dangerous for they are distortions which can lead us away from a rational approach to cancer prevention.

A review article on the subject of environmental cancer in a publication of the American Chemical Society has said:

> "Fact:
>
> There can be no cancer without a cancer-causing agent. As many as 90% of all cancers may be caused by environmental factors -- a substantial portion of which are chemicals -- and these cancers are potentially preventable." (Ember, 1976)

Another typical example of a misleading statement is the following, which appears in the newsletter of a leading environmental organization:

> "Finally, we must face the fact that the 'chemical revolution' of the past fifty years appears to be one of the chief factors behind the rapid rise in the incidence of cancer. And we may only be seeing the tip of the iceberg, because most of the suspected chemical carcinogens did not come into widespread use until after World War II. Ominously, the rate of cancer incidence increased 2 percent last year after rising at a rate of about 1 percent per year for many years. There is no obvious reason why we cannot have a high standard of living without dwelling amid a chemical minefield of cancer-causing agents." (National Resources Defense Council, 1976. "Cancer: The Price of Technological Advancement?").

Now as a matter of fact, cancer mortality declined last year by 2%!

Where has this increase occurred and what is it due to? If we look at cancer death rates for the past 40 years, we are forcibly impressed by the increase in lung cancer in males and females, the decline in stomach cancer in males and females, and the decline in uterine cancer in females. Some small increases in other tumors have occurred and we shall say a word about those presently. It is clear then that the major contributor to increasing cancer death rates is the increasing death rate from lung cancer. If one subtracts lung cancer from all cancers for the years 1973-1974, the incidence curve becomes identical to the 1943-1944 curve. The overwhelming causal factor in lung cancer is cigarette smoking and cigarette smoking is part of the causual constellation in other tumors. This then, is virtually the sum total of man-made chemical carcinogenesis as we can recognize it now.

One important exception is cancer of occupational origin. There is absolutely no doubt that cancer producing chemicals affect the workers who are exposed to them. Current estimates are that occupational exposure may be responsible for 1-3% of all cancer deaths.

What do we mean, then, when we say that on the basis of geographical and social variation and on the evidence of migrant studies, such important tumors as those of the stomach, colon, and rectum, breast and uterus are environmental in origin. For one thing, we mean that whatever the causes may be, they have been with us since early in this century. If we examine the mortality trends in Britain, they show unimpressive alterations in most tumors except for lung increases and stomach and uterine decreases in plots going back to 1911.

New emphasis is being given to diet, diet-determined intestinal flora, and such naturally occurring carcinogens as aflatoxin, a product of fungal contamination of food.

In a recent review of cancer hazards in man, Richard Doll points out that the relative risk from lung cancer in men employed in an asbestos textile factory has declined from 10X normal for those employed for 20 years with at least 10 of those years before 1933, to 3-1/2X normal for those employed before 1933 but for less than 10 years before that date, to 1-1/2X normal if they were employed after 1933. He then points out that the maximum concentration found in the air near the building sites where asbestos is sprayed is three orders of magnitude less than that which is the current standard (0.1 mg/M^3) and the amount commonly present in town air is still less by another two orders of magnitude, coupling this with comparative measurements of benzo-a-pyrene in gas retort works and that in town air. He goes on to say that these kinds of measurements tend to exculpate as major contributors to the gross variation in cancer incidence, agents which are known to be specific occupational hazards.

How does this help illuminate the question of the hazard of ingested asbestos? It certainly would seem fair to say that the minute quantities of asbestos present in water naturally or added to it by the use of asbestos-cement pipe could not be expected to produce a major increase in tumor incidence. Does it make any contribution even though small, and does that contribution assume greater significance when we recognize that 10's of millions of people are potentially involved.

My own belief is that there is no theoretical threshold for any carcinogen but that there is a practical threshold imposed by probability.

The practical threshold may be described as the improbability of demonstrating any tumorigenic propensities of any material at the lower reaches of the dose-response curve when zero is approached asymptotically.

A measure of reassurance is afforded by the fact that asbestos-cement pipe systems have been utilized for supply to large population groups in this

country and in Europe for 40+ years. To my knowledge, this has not resulted in an increase in peritoneal mesothelioma, which would be the effect to be expected from very low-dose exposure.

I trust my remarks will not be interpreted as providing any excuse for relaxation of vigilance. We must make certain that although we may not have poisoned the population at large in the past, we avoid doing it in the future. We must certainly pay particular attention to occupational exposures where a hazardous exposure must be considered socially unacceptable. We must widen our research into the causes of those tumors other than lung cancer, that is cancer of the breast and of the G.I. tract, which currently afflict us in large numbers.

In that regard, I would like to end by quoting the closing sentences of Sir Richard Doll's 1976 Kenneway lecture.

> "I see no reason why causes for the remaining common cancers should not be detected within one or two decades. That is not to say it will be easy to prevent the disease. For if, as I suspect, these hazards are associated with the common diet of developed countries, the problems that we are now having to face in preventing tobacco-induced cancer will seem childishly simple."

Asbestos and Safe Drinking Water - A Scientific Perspective

by

T. E. Larson, Ph.D.

Dr. Larson has been associated with the Illinois State Water Survey since 1932 and at present is Assistant Chief and Head of the Chemistry Section. In this capacity he has authored more than 80 publications on corrosion, water chemistry, analytical methods and water treatment.

Dr. Larson is a past President and former member of the Board of Directors of the American Water Works Association and Chairman of its Committee on Research from 1961-1967. He received the Goodell Prize for publication (1957), the Diven Medal for outstanding service (1966), and the AWWA Alvin Percy Black Research Award (1972).

I talked with Gerry Rohlich the other day (I've had a long-standing association with him) and he asked me to apologize for not being able to come and gives you all his best regards.

I am a chemist. I don't know anything about asbestos-cement to speak of, but I do have experience with corrosion of pipe for public water supplies. So I want to be talking about corrosion and mostly in a general sense. Let me preface my brief comments by saying that asbestos-cement pipe can and will corrode with certain acidic waters, just as other pipes do.

Gordon Robeck discussed in part, the EPA Proposed Secondary (Drinking Water) Standards. I was very pleased to see that the Secondary Standards even mentioned corrosion; the Federal Register had almost a full column of discussion on it. Unfortunately after reading the full column, I could see nothing there that would help the regulators, or the "regulees" (sic). There are no defined parameters for measurement and there is very little discussion about the actual effects of corrosion on the water system.

However, as I see it, the "proof of the pudding" may well lie with the analysis for corrosion products in the water: obvious staining of porcelain-ware by plumbing, loss in carrying capacity from tuberculation, or structural failures of components of the distribution system and of the household plumbing.

Now there are a number of calculated parameters such as the "Aggressive Index" mentioned earlier this morning, used by your industry. There are other simple and sophisticated indexes as well ... the Langlier or Saturation Index, the Ryznar Index and so on ... but none of these are really effective for all waters. They are usually used as guidelines for corrosivity.

There are also simple and sophisticated testing procedures for corrosive waters, but none are applicable to all conditions. It would be foolhardy to place a little piece of metal in the water and relate the corrosion rate from that little "coupon" to all of the variable exposures that the water takes when

it's going through household plumbing; from zero velocity to maybe six feet per second, or from being in contact with copper at one time and galvanized pipe in another, and at different temperatures. I think we've got a long way to go before we can really make good, reliable tests ... and they will not be "simple". The best tests are observations on pipe that has been in service for several years.

Now to discuss corrosion in distribution systems. There are a variety of pipes of which asbestos-cement is only one. Cast iron, ductile iron, and steel, all three of these have essentially gone over to cement mortar linings for protection. There is reinforced concrete for the large diameter pipes, and plastic or fiberglass reinforced plastic for smaller diameter pipes. All of these types of pipes have their place. All of them have their price. And all can be subject to corrosion to various degrees with a variety of aggressive waters ... even the cement-lined pipe and even the asbestos-cement pipe.

The types of water that we find in the United States are so varied that it seems almost foolhardy to try to set up standards for testing for water corrosivity as a predictor of corrosion.

In the Midwest, where I'm from, we have hard waters which are often quite mineralized. From Ohio to Kansas and Nebraska, the waters are relatively similar. Up in the Dakotas, there are some devilishly high mineralized waters -- the kind that are hardly fit to drink. Then we have the Great Lakes; Great Lakes' waters are rather medium in hardness (about 125 parts per million) and they are beautiful waters, probably one of the most stable waters that we have, usually even after treatment. I'm going to talk a little bit more about that later. Then we have the New England and the East Coast water, where it's very soft, almost like distilled water -- with a lot of "goodies" such as color (humic acid or fulvic acid) and sometimes with iron and manganese. The same very soft water occurs in the Pacific Northwest.

Some years ago I was asked to study corrosion in distribution systems, especially corrosion caused by treated water. It was a big question as to why, when the utilities took the mud out of the water and treated it for drinking purposes, why was that water more corrosive than the original water -- even the very stable waters of the Great Lakes? After about 11 years of study on various grants from the National Institutes of Health, and the Public Health Service (which preceded the Environmental Protection Agency) among our many findings on corrosion, one major factor was the presence of chlorine. Chlorine is an acid and if it is not neutralized, a more acidic water is created. If we add fluosilicic acid, as is done for fluoridation, we are creating an even more acidic water. If we are treating with alum, this too is an acid because it hydrolizes to sulphuric acid and an insoluable aluminum hydroxide.

It's very easy to neutralize the acidity of the water, even back to what is called the Saturation Index of zero, that is, having the water in such a condition that it will neither deposit calcium carbonate on the pipes nor will it dissolve the pipes. If we add only a little more alkali, calcium carbonate will be deposited on the surface of the pipe and will prevent corrosion of cement and asbestos-cement. This practice works fairly well in the Midwest.

Now, with some waters in the Far West and the Far East there is a different problem. These waters are very difficult to treat because they have very little calcium, little alkalinity and a pH of about 7.0 or 7.1. When we add the part per million of chlorine and a part per million of fluoride, the pH drops to about 6.7 and the actual acidity is doubled. Studies that have been made in the West Coast definitely show that copper corrodes at a very high rate at that pH. It has also been shown that if we treat with caustic soda or lime or sodium silicate, we can increase the pH and this copper corrosion can be slowed down considerably.

Now what does this tell us about asbestos-cement? It is acidity

softness that causes the asbestos-cement pipe to release asbestos into the water and the lower the pH or the lower the hardness, the more asbestos is released. If we're going to stop it, we're going to have to raise the pH, maybe up to 8 and perhaps treat the water with an additive such as sodium silicate. Again, as far as the asbestos-cement pipe in the Midwest, all we have to do is to stabilize the hard waters and I'm quite sure that this will be very effective.

For very soft waters, there is the possibility of treating with another combination: phosphoric acid and zinc sulphate. This seems to work very nicely for small copper coupons in a pH of about 7.2. However, I've also seen this tried at a pH of 8 at another municipality and it doesn't work for some reason or another. This brings me back full circle to my opening remarks.

The corrosion of piping materials by aggressive waters is an incredibly complex problem that depends on many of the variables I've discussed today. Understanding this complex process has never been ... and there may never be an easy solution. It's going to take time for studies, and it's going to be a nuisance for some people -- those who have never even thought about the acidity of their water. The asbestos-cement pipe industry would be well advised to generate field data on treatment alternatives to neutralize acidity and/or supplement sodium silicate for very soft waters as well as for stabilization of Midwest waters for calcium carbonate deposition.

Theoretical considerations are nice and laboratory studies can provide valuable insights, but it takes observations on actual field exposures at different velocities, temperatures, and a multitude of water quality combinations to evaluate the real life conditions with confidence.

The Ecology of Asbestos - A Scientific/Societal Perspective

by

Irving J. Selikoff, M.D.

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Mrs. Selikoff, Dr. Kotin, ladies and gentlemen, I very much appreciate the opportunity of being here, not only because I see many old friends, and have the opportunity as well to discuss tough problems, but because the question we're discussing is not unique to asbestos, but is a critical social issue at this time.

As we begin to learn the causes of cancer a new question arises and that is what to do with the knowledge.

These are very unsettled, thorny, difficult, with, as Dr. Kotin has said, differing points of view, varying inversely with the amount of knowledge available for their understanding.

We're in the midst of this at this time. For those of you north of the border, I would just remind you of the last six weeks in the United States, with our familiar saccharin now placed before us and the intense debate in the public press and scientific circles and now in a Congressional committee, on what do we do about this information, based upon several hundred rats in Ottawa that were fed, in a very good study, five percent saccharin; much more than you or I would ever have in a Sweet and Low tablet; a study in which 25 percent of the rats born to parents given saccharin and later themselves given it developed bladder cancer.

Here we have a paradigm of the whole question. I would also remind you, that no one is immune, no industry is immune, no group of scientists is immune, to the questions that have been placed before us.

If you need reminding, I would just point out that based upon no human data, pesticides such as heptachlor, chlordane and others have been very rigorously regulated or abandoned; that no small industry (steel) is now spending some $400 million to control emissions from its coke ovens, based upon a study in which there were 12 cancers of the lung instead of one expected for a small group

of men topside of those ovens. Yet following extensive hearings, at which I think the steel industry certainly puts its best foot forward, the regulation came into existence.

Or I might point to, let us say, fluorocarbons. Only in the last three years or so, based upon some very brillant chemical studies in California and elsewhere, there has been raised the question of depletion of the ozone layer of the atmosphere. Again, no human data but the prospect that perhaps some cancers of the skin would result from the depletion of the ozone layer, again no small company (DuPont) with about eight percent of its profits derived from fluorocarbon manufacture, faces the prospect of total abandonment of the use of this material in sprays and for other uses, following which it can enter the environment.

Or as a final comment, and I'm sure you can supply many others, it's only now three years ago, Paul that you and I were in Washington at the Department of Labor to discuss three cases of cancer of the liver resulting from or associated with employment at B.F. Goodrich in Louisville; men who died of angiocarcoma of the liver, an unusual tumor. The vast petrochemical industry found itself answering the question of control of vinyl chloride in which instead of the 500 parts per million that was then the legal limit, or instead of the 3,000 parts per million that commonly existed in many of the facilities, a level of one part per million was instituted and was upheld in Court of Appeals hearings. Again, no small industry.

This is because all of us, scientists, labor, industry, public groups, government, are now concerned with what do we do about the information that is beginning to be made available concerning these causes, and other, still undiscovered, causes of cancer.

Whatever the logic of it, I don't think that many in the public will share with Dr. Doll, his pessimism about being unlikely to do much about the

360,000 deaths of cancer each year in the United States at the present time. Rather, they will request that we do at least what we can about those things for which we have evidence pointing to a causal relationship between an agent and cancer. This debate is now very much in progress and your participation in it is inevitable.

I will review with you some of the facts, observations that can enter into your thinking, but facts are only one part of the picture. Indeed, I don't think that the details I will tell you, the facts that I will give you, the observations that I'll show you, will make the determination. Rather, it's going to be the evaluation of those facts, their interpretation, in the context of our time.

I will review then what we know and how we came to know it with some reference to your particular difficulties in relation to asbestos-cement pipe.

It was an x-ray like this that was seen in 1924, more than 50 years ago, in Leeds, England of a woman who had worked in an asbestos textile factory and had this diffuse interstitial fibrosis.

We've learned a great deal since this first case of lung scarring and asbestosis. And the most important think we learned is on the screen now. In fact, you may even learn enough to interpret the EPA study in Connecticut. Whatever asbestos does takes a long time to become evident.

For example, in New York, of the 725 asbestos insulation workers who we examined who were less than 20 years from onset of exposure, most had normal x-rays. This despite the fact that they worked every working day with the material. It was only after the 20 year point that most had abnormal x-rays and not infrequently these were extensively so.

So that in Connecticut, in Great Britain, in the United States and everywhere, nature has placed this constraint upon us. We really can't tell what asbestos does unless we have at least some 20 or more, often many more, years to see its effect.

We learned, too, another very important lesson.

This is a normal x-ray of a man who came to see me. He was slightly short of breath. I couldn't find anything wrong. I took a careful occupational history. He had worked as a truck driver, as a machinist, at Wright's at Caldwell. I have a pretty strong personality, so that when I told him that he was probably just nervous (a condition that we call hyperventilation or sighing dyspnoea, that occurs generally with nervous tension) and that's what was giving him his shortness of breath, he believed me. In fact, he did feel better when he left.

He came back in 1958. This time he had the typical changes of asbestosis. There was also a small area of calcification, which occurs almost only after asbestos exposure.

I said "Bob, you told me you never worked with asbestos." So he went through his history again. Just then his wife, Mrs. Kerr, who was sitting in the corner of the room interjected. She said "Bob, don't you remember in 1935 when we just got married you worked at the Worldbestos Corporation on Straight Street in Paterson, as a weaver in an asbestos brake lining plant?" He said "Oh, that, that was for six weeks." And that was the point! He <u>had</u> worked for six weeks, but the dust he inhaled into his lungs was there from that time on.

His last x-ray, was two years ago, with extensive bilateral disease. He's retired, he can't breathe very well, he lives in Hollywood, Florida, sits on his front porch and watches the world go by.

We learned to differentiate between <u>the duration of exposure</u> and <u>the duration from onset of exposure</u>. I was reminded of this when I saw Clark Cooper's slide with that rasp and that wheel giving peaks of, was it 65 fibers per cubic centimeter?

And a young man inhaling the dust. If that man is exposed at peak exposures, he could leave the trade, he might never see another piece of Transite pipe, but that overwhelming dose in his lung would be enough to give him, in all liklihood, risk of disease decades later.

We also learned that asbestos dust doesn't dissolve once it's in the lung. This is an ashed section of the lung of a man with asbestos fibers in it who had worked one year. When we examined his lung at post mortem in the 1960s, this is what was found. Here is another lung of a man who worked for one year in a locomotive plant doing lagging in the 1930s. He died of lung cancer. This was found in his lung many years later. The tissue imprint, as a result of these fibers being mineral and not dissolving readily, has given us a natural, unfortunate constraint.

The next lesson we learned was that the pleura, the lining of the chest, not infrequently became scarred. Here's a plaque. This doesn't cause much trouble. It's an oddity, seen on the x-ray. But it doesn't occur generally with dust. It occurs with asbestos dust, but not otherwise.

It doesn't occur with silica, it doesn't occur with coal, it doesn't occur with beryllium, etc., generally it's mild. Occasionally it can be quite severe. Here's an x-ray of a man with scarring of the pleura. When he died this was what his lung look like. He died gasping for breath because his lung, en cuirass as it were, just couldn't move. The pleura, the thickened pleura, prevented that. I don't think he would die now. I've learned since that you can do an operation called decortication, remove the thickened pleura. If the underlying lung is pretty good, he'll survive and in fact do fairly well.

So we learned the fact that the pleura is often involved. We also found that pleural changes, too, obey the 20 year rule. Of the 725 men with less than 20 years from onset of exposure, most had normal pleura by x-ray. Only after that point did fibrosis or calcification become common.

While we were learning that, nature was jogging our elbow. We didn't listen very attentively. In 1935, a case of cancer of the lung was observed in a man who also had asbestosis by Dr. Lynch who was then professor of pathology at the Medical University of South Carolina and later became Chancellor of the University there; he died several years ago.

He said there might be some association between these two, lung cancer and asbestosis. It could have been.

It's hard for us to appreciate now, perhaps, but in 1935 lung cancer was a very rare disease. I remember Alton Ochsner, a famous lung surgeon in New Orleans, once saying that his professor of pathology took him by the arm and urging "Come to the autopsy room, I'm going to show you a very unusual case, a case of lung cancer. You'll never see another one!" The reason was that in 1935, not many people had lung cancer because not many people began cigarette smoking in 1900 or 1910. Cigarette-smoking lung cancer also obeys the 20 year rule!

So that it was unusual then to see lung cancer. Since there were very few asbestos workers in 1900 and 1910, there were not many cases of asbestosis in 1935. To see two rare diseases in one person, Dr. Lynch thought, was surely unusual.

However, there were many who said that well, how do you know that this isn't a chance association? The matter remained undecided.

In 1953 a doctor in Germany reported that the lining of the chest had become malignant, in an asbestos worker. The lining of the chest is technically known as the mesothelium. Therefore, when it becomes cancerous we call it a "mesothelioma". He reported this unusual tumor. How unusual? We don't really know. It was so unusual that it was not separately coded in the International Classification of Causes of Death. In autopsy series, it was somewhere about one of 10,000 deaths. It was an unusual tumor. So Dr. Weiss said, "Isn't this unusual." Unusual and invariably fatal.

In the next year, 1954, another asbestos worker was found to have the lining of his abdomen (that's also a mesothelial lining, the peritoneum) malignant. Therefore, we call it a peritoneal mesothelioma.

Again, the same argument. Well, yes it occurred in an asbestos worker, but how do you know that this was not a chance association? And the truth is, we didn't know. It could have been a chance association.

Dr. Doll in 1955, reported a brilliant study of 11 deaths of lung cancer in one asbestos factory in Britain in a group of men among whom only one such death was expected. That began to clear matters up.

J. C. Wagner in 1960 reported many mesotheliomas in a part of South Africa where there were many small asbestos workings. Chance associations became less and less likely.

Now Dr. Hammond and I have looked at it another way. We made a list of the men (insulation workers), their ages, etc. We traced all 632. We found that, given their ages in 1943, there should have been 203 deaths. Instead, there were 255.

Interestingly, as you will notice, for the first ten years there was nothing unusual to be seen. For example, in the first five years there were 3 deaths expected and only 28 occurred. Apparently, these men were healthier than everybody else! This is generally found in occupational studies and is called "the healthy worker effect". In the next five years there were 50 deaths expected and about the same number observed. It was only after passage of time (many of the men were now 35, 40 years from onset of exposure) that the increase became marked.

Now, why did 50 or so men die who were not expected to die? There would have been six or seven deaths from cancer of the lung and pleura, and instead there were 45. We were able to prove that Dr. Lynch's hunch in 1935 was correct.

Interestingly, and this is where you have greater interest, there was

another unusual finding. It came sort of as a surprise to us. There should have been nine or ten deaths of cancer of the stomach, colon and rectum. There were 29. A modest increase in statistical terms. Of course, there were deaths of asbestosis.

To give you some sense of the overall situation, I call your attention to still unreported data. In the group of 632 men, observed now to 1975, there should have been 305 deaths, 451 were observed. The excess was largely due to cancer, with 52 deaths expected and 200 observed. The excess was largely due to lung cancer, with 12 expected and 89 observed. One out of every five deaths was due to lung cancer. There should have been no deaths of mesothelioma, there were 35. And the same modest increase in gastrointestinal cancer.

We have looked at a larger group. We made a list of every insulation worker in the United States and Canada on January 1st, 1967. We have followed these people since. And data to January 1st, '76, again unpublished, shows very much the same, with almost 1,500 deaths expected and 2,003 observed.

Again, the excess was mostly due to cancer. 281 deaths should have occurred, 867 died. Once again, most of the excess was lung cancer, with 92 expected, 427 observed. 144 deaths of mesothelioma; cancer of the esophagus, stomach, colon, rectum, a modest increase; and cancer of the larynx and oral pharynx in excess, but very few cases seen.

We had the opportunity of making another observation, to see whether the 20 year rule really held. You saw that it held for asbestosis. But did it hold for cancer? It does. For example, for lung cancer, we found virtually nothing in less than 15 years from onset.

It was only 20, 25, 30, 35, 40 years after the men began to work that we found any significant increase. For example, even at ten to 14 years it was only seven percent of all deaths, and only 0.3 deaths per thousand person/years at risk. The same is true for pleural mesothelioma, nothing seen in less than 15 years.

It's only at 30, 35 years after onset that you begin to see a significant number of cases. Again, for peritoneal mesothelioma. Nothing less than 15 years, most of the deaths of peritoneal mesothelioma occurred 25, 30, 35, 40 years from onset.

Once more, I trust this fact will be applied to analysis of the Connecticut data, in relation to when the pipe was put in the ground. If it was put in place in 1960 in large part, or '65 or '70, we'll have to wait until the year 2,000 to know whether or not it will be associated with this signal tumor.

What I've shown you so far has been largely the kind of "yes - no" research that has to precede more detailed studies. It tells us yes, this can cause trouble, no, it can't cause trouble. But we've looked more critically.

This is the old Nicholson File Plant in Paterson, New Jersey. It almost was wrecked in 1940 when the Navy rescued it. They saw to it that the Union Asbestos and Rubber Company leased the plant, to build insulation material, pipe covering, block, asbestos mattresses for the growing Navy. There was amosite used here. Insulation workers, incidentally, were exposed to chrysotile at first and later, starting within the '40s to chrysotile and amosite.

From 1941 to 1945, 933 men worked there. We followed all of these people. We've traced them. By 1975, we found the usual excess deaths of lung cancer, mesothelioma, etc. This comes as no surprise. But this was an unusual plant. A dirty plant, with very heavy exposure. Men worked for a day a month. Some worked over the summer, some worked for two or three months, while waiting to go into the service. It didn't pay very much, so some worked until they were able to get a better paying job in defense industries or elsewhere.

When we analyzed their experience by duration of exposure (in other words, dose, how much asbestos did they inhale), we found that even one month of

work in those very bad circumstances was enough to increase the risk of lung cancer.

With exposure for one month or less, you get an increase of lung cancer. But nowhere near as much as if you worked for two years, or in fact, if you worked until the plant closed in '54.

This is clear evidence of a dose-response relationship for human cancer associated with asbestos. The greater the exposure the greater the risk.

We also found, incidentally that the people who got cancer with heavy exposure, got it in around 15 years, 20 years. The people who eventually got cancer after only one month of exposure, although there was more than expected, didn't suffer increased risk until about 30 years after onset.

This is a very interesting observation. It means that if we can reduce the dose, we don't eliminate the risk of cancer, as Dr. Kuschner said. You can't guarantee that there won't be some cancer somewhere, sometime in somebody, but it may come so late as to be beyond the normal human lifespan.

This is very much like the data that J.C. Wagner has shown us in his classic animal experiments, when he exposed rats by inhalation to crocidolite. One day of exposure in those chambers was enough to produce lung cancer or mesothelioma. The same thing was true of chrysotile. One day of exposure, provided the animals were allowed to live out their lifetime, was enough to produce the disease.

Therefore, we learned a very important lesson. One that's critical for your deliberations and that I hope becomes critical and central to your societal discussions that are now underway, <u>the importance of the dose-response relationships</u>.

Some people are very stiffnecked when posed with problems, and fall back on "yes or no", and "I favor no". There may be yes, but how much, when? With some doses will it be seen and in a significant number of people, will, in other words, it be a public health problem?

We also learned that brief exposure, and here Dr. Cooper's data are very important for you, that brief exposure if excessive can be hazardous. A man may walk away from his job but he doesn't walk away leaving his dust behind.

We've also come across something else, which I consider important. In the workers in New York, of the 370 men who were still alive on January 1st, 1963, when we examined them, each was asked about his smoking habits. Eighty-seven of the men had never smoked cigarettes. Two hundred and eighty-three had a history of cigarette smoking. Followed to 1967, we found that of the men who never smoked cigarettes, not one died of lung cancer. Mind you, they died of other things. When examined at post mortem, their lungs were full of asbestos. But they didn't die of lung cancer.

On the other hand, of the 283 men with a history of cigarette smoking, there should have been three deaths of lung cancer, given those smoking habits. Instead there were 24. So it wasn't the asbestos alone, none died of lung cancer. It wasn't the cigarette smoking alone, only three would have died of lung cancer. The combination of the two, the multiple factor interaction produced this extraordinary rise.

We've looked at it in larger numbers since then. When we started the study of the 17,800 men, we asked them about their smoking habits and found that 7,756 had never smoked cigarettes regularly and over 9,591 had such history.

By 1976, we found that of 9,591 men who had a history of regular cigarette smoking there was the huge expected increase of deaths of lung cancer, 52 expected and 285 observed. But of those who had never smoked cigarettes regularly, deaths even among nonsmokers exposed to asbestos, it's not a major problem.

When looked at statistically by deaths per thousand man-years of observation, there are ten times as many lung cancer deaths among asbestos workers with a history of cigarette smokers compared with those who do not.

This is not seen for mesothelioma. The rates are exactly the same or virtually the same, among smokers and non-smokers. The cigarette smoking risk only applies to lung cancer. But since lung cancer is the major cause of excess deaths, this is of tremendous significance. So we learned our next unhappy lesson, the importance of multiple factor interaction.

We'll now come back to mesothelioma with a little personal note. It's been a disease that we've been very interested in at Mount Sinai for a long time. The reason is that the first modern paper on the pathology of the subject was written by Dr. Klemperer and Dr. Rabin at our hospital, in 1931.

We had a surgical pathologist there by the name of Dr. Otani, a brillant man, who didn't believe this. He said anything which occurs -- they reported two cases -- which occurs so rarely probably doesn't exist. So Dr. Rabin said it did exist and Dr. Otani said it didn't exist and we kept looking for it ever after. And from 1930 to 1960 we saw three more cases. It was a pretty rare disease!

You can imagine everyone's consternation, then when in 1960, Dr. Wagner reported 47 cases of mesothelioma, all in one part of South Africa in which there were many asbestos mines and mills, in the northwestern portion of the Cape Province. He had visited the relatives and had found that in 45 there had been, 30 years or so before, opportunity for asbestos contact. Many of these never worked in the mines or mills but simply lived in the area.

Molly Newhouse, a very good epidemiologist at the London School of Hygiene, looked at the 76 cases of mesothelioma in the files in the London Hospital, one in 1917 and the rest mostly around 1950-1960. There were 76 cases. When she visited the relatives, sure enough, 30 had worked with asbestos, Well that came as no surprise. But of the 45 who had worked with asbestos, nine had simply lived in the household of an asbestos worker, generally wives who washed their husbands' clothes when they came home from work.

Now this is a far cry from the general atmosphere, but it's certainly nothing like what's in a factory. Of the 36 who had neither worked with asbestos, nor lived with someone who worked with asbestos, 11 had simply lived within a half mile of one of the asbestos plants in London.

Now we've been looking at this. In the factory that I showed you before, when we traced the men employed from '41 to '45, we've also been tracing their wives and children. What happened to wives or their children who lived with asbestos workers from '41 to '45? In the first 626 people we've traced and x-rayed, we found that 225 had radiologically abnormal findings quite characteristic of asbestos, with pleural thickening, pleural calcification, or interstitial fibrosis.

It made no difference whether they were wives, sons, daughters. About one-third, when looked at 30 years later, had x-ray findings of asbestos disease. And as we've looked at these first 626 cases, wives and children, we've already found four deaths of mesothelioma. These were people in their 30s and 40s who were five, ten, eleven, twelve years old when they lived with their parents in '41 to '45.

So we've learned the importance of family contact disease. I was interested in one of Clark Cooper's slides. When the man was cutting, his shoes were full of asbestos. That man is going to go home with those shoes and the dust on those shoes gets into the carpet, gets into the house. Once in the house it's very difficult to get out.

Our last unhappy piece of news came a few years ago. A very clever, capable young physician, Peter Harries, the physician at that time at the Royal Navy Dockyard at Devonport, reported five cases of mesothelioma in 1968 at the Dockyard. Well, what's surprising about five cases of mesothelioma? -- there were hundreds known by that time. What was interesting was that not one was in an asbestos worker. There was a boiler maker, a fitter, a laborer, a ship-

ight, a welder. In other words, all the other trades, the "bystanders" cause in shipyards, at least in the United States, we have very few asbestos rkers, 499 are in other trades (one out of 500 is a pipe coverer).

When one looks at the inside of a ship, it's pretty obvious that the ist of one trade certainly can be distributed to others. In his most recent iblication, Dr. Harries has reported, from this yard, 55 cases of mesothelioma. vo in asbestos workers, 53 in other trades.

So the problem is beyond the asbestos workers. It's beyond those ngularly intimately involved.

Next, I call attention to a paper by Gibel et al, from East Germany. ey were worried about asbestos that would come from food filters. Do we have tential trouble when we filter food or wine or beer through filters -- can cause trouble?

They took food filters and simply cut it up into little pieces and fed ts little pieces of asbestos filter material. Surprisingly, four rats died th kidney cancer. Now this is a small study, only 50 rats exposed to asbestos, ly four cases of kidney cancer in those rats. You can't put too much reliance this singly study, but it does give us some pause.

In Lake Superior, after a storm, we find roughly around one billion bers per liter. Ordinarily, it's around 100 million or fewer fibers per liter. w what is the significance of this? Let me tell you. I will show you some ta of selected neoplasms among the 17,000 men we've been following. These are l based upon over 150,000 person-years of observation. We found no increase cancer of the skin, no increase in cancer of the brain, no statistical increase yhow. No increase in cancer of the testicles, prostate, no increase in cancer the liver, no increase in cancer of the bladder, no increase in leukemia, mphoma. But look what we found with cancer of the kidney. In this group of men, 150,000 person-years of observation, there should have been seven deaths of cancer

of the kidney and 17 were found this is statistically significant at the .0001 level.

Now it's not a very large number, with 17 observed among over 17,000 men, over a nine year period. But with the animal experiments, it gives us some pause. And that pause, in my opinion, should be utilized to do everything possible to decrease exposure of human beings to asbestos by ingestion.

Thank you.

The Biology of Asbestos - A Scientific/Industrial Perspective
by
Paul Kotin, M.D.

Dr. Paul Kotin joined Johns-Manville in 1974 as Vice President for Health, Safety and Environment. He is responsible for the company's employee health and safety programs, and for maintaining environmental quality at J-M facilities. In 1975 Dr. Kotin was appointed Senior Vice President.

Prior to joining J-M, Dr. Kotin was Vice President for Health Sciences, Dean of the School of Medicine and Professor of Pathology at Temple University. He was Director, from 1969 to 1971, of the National Institute of Environmental Health Sciences (NIEHS) and in 1976 was apointed to the National Advisory Committee on Occupational Safety and Health by the Secretary of Labor.

I now have the difficult task of deciding whether I should expose u to my prepared 25-minute presentation or abbreviate it. Out of deference you primarily and to my voice secondarily, I'll only read the conclusions my text and let it go at that. I am with you, I am of you, and you will have ple opportunities in the future to hear me. I promise to send a copy of my full esentation to every member of this group, but minus the emphasis and emotion at go with virtually everything I say or do. So if you'll give me 30 seconds, ll dig out my presentation and cut it down.

On page one I make the point that the decisions relative to regulation cancer -- federal as well as state regulation of cancer -- involve both science d public policy.

A brilliant man by the name of Dr. Alvin Weinberg coined the word "trans-ience," which he defined as an area which synthesizes science and public policy en the body of scientific knowledge is inadequate for unanimous agreement to et the needs of the regulator, yet the regulator has the need to control and gulate. Certainly the need to control and regulate environmental carcinogens one that is universally accepted.

I harken back to Sir John Simon, who was the health officer in London tween 1880 and 1900, and was the first to show that regulation is not a new oblem. Sir John framed the dictum that understanding of disease and demonstration cause and effect is the necessary base for regulation. Actually, he was adamant his insistence that legislation should be based on accurate knowledge. Dr. hn Higginson, who is the director of the International Agency for Research on ncer in Lyon, recently noted in an article in the American Journal of Pathology ile referring to Sir John Simon: "Today in contrast, while this view would pear eminently reasonable to all modern pathologists (the view that fact should a major determinant) there is a dangerous tendency in legislative circles to se action requiring scientific judgments increasingly on considerations other

than the evaluation of scientific data."

The complex nature of the problem becomes immediately apparent when we try to specifically identify environmental carcinogens. The extent of exposure to carcinogens is widespread. They can be found in each compartment of the environment (air, water, soil, consumer product, food), and are related not only to one's occupation or workplace but to cultural habits (smoking, diet, sun "worship," etc.) and socioeconomic level (e.g., uterine and gastric cancer).

So that we can be sure of a common usage, definitions are given below for some of the technical terms usually applied in discussing carcinogenesis:

(1) Tumor: Swelling

(2) Neoplasm: A specific form of tumor
any new and abnormal growth of cells (tissue)

Benign: Growth of limited potential producing host effect by virtue of mechanical presence, or rarely, excess hormone secretion.

Malignant: Uncontrolled growth leading to death unless interrupted (cancer)

(3) Oncogen: Agent capable of inducing a neoplasm

Carcinogen: Agent capable of inducing a malignant neoplasm (cancer)

(4) Jargon: Tumor = Neoplasm = Cancer
Oncogen = Carcinogen

It is imperative in any discussion of environmental carcinogen to distinguish benign from malignant neoplasms and to avoid jargon that equates tumor and neoplasm and cancer.

Now that we have a common vocabulary, how are carcinogens identified? Tables I and II list those chemicals recognized as carcinogenic in man and those

TABLE I
CARCINOGENS IN ANIMALS TO WHICH HUMAN POPULATIONS ARE EXPOSED **

CHEMICAL MIXTURES	SITE OF CANCERS
CYCLAMATES	BLADDER
STERIGMATOCYSTIN	LIVER
CYCASIN	LIVER
SAFROLE	LIVER
PYRROLIZIDINE ALKALOIDS	LIVER
NITROSO COMPOUNDS	ESOPHAGUS, LIVER, KIDNEYS, AND STOMACH

TABLE II
CHEMICALS RECOGNIZED AS CARCINOGENIC IN MAN **

CHEMICAL MIXTURES	SITE OF CANCERS
SOOTS, TARS, OILS	SKIN, LUNGS
CIGARETTE SMOKE	LUNGS
INDUSTRIAL CHEMICALS	
2-NAPHTHYLAMINE	URINARY BLADDER
BENZIDINE	URINARY BLADDER
4-AMINOBIPHENYL	URINARY BLADDER
CHLOROMETHYL METHYL ETHER	LUNGS
NICKEL COMPOUNDS	LUNGS, NASAL SINUSES
CHROMIUM COMPOUNDS	LUNGS
ASBESTOS	LUNGS
ARSENIC COMPOUNDS	SKIN, LUNGS
VINYL CHLORIDE	LIVER
DRUGS	
N,N-BIS (2-CHLOROETHYL)-2-NAPHTHYLAMINE	URINARY BLADDER
BIS (2-CHLOROETHYL) SULFIDE (MUSTARD GAS)	LUNGS
DIETHYLSTILBESTROL	VAGINA
PHENACETIN	RENAL PELVIS
NATURALLY OCCURRING COMPOUNDS	
BETEL NUTS	BUCCAL MUCOSA
AFLATOXINS	LIVER

TABLES FROM HEIDELBERGER (1975)

chemicals that are carcinogenic in animals to which human populations are also exposed. As can be seen, no tissue is really immune from environmental cancer, but the question which must be asked is, are the data for these and many other agents equally convincing? As I will show, there is a hierarchy of levels of proof, and each level has its own index of certainty and, I believe, utility for the regulator. The first level, or Group I, consists of both epidemiological (human) data and experimental laboratory data, in which the data are concordant and the evidence of carcinogenicity is conclusive. Examples of carcinogens in this group and the cancer associated with them are:

Beta Naphthylamine	-- Urinary Bladder Cancer
Vinyl Chloride	-- Angiosarcoma of the Liver
Asbestos	-- Mesothelioma
Uranium during Mining (Radon and Daughters)	-- Lung Cancer
Polynuclear aromatic Hydrocarbons (coke oven operations)	-- Lung Cancer

In Group II, epidemiological (human) data are available but the experimental laboratory data are negative. Despite the lack of positive experimental data, the human data are convincing. Examples of carcinogens in this category are:

Arsenic -- Lung Cancer

Benzene -- Leukemia

In Group III, observation of human populations has resulted in case reports of greater than expected incidence rates for certain population groups, but the individual agents responsible for the observations have not been identified so that laboratory verification of the observations cannot be done. Some examples are:

Furniture Industry -- Upper respiratory cancer, and cancer of the nasal passages and sinus

Shoe Industry -- Upper respiratory cancer, and cancer of the nasal passages and sinus

Rubber Industry -- Cancer of the brain

The next group (Group IV) consists of laboratory data only; human studies, though adequate, are negative. For example, in laboratory studies, implantation of foreign bodies, fibrous glass, or plastics in experimental animals has produced sarcomas at the implantation site. Isoniazid has produced pulmonary tumors in mice, and beryllium inhalation has resulted in lung tumors in experimental animals. Despite these laboratory data, studies of humans receiving plastic prostheses or receiving isoniazid in the treatment of tuberculosis and studies of humans occupationally exposed to beryllium indicate no real evidence of carcinogenic risk.

The final level, or Group V, in our hierarchy of proof of carcinogenicity consists of laboratory data only. In contrast to Group IV in which the human studies are negative but adequate, the human studies in Group V are negative but limited or inadequate or haven't even been done. Examples of agents in this category are:

Cyclamates/Saccharine

Red Dye No. 2

Carbon Tetrachloride

DDT, Heptachlor, Chlordane, Mirex

For the agents in Group V, there are two regulatory universes: The one relating to the Federal Drug Administration (FDA) and the Delaney Clause, and the other to the remainder of the regulatory apparatus. In the non-FDA area, a complex calculus exists that can be, I believe, reduced to a series of issues and

questions. The issues and questions can be more clearly understood if they are analyzed in relation to:

(1) Experimental design, data analysis, biological interpretation and extrapolation: In a word, the "Protocol" for laboratory data generation.

(2) The Fundamental Biology of carcinogenesis and neoplasia

(3) The Sociopolitical and Cultural Influences affecting regulatory decision making.

I. Protocol

In this area, a crucial issue is the cogency and the limitations of extrapolation of laboratory animal data to man. Qualitative extrapolation is highly, but not universally valid. Quantitative extrapolation is of very limited use, if, indeed, it can be used at all.

A second issue is the relevance of findings from high experimental exposure dose levels (maximum tolerated) in animals to low dose exposure in animals and, more critically, in man.

A third matter is the confounding influence of:

(1) The character of experimental exposure in animals (duplicative of man? Esoteric?)

(2) The strain and species-specific characteristics of animals selected for study.

(3) The limited numbers of animals that can be used reasonably in laboratory studies.

This is in contrast to:

(1) The genetic heterogeneity in homo sapiens.

(2) The varied nature and physical state of the population at risk.

(3) The massive number of people potentially at risk to a ubiquitous carcinogen.

As can be seen, there are factors that enhance, and others that dilute, the application of experimental findings to man.

A fourth matter relates to the sophistication and quality of epidemiological studies in animals and man and the biostatistical tools used in data analysis and interpretation. Indictment or exoneration of suspect carcinogens is more frequently in error because of deficiencies in this aspect of research protocal than, perhaps, in any other.

II. Fundamental Biology

In discussing the fundamental biology of carcinogenesis and neoplasia, the following questions must be asked:

(1) Is there a dose response to chemical carcinogens? The consensus seems to be that there is.

(2) Is there a no adverse effect level of exposure or, in fact, a threshold?

(3) Are carcinogens metabolized differently in relation to dose, in relation to species, and on the basis of the physiological state of the host?

(4) Can carcinogens interact with one another or with other environmental agents in a way that allows prediction of summation, synergism, or inhibition?

(5) Can carcinogenicity be proven by any test or model system in which neoplasms are not induced? I refer, of course, to the rapid bioassay procedures for mutagenesis using bacteria (Ames test) or cultured cell lines. These tests have great potential utility, but they cannot by themselves verify the carcinogenicity of any agent.

III. Sociopolitical and Cultural Influences

In the area of sociopolitical and cultural influences, we must ask:

(1) Is the concept of an acceptable level of risk a viable one?

(2) Can workers be characterized and classified biologically in order to identify "susceptibility" and resistance to chemical carcinogens?

(3) Is the determining rubric for the regulation of carcinogens the "presence" of the agent(s) or protection from hazardous exposure?

(4) How does one apportion to the various constituencies (government, management, labor, society as a setter of values, etc.) the obligation or responsibility for compliance with regulations and for the results of the deficiencies of the past? Once responsibilities are identified, how can they be enforced?

With these issues and questions as the bases for analyzing carcinogenicity, what remedies to the problems are available to the regulator?

First, certain basic realities need to be identified and articulated:

(1) Some manmade carcinogens entering the environment are inescapable (e.g., carcinogens from vehicle exhausts and from cigarette smoking).

(2) Some carcinogens are present as part of a desirable environmental experience (e.g., peanuts contaminated with aflatoxins).

(3) Some carcinogens are expedient (e.g., saccharin).

(4) Some carcinogens are indispensable (e.g., essential amino acids, hormones, and certain life-prolonging drugs).

Identification and articulation of the above categories of carcinogens recognizes and acknowledges the concept of socially acceptable carcinogens.

Secondly, acceptable risk as a viable concept needs to be probed in depth. Acceptable risk should not be measured by the incendiary and unacceptable

bric of how much a human life is worth, but rather by the practical demonstration no adverse effect in those exposed for a working life, even though a theoretical zard may not be eliminated from our thinking.

Third, an environment needs to be created in which the worker, through s own efforts and those of his representatives, enter into a partnership with nagement to ensure an acceptable work environment. Arrangements of this type e working well in some industries, whereas they are foundering in others. The y issue is the time-honored one of balancing responsibility and authority, as r example the willingness of a union to help eliminate the contribution of garette smoking to occupational bronchogenic cancer by helping to enforce -smoking policies.

Fourth, both the positive aspects and the limitations of the information all five categories I referred to earlier need to be utilized as the basis for generic approach to the control of chemical environmental carcinogens. This l' permit recognition and assessment of the obvious differences that exist

(1) The scope and weight of the biological evidence.

(2) The chemical, physical, and product state of the agent.

(3) The exposure experiences in the various environmental compartments in which the agents are encountered.

Such an assessment must include the issues of mixtures with carcinogens varying percentages, and the presence of residual carcinogenic contaminants. other words, the total hazardous exposure must be a key element in evaluating gulatory controls.

Fifth, engineering and technological measures adequate to ensure ntrol need to be demanded, with full recognition that employee protection by onal devices such as respirators are but interim measures.

Sixth, worker surveillance and evaluation through techniques whose

benefits and limitations are clearly understood need to be required. All such techniques should be based on scientific understanding, not on expediency or on pressure. For test procedures on the leading edge of diagnosis, a distinction should be made between those monitoring methods of documented value and those still in the research state. Actually, industry alone can frequently provide the nucleus for assessing the value of new test procedures and should, I believe, enthusiastically participate in such research efforts (e.g., developing susceptibility and resistance profiles, early diagnostic techniques, etc.).

Seventh, management needs to be granted the capability of using impartial (academic) expertise to identify the susceptible and resistant variations due to polymorphism (genetic difference) or to personal cultural characteristics.

Finally, the consuming and paralyzing fear that manifests itself in the automatic denigration of all negative data needs to be overcome. There are, in fact, a host of associations in our environment that:

(1) Are not cause and effect.

(2) Require adequate above zero-level dosage for an effect to occur.

The assimilation of science and its data into the ultimate decision making is really a societal function reflected in our elected officials as they represent social values, the laws these officials pass, the regulations they authorize, and the punishments for noncompliance they set. What are the most fragile areas subject to misinterpretation, manipulation and misuse? No constituency that I'm aware of is really immune from an accusation of one or the other -- I suspect for the most part, innocently. But to answer my question: first, failure to use all data available and secondly, projections into the future. I find the latter to be very difficult, and not on the basis of any special knowledge but on the basis of the last several decades' experience.

I am troubled by the tip of the iceburg concept. Where projections

n made on data, I have no concern. But I'm sure we all recall headlines at he time of the angiosarcarcoma investigations of the projected number of ngiosarcarcomas that were going to be identified in persons exposed to vinyl hloride. I took the liberty of checking with the National Institute of ccupational Safety and Health in the United States and with four analagous gencies, and to date there are 54 cases of angiosarcarcoma accepted officially) ld-wide: twenty-seven in the United States, ten in Canada, and peculiarly ough 27 in Europe, with a significant portion of those in Eastern Europe.

Again, we should have seen by now the projected epidemic of cancer ic was going to ensue from chlorinated hydrocarbon pesticide exposure. That lorinated hydrocarbons are animal carcinogens I fully accept, and the cancer ey produce (liver cancer) is a sufficiently unusual one so that if there were i g to be a significant increase I think there would be some manifestation it.

I think that the body of knowledge that was presented this morning erly states and supports that exposure to chemical carcinogens has over the st half century been an inducer of cancer in high risk populations in some those exposed, though not all and actually in a small percentage. By the d token, the one to three percent Dr. Kuschner referred to as the current imates by Dr. Higginson of occupational cancer's role in the total of environtal cancer is one to three percent too many and we fail to address ourselves hat at our own peril.

An Occupational Safety and Health Administration (OSHA) Regulatory Update

by

Guy G. Gabrielson, Jr.

Mr. Gabrielson is Chairman of the Board, Nicolet Incorporated. A Vice President of AIA/NA, he also serves as Chairman of the Association's Asbestos Regulation Task Force. Mr. Gabrielson is a lawyer, businessman, and prominent civic leader.

This morning you've listened to a great volume of scientific data and opinion, and I'm sure that many of you found it difficult going at times, as I did. Now, by way of comic relief, you are to be treated to the spectacle of a lawyer-businessman trying to take that body of scientific knowledge and ignorance, and develop it in a way which will enable us to arrive at government regulations which will protect the health of our employees and the employees of our customers, and still leave us with a viable asbestos industry.

In speaking this morning about a court case in which EPA is involved, Dr. Robeck said that lawyers provide little assistance for scientists, and Paul Kotin had something unkind to say about lawyers, too. As a rejoinder, I would like to say that there are times in this asbestos/health issue when scientists provide little assistance for lawyers. I have had occasion, from time to time, to ask my scientific advisors whether or not I can make a particular statement. I'm sorry to report that in a majority of cases, they will say, "Well, perhaps you can and perhaps you can't." Or, "You can make that statement with the following qualifications." I never seem to get a straightforward, "Yes, you may make that statement, and make it safely." Admittedly then, (and we all know this) we are dealing with an incomplete body of data and a great many diverse opinions about how that data should be interpreted.

Our task is not an easy one, and as Dr. Selikoff indicated this morning, the gaps in our knowledge are going to remain with us for a substantial period of time.

I think most of you know that exposures to asbestos in the United States are subject to regulation by a great many agencies of the Federal government and of the states as well. I'm going to talk today about only two agencies. Perhaps that will, at least, limit your confusion.

I'm going to talk about the Occupational Safety and Health Administration of the Department of Labor, that agency which we call OSHA, which is charged with responsibility for setting exposures standards exclusively in occupational settings. They are not charged with setting exposure standards in the ambient air. They are not concerned about risks to the general public. They are concerned only with risks to employed persons.

The other agency to which I will refer is the National Institute of Occupational Safety and Health, or as we call it, NIOSH, a part of the Department of Health, Education and Welfare of the United States government. NIOSH is charged with responsibility for making recommendations to OSHA for exposure standards in the occupational setting.

Now, to review briefly where we stand in the asbestos industry in the United States. Since the Occupational Safety and Health Act was adopted, OSHA has published first a temporary exposure standard, and then a permanent standard. Now, the permanent standard, which OSHA adopted back in 1972, called for a time-weighted average exposure of five fibers per cubic centimeter, averaged over an eight-hour period, with a peak exposure of ten fibers. That standard was to go down to two fibers per cc (TWA) with a peak exposure of ten fibers on July of last year. The regulation which was adopted in 1972, and which is in effect today--the regulation with which we are obliged to comply--covers all occupational exposures, without exception.

However, between the effective date for the five fiber standard, which was a temporary one, and July 1 of last year, when the two-fiber standard came into effect, OSHA made a new proposal. This time their proposal was limited to all occupational exposures excluding construction. This standard or proposed standard we choose to call the manufacturing standard. The proposal, made on October 9, 1975, tightened up many of the provisions of the existing standard, and also proposed to lower the time-weighted average

exposure to 0.5, or one half fiber per cc, time-weighted average over an eight-hour work day. That remains today a proposal by OSHA, and as I said, it excluded construction. When the proposal was made, OSHA said, "We will, at a later date, propose another standard to cover occupational exposures in construction."

Now, when the October, 1975, proposal was made, Executive Department orders required that an economic study be made before the standard was put into effect. At that time, the government's economic impact study followed the publication of the proposed standard. Since that time, the government's rules have changed. Now the government requires that an economic impact statement be made before a proposal is made; so that the construction proposal, when it is made, can be made only after an economic impact statement has been prepared.

Today we are awaiting hearings on the manufacturing standard. I should correct that. We are awaiting completion of the government's economic impact study, which has not yet been certified, and then we will be awaiting hearings on the manufacturing standard. We also are awaiting the completion of the government's economic impact statement on a proposed construction industry standard, to be followed in due course by a proposed standard, and then by hearings.

Now, this rather complicated set of circumstances has been made worse by two other developments which have occurred in the United States. In December of last year--that is, December of 1976--NIOSH came forward with a new recommendation to OSHA. This time, recommending that the occupational exposure standard be set at 0.1, or one tenth of a fiber, per cc, averaged over an eight-hour day. Then, to make matters even more difficult to analyze, in January of this year, OSHA itself came forward with a protocol for, or an outline of, a proposed generic standard for exposures to all industrial carcinogens. And this proposal contained some rather alarming suggestions.

The first is that a material be defined as a confirmed carcinogen, if the results of rather limited animal studies show that the material produces cancer in animals. Now, that's not of immediate concern to us in the asbestos industry, because epidemiology has already demonstrated that asbestos is a carcinogen in man. But this proposal can be a rather disquieting one to people working with other industrial materials, the cancer-producing potential of which may still remain in doubt.

A second feature of the January generic carcinogen proposal which is of direct concern to us, is that it proposes that, when a material has been defined as a confirmed carcinogen, it must be regulated to the "lowest detectable level." And that in turn refers us back to the December proposal of NIOSH, because NIOSH proposed 0.1 fibers per cc on the grounds that that was, or is, the "lowest detectable level."

Lastly, the January proposal states that OSHA wishes to exercise the right to ban a material from use in industry if it--OSHA--concludes that there is a feasible substitute for that material, which substitute is noncarcinogenic. Now, on this last point, there is some doubt in my mind. I have not reviewed the statute, but I have been told by some that there is a question as to whether or not OSHA has statutory authority to ban a material from use in industry. Perhaps this proposal will require attention by our Congress. In any case, in a practical sense, OSHA may not need statutory authority; because, if they wish to ban a material, it should be easy for them to set a standard so low that we cannot achieve it, then forbid us to use respirators. In that event, we would have a practical ban.

This latest initiative by NIOSH--these two latest initiatives by NIOSH and by OSHA--are important for us to understand because they indicate that, within and outside the government, among those groups who are most vocal in demanding controls of industrial materials, there is a school of thought which strongly will advocate, to all intents and purposes, zero

exposure. These people are advocating zero exposure because they see no data available which will define an absolutely safe level for the most sensitive person who might be exposed to one of these substances. And I think they also are advocating this approach so that they can bypass the issue of risk analysis.

We, on our part, are going to have to fight this kind of approach to the regulation of dangerous materials. We are going to have to advocate risk analysis. We are going to have to say that there is no such thing as riskless employment or even a riskless society. And that risk, at some point, must be measured.

This lays us open to the charge that we are prepared to use human beings for scientific experiments. That's always the kind of response you're apt to get. Unhappy as that may make us, I think that we have no choice but to argue for some kind of risk analysis approach to the problem of setting standards.

I would not be too discouraged, however, by the prospects. We are inclined to try to simplify our problems. We are inclined to say that the government takes this position or the government takes that position. Actually, of course, that isn't true. The government is a giant institution, made up of many, many individuals who are interested in and working on problems of this kind; and they have divergent opinions on the matter.

For instance, I am told that when NIOSH made its December recommendation of 0.1 fibers per cc, there was considerable surprise at OSHA. NIOSH had come forward and said that 0.1 fibers was the "lowest detectable level," and here apparently OSHA was working on a generic carcinogen standard which advocates controlling carcinogens to the "lowest detectable level." OSHA was thinking, I presume, that the lowest detectable level for asbestos would be substantially higher than 0.1 fibers. You see, the government has communications problems, just as we do.

This reminds me of the story of a Hollywood actress who wanted to have her portrait painted. She looked up an eminent artist and told him of her wish. "But," she said, "I want to have my portrait painted in the nude." The artist replied, "I'm sorry, I don't usually paint in the nude. There's going to have to be an extra charge for this." And she said, "That's all right. I'm willing to pay the extra charge, just as long as you paint me in the nude." To which he replied, "In that event, there will be one other condition. I can't paint you entirely in the nude." When she asked the nature of the other condition, he answered, "I'm going to have to wear my socks so I have a place to put my brushes."

Where do we stand, then, in the OSHA regulatory process? Let's go back to that. As I said earlier, we have a proposal for manufacturing, in connection with that proposal, and the government has commissioned an environmental impact study to be performed by a contractor called Consad. Consad, to all intents and purposes, completed their study last August and have done nothing on it since that time. Nevertheless, the Department of Labor has not yet certified the Consad report. Then, just recently, the Department of Labor called the contractor in and said, "We'd like you to do a supplemental study, measuring the impact of a 0.1 fiber standard versus the original 0.5 fiber standard." I guess OSHA had to do this, because NIOSH had proposed a change to 0.1 and OSHA cannot ignore a NIOSH proposal.

OSHA has given Consad a very brief period of time within which to complete this supplementary study. It is due for completion on the 18th of May; the government has indicated that it will give no extensions of time to Consad to complete the job.

AIA representatives have talked informally to the Consad people about their new assignment. They told us that they had gone to the Department of Labor and had said, "In our opinion, there is no way that we can measure the economic impact of a 0.1 fiber standard." OSHA apparently replied

to Consad, "That's all right, don't spend too much time on the 0.1 fiber economic impact. Just look at substitutes for asbestos, find out what may be the substitutes for asbestos products, and tell us about the possible intrusion of these substitute materials into the marketplace."

When we were having our conversation, I said to the Consad people, "That's an interesting point of view. Does that imply that OSHA considers a 0.1 fiber standard to be tantamount to a ban on the use of asbestos? Otherwise, why substantially limit your study to substitute materials?" They were quick to say,"No, that doesn't imply that OSHA considers 0.1 fibers to be a ban;" and they then turned to me and said, "Do you consider 0.1 fibers to be a ban?" I replied, of course, "Yes, I do." In any event, it remains an interesting fact that the informal assignment of work to Consad specifies that they shall pay little attention to the economic impact of 0.1 fibers and concentrate on substitution. This means that if you U.S. manufacturers of pipe are contacted by the representatives of Consad (and they are making their survey by telephone), you may expect that they will be quizzing you primarily about substitute materials.

This is where we stand on the manufacturing standard. Presumably, when this supplemental study is completed, OSHA will be ready to take its next step. If they are going to change the manufacturing standard from 0.5 to 0.1, they must again publish a proposal in the Federal Register and the clock will start to run once more. On the other hand, if they are going to stick to 0.5, they simply can call for hearings on the standard, which has already been published.

Now, on the construction standard, we are still awaiting a proposal, and that proposal cannot be made until Research Triangle Institute, which is the government's contractor on this economic impact study, has completed its work. Research Triangle Institute also is incorporating into its analysis a 0.1 fiber alternative; so that when Research Triangle Institute

has completed their work (and it should be completed, I am told, most any time now), the government will be in a position to publish a proposed construction standard. Or, taking all this together, the government could, if it chose, publish a combined standard for manufacturing and construction. It will have both its economic impact studies; so, as one alternative, it could publish a combined standard, and call for hearings on that combined standard.

All in all, it is our expectation that we may have hearings on both these standards or on a combined standard sometime early this autumn.

Now, I'd like to talk briefly about what the AIA has done. As you already know, we responded to the October 9, 1975, manufacturing standard. That written submission was filed back in April of 1975.

As far as the construction industry standard is concerned, we've had a more difficult problem because we did not have a government proposal to which we could address ourselves. We have no idea what the government might propose in the way of a standard for construction, but we felt that we had to gather our data, develop our data base, so that we could respond promptly when the proposal is made. And that is simply because, under the law, the time allowed to us to respond could be as short as 30 days after the proposal is made.

For this reason, we let a contract to Equitable Environmental Health to begin studying a proposed construction industry standard. I am pleased to report that the results of that look very good to me. Obviously, we do not yet have any conclusions from it. But I think we have a fairly good data base from which to work. We have our census of employees exposed in the construction industry. We have information about the time periods during which they are exposed, so that time-weighted average exposures can be calculated.

We found, when we went into this study, that there was very spotty

data available on dust counts in actual field construction operations. For that reason, we have done a fairly significant number of dust count studies of our own, to fill in the gaps in our knowledge. And we have now, I think, probably the best body of dust count data available anywhere, as far as broad construction industry exposures are concerned.

Your association has provided us with the data which we saw this morning, as one element in our total package. We now are in a position, when the government makes its proposal, to respond by costing out that proposal. We propose also to respond by developing and submitting an AIA alternative regulatory proposal. And our data base will permit us to cost out the AIA alternative.

Now, it has become customary in the United States rulemaking process, to try to develop an economic impact statement for each new regulation, and it has been traditional to do that in the macro-economic sense. What would this regulation do to the United States economy?

Those of us who have been close to these procedures, and even those who have been doing the economic analysis work, have grave doubts about the significance of any such study. The work that is being done by these economists reminds me of another story, which I'll share with you.

There were three men who were shipwrecked on a desert island. Happily, several cases of canned food were washed up on the island at the same time, so there was food there to sustain them. The three men were a chemist, a physicist and an economist. And obviously, they had the problem of trying to decide how they were going to get at the food in the cans.

The chemist said, "I'm going to look around the island for some berries, and for some mineral substances. Perhaps I can mix these materials to achieve acidic or other properties that will eat away the can so that we can get at the food."

The physicist said, "No, that won't do because you may contaminate the food, and then we'll be at risk. I have a better idea. I'm going to work out a formula that tells me how tall a palm tree I must climb to drop a suitable rock on the can and break it."

And the economist said, "Gentlemen, neither one of your solutions has any merit. Please leave it to me. I'll solve your problem. First, we'll assume we have a can opener."

Economic impact studies are so full of assumptions that when you've finished reading them, you wonder whether they have shed any light on the problem at all. It is traditional, however, to use such a study and EEH is prepared to do that for us; although they will point out what the weaknesses of a macro-economic study are.

EEH will be prepared in the alternative to make what they call a micro-economic study. We think this kind of study is much more pertinent to the decision-making process. It will be designed to show what will be the cost of each segment of each regulatory alternative, and what benefits we might expect to accrue from spending money on that segment.

The AIA alternative is now entering its fourth draft, despite the fact that we have not yet had anything from the government to look at. I think that you in the pipe industry would be interested to know, briefly, what kind of approach we are using.

Our AIA proposal is being developed by representatives of asbestos construction material manufacturers, together with representatives of contractor associations who are helping us keep our alternative both responsible and workable.

We do not abandon entirely the numerical exposure concept. We propose to continue to embrace a two-fiber standard. However, the construction industry poses certain very difficult problems for the implementation of a standard like that which has been proposed for manufacturing.

To take an example: Monitoring. How practically can you monitor on every construction job? The labor force is transient, very often the job moves from place to place, the length of the job is very brief, a sample taken on a job might not return from the laboratory until after the job is finished. It seems to us that the difficulties of trying to use a monitoring method of compliance in the construction industry are enormous, and really preclude the use of such an approach.

By the same token, what do you do about medical surveillance? People enter and leave the construction trades rather easily in the United States. Employers enter and leave the construction industry rather easily. Contractors come and go. Many are quite small and under-financed. Employees move typically from contractor to contractor. How are you going to ascertain when the man last had a physical exam? And once you have done that, if you do give him an exam, how are you going to maintain the records? Does it make any sense for the employer to keep records on a permanent basis when the fellow may work for him only once and go on to work for other employers thereafter? Where would you go to look for the man's health record? Fairly difficult problems.

Our response to this is to continue to accept the two-fiber standard, which is very deeply ingrained into U.S. official thinking at this time; but to say that employers shall comply with the regulation, not by continually monitoring the workplace environment, but rather by the use of certified work practices. We are not going to write work practices into our regulation, but we are proposing a mechanism whereby interested persons--contractors, manufacturers, labor unions, whatever--may develop and have a work practice certified at a licensed, private testing laboratory.

Once that work practice is certified, it will be available to any contractor for his use. As long as he is using that work practice when the OSHA inspector comes to his job site, he is deemed to be in compliance, even

if the OSHA inspector should take an air sample and find that it is higher than the prescribed standard. However, if the OSHA inspector comes back to the job site a second time and takes a second air sample, and finds again that the contractor is over the prescribed standard (say, two fibers), then the contractor may be cited. In other words, the first OSHA monitoring should serve as a warning that something is wrong. He may be following the certified work practice, but he isn't getting the dust count which he is supposed to get. He'd better do something about it. And if he does nothing, he does so at his peril.

By the same token, we are proposing that the government license local or regional health centers, where medical surveillance examinations can be performed on individuals in the construction trades, and where those records may be kept on a permanent basis--kept at the licensed clinic where the examination is performed.

There are many other details of our proposal into which I will not go today; but, essentially, the position of the AIA today is that we are going to stand by the two-fiber standard in manufacturing, and we are going to advocate the same level of exposure in construction. However, in the latter case, compliance will not be by employer monitoring, but by employer use of certified work practices which are designed to achieve a specific maximum dust exposure.

Now, generally, I thing it can be said that the dust count data which we have gathered in the course of the EEH study show that time-weighted average exposures in construction are relatively low. We do not know whether to be pleased or disappointed by that result. We can argue that since the data indicates that average exposures are relatively low in construction, little risk should be run by adopting a work practice type proposal such as that which we have made. On the other hand, those who argue for a numerical standard could conceivably say, "Your low average results

would indicate that you would have little difficulty complying with a numerical standard, so why worry about it?" Nevertheless, we are trying to do a responsible job, and we are trying to call the facts as we find them. We will submit to OSHA the dust-count data that we have gathered, and then we will make our proposal as I have outlined to you.

Generally, it is my view, and this view is shared by the Executive Committee and the Board of Directors of the AIA, that we should stand by the two-fiber standard. We still believe that the medical evidence which has been gathered since 1972, largely duplicates the evidence that was available to us at that time, and that there is, therefore, no new evidence which would justify the United States government making a change from the two-fiber standard upon which we all have relied, and upon the basis of which we have made substantial investments--there is no justification for changing from that two-fiber standard to a lower standard. And I believe that to make that change without significant new evidence would be a denial of due process to our industry. It also is our present view that if the results of the rulemaking process give us any standard lower than two fibers per cc (TWA), either in manufacturing or construction, we will have to look very seriously at the possibility of challenging the result through our court system.

Thanks very much, gentlemen.

Panel Discussion
Moderated by
Emil M. Mrak, Ph.D.

Dr. Mrak is Chancellor - Emeritus of the University of California, Davis Campus, having served as Chancellor from 1959 to 1969. He is also Professor - Emeritus of the College of Agricultural and Environmental Sciences and is known nationally and internationally for his work on the preservation of foods.

In 1969, Dr. Mrak was appointed by the Secretary of the Department of Health, Education and Welfare as Chairman of the Commission on Pesticides and the Relationship to Environmental Health. He also served as Chairman of the Environmental Protection Agency's Hazardous Materials Advisory Committee and is presently Chairman of EPA's Science Advisory Board.

Dr. Mrak: Thank you very much, Dr. Kotin. I'm so pleased to be here because I'm being educated and I hope that this education will be of value in EPA. The papers presented this morning were marvelous. I hope they'll get out soon and that I can get them into EPA so we can have the people using them there. A lot has been said about the attorneys in EPA. There are some very good men. There are also some attorneys. Where is my friend Mr. Gabrielson? I'll apologize. You did a marvelous job by the way.

It brings me to a story, a real one, about heptachlor and chlordane and their banning; I don't think the average person knows how this came about.

I was in Washington one night and I turned on the TV and there was a high level official of EPA telling why heptachlor and chlordane were to be banned. The next day I rushed in and said "If you're concerned about what the scientific community thinks about you, you didn't make any brownie points last night." He wanted to know why and I told him. I asked how the decision was made and he said he didn't know. So he called in the attorneys. The facts of the case were that the attorneys had not informed the Assistant Administrator for Research and Development or the scientists in the pesticide area or in fact any of the scientists in EPA. The result was that there were a lot of changes made.

Well anyway, I hope in the future we will be able to make decisions by the rule of reason, rather than by the rule of emotion. I would hope that there would be scientific input. I used to argue with the Administrator that the one thing I wanted very much to see was that there was scientific input. Then, if he wanted to make his decisions on the basis of economics, emotion, pressure, politics, social or something else, okay.

The second think I insisted on was that he tell the reason he made the decision and where we put science. We were just about getting that and then

we had an election and now things are changing. I hope that Mr. Costle will continue.

I thought what I would do is call on the distinguished speakers to see if they wanted to challenge each other on some of the statements made this morning. Then when we get through with that, open it up to the audience. We'll start with Dr. Cooper. Would you like to ask any questions of the others?

Dr. Cooper: There were two or three very interesting lines of questions this morning, particularly on the idea of dosage and response; that is, decreasing risk with decreasing exposure and how we translate the idea of "relative risk", the probabilities of something happening to a person, to a language that can be generally and widely understood. I think this is extremely important.

Now I want to ask a question. I thought that one of the most interesting new facts that was brought to us this morning was the demonstration of the small, but apparently significant, excess of kidney tumors in asbestos workers. This is something that I had not realized was happening or even might happen. When Dr. Selikoff made the observation that fibers could be found in the urine of residents of Duluth after drinking fiber-containing water, I don't know whether he said anything about fibers in the urine of asbestos workers. I assume that these are fibers in the electron microscope size range.

I want to ask the question, how do we bridge the gap between the information we have on the relatively large fibers in insulation workers (upon which our standards have been based, and which are often accompanied by many, many more electron microscope size fibers) and epidemiological evidence based upon this type of fiber with the very large numbers of short, very small fibers in the electron microscope size range? Which does he think are responsible for the kidney changes and what type of studies are necessary to bring these two different bodies of environmental evidence together so that we can understand how to utilize it?

Dr. Mrak: I judge that's for Dr. Selikoff, but when he gets through, I'd like to call on Dr. Kuschner and the others if they wish to comment.

Dr. Selikoff: First, I might say that the kidney tumors came as a surprise to us. We were determined to analyze our data on the experience of these more than 17,000 men to see about a number of cancers about which claims were made, but about which few data were available.

You may be aware of the fact that there are papers in the literature which state that there is an increase of lyphoma and there is an increase of leukemia among these asbestos workers. These were primarily, as I have observed, based upon the fact that in autopsy cases of asbestosis, they saw a number of leukemias and lymphomas. But that's no proof because obviously, more interesting cases of asbestosis tend to come to post mortem; routine cases might not, so that autopsy data may be skewed.

Therefore, we decided to look at "uncommon" tumors besides the usual ones, the mesotheliomas, lung cancers and so forth. As I mentioned this morning, we have found that you can't disprove something; that epidemiological techniques are insensitive at levels below a 30% increase so I can't tell you that there are no increases in the bladder, testes, prostate, liver and so forth. But at least we can surely say what we have experienced with 150,000 person-years of observation: there can't be any significant or marked increase of these neoplasms with asbestos exposure.

However, there are three cancers that came to light, two had been suspected seven or eight years ago. First, oropharynx, that is tongue, sinus and the epiglottic area and so forth. Similarly, the larynx had been predicted on the basis of somewhat less elegant epidemiological techniques and so it did not come as a surprise either. Mind you I don't think you should necessarily extrapolate to your problems from our observations because in my slides this morning, we were talking about people fairly heavily exposed and as Dr. Kuschner said, the ingestion

of large amounts of asbestos probably was present.

How did we relate that to what we find in terms of fiber size and dose-response? I don't know. In 17 cases you can't talk about a dose-response relationship. Perhaps five or ten years from now, in our other population which had differing exposures, I might be able to tell you something, I just simple can't now.

How about fiber size? Well, I've sent Dr. Kotin the data from the scientist that did the urine studies. They're new and they will be published, I presume, shortly. Now these were virtually all sub-micron range fibers. That doesn't mean that sub-micron particles are necessarily the ones that cause the kidney cancer. Again, I don't know. These are the ones that appear in the urine. It may be the larger ones that get stuck in the kidney and are causing trouble although I don't know this either.

We are now in the process of ashing kidneys of asbestos workers to see what the asbestos content is and what the fiber size will be. I do not know this at this time; this is new information which we will later have.

There is however, a corollary to other experiences. I would point to the interesting data concerning pleural mesothelioma as an environmental cancer. In environmental circumstances, we don't find fibers that can be seen with the optical microscope; there are only those present that are visible solely by electron microscopy. In other words, a mile from an asbestos plant, the large fibers have been broken up in the air and have been deposited by impaction and so forth.

So you literally don't find very many optically visible fibers in environmental pleural mesothelioma and this then would be an example of small fiber disease. I would also call attention to the elegant studies of Sebastien, Bignon and other French investigators, in which they examined the fiber size distribution in the lungs of workers who died with asbestosis and mesothelioma in the French ports of LeHavre and so on. And they find as you go out to the

periphery of the lung, you always tend to get smaller and smaller and smaller fibers. And when you get to the pleura, only very small fibers are present; only those particles which can be seen by the electron microscope.

So there is this filtering mechanism and that I would presume Dr. Cooper, would be the same explanation we might find.

Dr. Mrak: Thank you very much Dr. Selikoff, you've answered the question in my mind, Dr. Kuschner, do you have anything to say, questions or whatnot?

Dr. Kuschner: (Due to technical problems, comments inaudible)

Dr. Cooper: I'd like to comment on the reference to the evidence that Dr. Selikoff gave in regards to the potential of very small fibers to produce mesothelioma. I feel that, one, the evidence is really not very good for airborne fibers in the environment being the cause of mesothelioma.

Secondly, I feel that a fairly large number of fibers in the optical range travel quite a good distance. You get a fiber 2-3 microns in diameter and it will remain airborne for quite a long time. So I'm assuming that there is not such a rapid "filtering out" of fibers in the respirable range. I also find it difficult to reconcile the finding of smaller and smaller fibers in the periphery of the lung to how it relates scientifically to Mearl Stanton's work. I find that I'm not really convinced that the demonstration of smaller and smaller fibers in the periphery is really contrary to other evidence we have, except for size.

Dr. Mrak: Thank you. You were speaking of "some distance from the plant" and calling on Gordon Robeck next brings to mind that the toxic substances control people in EPA are trying to work up 50 substantial materials they're going to work on and the last time I talked with them, your material (asbestos) was on that list.

Mr. Robeck: We in the water supply area are trying to respond to our legislation (Safe Drinking Water Act) and I want to confine my remarks to that. I would like to go back, if I may, to the matter of size. Some of you served on

the American Water Works Association Research Foundation Committee. It was something discussed at great length at that time too, and the evidence was that fiber size certainly was a factor in the onset and causation of tumors. Dr. Hart at Ohio State University has designed a rather extensive experiment to test the effects of the sizes of asbestos fibers on cellular DNA, membrane structure,intermediary metabolism and cellular transformation. Dr. Hart has reported on some of his work in the (New York) Academy of Sciences for September and he reports some rather promising progress. I don't intend to go into the details. Dr. Tardiff, our toxicologist and the Project Officer, is receiving quarterly reports on the project. What I am interested in is Dr. Selikoff's contention that in the Duluth situation, for instance, that all those small particles are obviously distributed unequally and dose is involved. I wonder if he would expand on that from some data base. It seems to me that it's a matter of the cell being able to handle the small fibers.

(Due to technical difficulties this portion of the Panel Session was not able to be recorded.)

Dr. Selikoff: (Continuing recommendations to the asbestos industry):

The second thing is that the attitude that you can take is that you are part of society's general thrust to eliminate cancer as a public health problem. It's not, "We want to do as little as we possibly can; if we can expose people at 1/2 fiber/cc or 1.0 fiber/cc, we're not going to do that if we can get away with 2,3,5 or whatever." On the contrary, you should be seen as part of the effort because you are. I find no difficulty in working with many of these people as individuals, I find that you are just as dedicated to solving society's problems with regards to eliminating cancer risks whenever possible. Your attitude then should be "we want to eliminate cancer".

This has another side to its own point that I've put down as "no unnecessary exposure to asbestos". If we don't know they're safe, any unnecessary

exposure beyond that is unacceptable. If you can have exposures at 0.1, make it 0.1, at 0.2, make it 0.2. Do the best that you now can do. And incidentally, this goes for environmental exposures as well as for worker exposure.

Mr. Gabrielson, I'm not sure that you're absolutely correct when you stated that the OSHA Regulations only related to workers' disease. If my memory serves me correctly, the regulations take into account the necessity for change facilities. This has nothing to do with worker exposure, but was designed to protect the worker's wife and children and they were not in the workplace. This is becoming a matter of greater and greater concern for the regulatory agencies and I don't think that they're going to be bound by the fact that they're supposed to look after workers only.

The third recommendation would be that products where the asbestos is not "tightly bound in" should be abandoned. Mr. Gabrielson has pointed out that some already have. Not voluntarily, I can tell you because I was in on the whole question of getting the contractors in New York who were spraying asbestos all over the city to have the Board of Building Departments ban this practice. I'm against this kind of action. I think that control is, by far, more acceptable in our society. But I was at a meeting at which the City Health Commissioner told the contractors, in the presence if I'm not mistaken, of a number of J-M officials, that if you don't do 1,2,3,4,5,6, we're going to have to put you out of business. For the next six months, they went right along and did what they wanted. So whenever there are products, which by their very nature lead to hazards, I would strongly suggest you abandon their manufacture.

As a corollary to this, I think that the asbestos industry has to now recognize that it should have responsibility for end-product use. That would be recommendation number four; responsibility for end-product use. I don't mean "legal responsibility" because there are going to be third party suits. They're a bloody nuisance and they're expensive to you and they're difficult for everybody.

much more control with the safe use of your products. You are in a better position to educate the user as to the methods by which such products can be safely used. When the product leaves the factory door you are in a sense, still responsible. I think the attorneys among you will tell you that, but as far as I am concerned it's from a public health point of view.

Number five: I think you are responsible to make amends for the mistakes of the past, the deaths and diseases that are the result of extraordinarily high exposures in the 1930's, 1940's and 1950's. That was a mistake, but people were injured, people died and people are still ill and will die. You have a responsibility, in my opinion, of making reparation for those who have been injured.

Number Six: I think you have the responsibility of utilizing the most feasible technology. Since there is no known threshold, I believe you have the responsibility, from a public health point of view and from an ethical point of view, to use the best technology available. The best available to you, at least as a floor, not what the least efficient manufacturer in the world can do or even wishes, wants to do. We have a public idea of the best and not the worst. And here I'm not sure that what has been outlined in the [illegible] proposal will suffice. I know already the labor unions are thoroughly amazed at the position of the AIA. In this regard they are planning to combat it from the point of view of the voluntary use of information. The voluntary use of technology has failed them in the past. Might it work in the future? Yes, anything might happen; but if previous experience is any guide, it's not going to happen.

Let me tell you an experience that I had. When the OSHA Standard for Asbestos came into effect on June - July 1, 1972, it called for every industrial user of asbestos to do at least one dust count in the next six months. One. Not too much to ask. One. I waited then until November 30, 1972 and I sent a

letter to all insulation workers in the country asking them about the number of dust counts that they had personally seen in the previous six months. I found that roughly 4% of the workers only had seen dust counts done. Now this was law.

I learned this morning, to go further, that even a company as knowledgeable and as responsible as Johns-Manville still allows the use of the technique that gives fiber levels of up to 65 fibers/ml. No dust counts appear to have been done until the law came into effect and furthermore, they don't label their product.

So that's the question of voluntary compliance; you devise very good, effective practices and deposit them somewhere and hope that the socially conscious will come into this place and say, "Please tell us the best way to do it, the best way possible without regulations, without controls, without statute." I'm not sure that will work. As far as the unions are concerned, this has certainly not struck them in a way that would give them great enthusiasm.

Finally, I think you have the obligation now of doing research that I put down as "technology for the future". In the United States, I don't know about Great Britain, we know we have in place over 25 million tons of asbestos in our buildings, refineries, chemical plants, etc. These are products made since 1890 and now in place. One day these buildings have to come down. One day these refineries are going to change over. One day they'll be renovated. And at the moment, the technology for waste disposal, for renovation, for repair even, is not available. You go into a building that has been sprayed with asbestos and have a worker break into the surface to do plumbing work or electrical work and you take some counts and the place has high levels. The technology should be sought now for what is going to happen in the future with demolition, waste disposal and repair. This is primarily an industry/engineering job. It's not going to pay very well, except with the companies that get the contracts to do it later.

This again, I would strongly recommend to you. I think that's about what I have at this moment.

Dr. Kotin: Three mini-questions, if I may.

Dr. Mrak: You still have the floor, Paul.

Dr. Kotin: Thank you. The three mini-questions relate to that one recommendation relative to "bound" or "unbound" and "responsible product" or "less than responsible product". Let me just pick three. I realize I'm putting you on the spot and I will get the answers off the top of your head: brake linings, built-up roofing and asbestos-cement pipe. As of 4:05 today, how do you view them as a general population hazard? This is moving away from the workplace and moving into the 220,000,000 people who are exposed to them as part of their daily life.

Dr. Selikoff: I'll go in reverse. The A/C pipe. We may get data, we don't have it now, that some disease has resulted from past practices. I see nothing, I have heard nothing to date so far, that would lead me to believe that this is a sizeable problem, especially if what I hear called the "aggressive water index" is utilized. There would, perhaps, be some places where you're not going to be able to sell A/C pipe. From what Mr. Robeck has just said, which amazes me, there are some circumstances where this (corrosive attack) can give not only a large number of fibers, but fibers of small and large dimensions. You will have to become sophisticated and learn when your product can be used and when it cannot be used. We see this all the time. We see products that say "not for use in" or "we do not recommend this use in". I think the occupational hazards can be well-controlled. You have not yet begun to look at this and yet the levels are already low for most practices. Should you put your engineers to work on this, I'm sure this is a soluble problem.

The second thing is the built-up roofing; there I already know the answer. It's another study. We were interested in cancer resulting from the

use of tars and asphalts in roofing work. As you know, tars can give skin cancers among roofers and we later showed it could give lung cancer and bladder cancers. Well that's no great discovery; we knew that there are many carcinogenic hydrocarbons in roofing materials. What we did was to make a list of every member of the roofing workers union in the United States on January 1, 1960. There were 6500 men. We have followed all 6500 to the present. Some 2500 or so have died and there is an increase in lung cancer, bladder cancer and so forth, but in the 2500 deaths I didn't see one mesothelioma, not one. Now lung cancer could have been due to benzopyrene or any of the polyaromatic hydrocarbons. But if there was enough asbestos exposure in built-up roofing to give a significant hazard due to asbestos, I would have seen at least one mesothelioma. I didn't in 2500 consecutive deaths and these were all people who were in the union in 1960 and incidentally, had to be in the union also to enter that cohort in 1951. So these people were 25, 30, 35, 40 years from onset of their work and I didn't find mesothelioma. So I know that there is not a significant increase although I can't prove that there is none. In the next 2500 deaths, there may be 1 or 2, but certainly there can't be any great asbestos hazard with built-up roofing. There we have good human data. By the way, we had to do a lot of work to do this and this is the kind of thing that asbestos companies should have been doing over the years.

The last with regard to brake lining. This is a disgrace because here is a problem that's soluble fairly easily and nothing was done over the years. We have in this country at this time over 1 million men who are either regularly or intermittently doing brake repair and brake maintenance work. I don't know what the turnover has been, it must have been immense over the years. These men have been exposed to levels of anywhere from .3 to 20 fibers/ml, which translates as you know, 20 fibers/ml is 20 million fibers per cubic meter. A brake repair worker inhales, like most workers somewhere around 8 cubic meters in an

[illegible] would have been inhaling 160 million long fibers, that is over 5 million, in an 8-hour day, by taking the air gun and blowing out the dust. Nobody told this man from 1930-31 to the present time that he should reverse the air flow in that hose to suck out the dust instead of blowing it out. As a result, when we examined brake repair workers, in a significant proportion we find evidence of asbestosis. More than a dozen mesothelioma have also been reported in brake repair and brake maintenance workers in a number of countries, so that this is an unhappy situation into which we have fallen. At the same time, if you look at the industrial hygiene of this situation, there is so much room for improvement that I would hesitate to make any projections until I see what can be done on the basis of better industrial hygiene. Simple things like using wet cloths instead of dry cloths, vacuuming instead of blowing, etc. So that here I think we also have room for hope. I only have one caution. Let me tell you that caution.

There's a paper coming out in June from the Connecticut Department of Environmental Protection by Mr. Brockman and his colleagues, in which they report a mesothelioma in a tollbooth collector. Now here we have people who come to a halt by applying their brakes when they come to the tollbooth. They measured the background levels of airborne asbestos by optical microscopy and electron microscopy in three Connecticut cities backgrounds and at tollbooths. They found that the levels at the tollbooths were at least three times as high around the city background counts. I think again that your engineers are going to have to look at the question of how we contain asbestos and minimize exposure and contamination of the environment. However, these are very scant data. There is only one tollbooth collector with a mesothelioma that I'm aware of. There are only one set of measurements, but they should attract the attention of the industry to see immediately what can be done to correct this situation by engineering means.

Dr. Mrak: I'd like to raise a question about the utility of animal experiments. I brought this up because I have seen data on noise, darkness, proximity male to female, ad-lib feeding, males drinking less water than females the ammonia from animal wastes, altogether about 15 or 20 environmental factors that might be construed as being "carcinogenic." Here we are working with EPA to improve our environment, then we're putting animals in the lousiest environment in the world to run cancer tests so that we can see what is happening to us in a better environment. Can you answer that?

Dr. Kuschner: I think that Dr. Mrak has explained why we use controls that live under the same conditions. In inhalation experiments for instance, the controls are handled in a fashion which involves sham exposures and exposures to the same conditions to which the experimental group is exposed. We recently concluded a series of exposures to dimethlcarbamyl chloride. In the exposed animals, at one part per million, we got cancers of the nasal cavity in 94 out of 98 test animals and this is a tumor which one doesn't see in thousands of rats and we found no tumors in controls. Now I think that it's hard to attribute such results to the mistakes of manipulation, although there are some experiments in some species in some tumors where one can evoke them by spitting in the control box. This is not one of them.

Dr. Mrak: I didn't mean to put you on the spot on this, but I have been disillusioned in sense that the mice may be telling me what has happened with your product.

Dr. Cooper: I want to make one correction. Dr. Selikoff "pointed the finger" at Johns-Manville for permitting the use of a tool that generates 65 fibers/cc. For the record, I want to say that this was not a Johns-Manville operation that was being tested. It had nothing to do with Johns-Manville contract or contractor.

Dr. Selikoff: He owed me one and this is as good a time as any.

Dr. Mrak: Joe Jackson has something to say.

Joe Jackson: (President, A/C Pipe Producers Association) Dr. Selikoff, I am going to take the adversary position and correct what I think is misinterpretation of data. One: to the best of my knowledge, none of the member companies, and I can only address myself to A/C pipe, none of the member companies recommend the use of abrasive disc saws. They published this in their installation manuals and this action was taken in 1973.

Secondly, we have taken not defensive research but offensive research. It was the A/C Pipe Producers Association, through it's member companies, which funded the AWWA Research Foundation's "Study on the Problem of Asbestos in Water" for the purpose of lending credibility to the work and to isolate what research needed to be done. I think that Gordon Robeck would confirm that we have been very diligent in following up and insisting that the research be concluded at the earliest possible time.

Thirdly, the work that Dr. Cooper reported was funded by the A/C Pipe Producers Association for the purpose of ascertaining what the fiber levels were from A/C pipe field operations. The abrasive disc saw was put in there so that we could quantify what we already subjectively knew as well as to reaffirm a great deal of work previously done by Johns-Manville in determining fiber levels. I think this is again, positive research.

Fourthly, we as an industry have voluntarily included in every national product specification, that would include ASTM, AWWA, any of the other specification writing bodies, guidelines for the use of asbestos-cement pipe in aggressive water.

Turning the tables on the scientific community, why won't the doctors, why won't the regulatory people address the real problem in water supply. It's not asbestos-cement pipe, it's not ductile iron pipe, it's not PVC pipe, it's aggressive water. It was concluded in 1974, I believe the work was done by Schroeder, that the cardiovascular disease death rate was twice as high in cities

where the water was softest than in cities where the water was hardest. And CVD is still the number one killer in the United States. I'm just trying to say that I think there are some points that have been misconstrued. Thank you.

Dr. Selikoff: May I add something? Mr. Jackson said some things that pointed to "misconstruction". When we were talking about defensive research, I wasn't talking about the A/C pipe manufacturers but about the asbestos industry in general in the past. If there was misconstruction to indicate that I meant the A/C pipe manufacturers, this of course, was not meant. Indeed, I think I stated in relation to Dr. Cooper's report, that I congratulated the A/C pipe manufacturers in this regard.

Dr. Mrak: Thank you, Dr. Selikoff, I hope that you don't mind me for trying to be a brutal chairman. Dr. Kuschner.

Dr. Kuschner: I think I must pick up on Dr. Kotin's three mini-questions because they relate to what I thought we were going to concern ourselves with. I think it might be productive if we did spend the rest of the time limiting our concerns. All of us here, will concede that every bit of data that Dr. Selikoff has presented to us in relation to occupational exposure is worthy of note and deserving of the most active kind of intervention on the part of the government, on the part of industry, on the part of regulatory agencies and on the part of the unions. I stated in my remarks that I thought the hazard of cancer in the workplace was totally and socially unacceptable.

I think that what concerns us at this meeting is population exposures resulting from the utilization of asbestos products. When we look for the evidence of hazard at low levels, there we find we do not have any data that would indicate a risk at the current levels of usage. I think that's what Dr. Kotin probably meant in asking those questions. I don't think that Dr. Selikoff has indicated any different feeling. He's indicated the question is not settled.

It would be worthwhile having it made clear that the neighborhood cases

and the familial exposure cases, I think Dr. Selikoff would agree, are not necessarily low-level exposures. He indicated in his talk, that the exposures might be quite high, even though of short duration. There is an old toxicologic law which you're all familiar with, Harber's (phonetic) Law which is something like dose times time equals an effect. Even in the case of radiation this is true within certain limits, although very short bursts of radiation are not as hazardous, nor is very extended radiation hazardous. Still, one can get a dose times time effect and certainly in asbestos one would expect that would be so.

Peak exposures, then, are of importance as he's pointed out. But that is not, I think, a major issue in terms of general population exposures. I know of no evidence that the low level exposures to which the general population is subject are hazardous. Indeed, the New York Department of Health, I think now questions the wisdom of having banned asbestos spraying, if only because the exposure of the workers probably could have been controlled, and the exposure to the population is at a level which might be considered trivial.

In that regard, I'm a little worried about the tollbooth collector, just as you were. He is only a single tollbooth collector and I would be very much more sanguine about that mesothelioma if Dr. Selikoff had collected the occupational history. He might have turned out to be that fellow who worked for Raybestos for six months, but forgot about it especially since the levels at the booth were only three times what the general urban levels were and we have already heard that those are orders of magnitude below what workers are exposed to in hazardous situations.

I would think that the question still before us, and one which is a very real question, is "are the levels to which the general population is unquestionably exposed either by ingestion or by inhalation, and inhalation may often mean ingestion, 20 years from now going to blossom into a spate of tumors?" I don't think we have any reason to believe that and I think that this is a

statement which is becoming more and more capable of being made with confidence.

Gordon Robeck may be able to remember, I don't recall the committee discussions that he's referred to, there was some very real consideration given to those population groups in which asbestos-cement pipe had been used for 40 years or more. He's probably more familiar with those instances than I am. These are test populations. They may have received doses which are not below threshold in the ordinary sense, but which, as Dr. Selikoff has pointed out, may lead to tumors after a great latency period. This is one of the effects of reducing dosage; you not only reduce the numbers of tumors but more importantly, the latent period with which the tumors evince themselves is beyond the normal lifespan in which case they probably are of very little interest to us since post-mortem tumors are notoriously unhazardous.

Dr. Mrak: Mr. Robeck, will you say something on that?

Mr. Robeck: No, other than we're conscious of all of these factors and trying to study a variety of installation ages and make sure that the people weren't subjected to any other insults of a similar nature.

I will say in general, that the asbestos fiber levels were very low in the Connecticut study and certainly far lower than where we have 32 million or so fibers per liter in places like Montclair, Florida. You have to be careful in jumping to conclusions from these kinds of limited tests.

Mr. Cross: Mr. Chairman, I'm Alex Cross and I'm here today in the capacity of Director of the Asbestos International Association and I thank the A/C Pipe Producers Association for the invitation to be here. I wouldn't have spoken, unless in effect, put on the spot by Irving Selikoff, who made various anonymous references to things I'd been connected with.

There are a number of points which from, if not the international, certainly from the U.K. experience, may be relevant to the discussion today. I would like to put one or two things straight for the record.

To start off with, I can reassure Dr. Selikoff that there are very good reasons why there should have been gaps. He says he was surprised to find gaps in the area of control in the U.K., although he understood there had been controls for many years. If you understand the system under which we operated from 1931 onwards, it was designed to cover only certain parts of the industry. The gaps are the ones which were shown up by the inadequate coverage of those regulations. Acknowledging Dr. Selikoff's point that you need to have a period of more than 25 years to see what the effect is, we've had since 1933, over 30 years with those regulations. It's been quite clearly demonstrated that where controls have been statutorily applied and enforced, however inadequately in light of our present ideas, they were effective in reducing disease. It's in those areas which were not subject to those regulations where the disease continued to develop and where we are going for some years still to come, "reap the whirlwind."

So we produce from those controls, improvement, but not elimination. With that in mind, our present standards and forms of control are both tighter and, as far as we can tell, all-embracing. They cover every employed person whose work, whether in manufacture or use, may expose him to harmful levels of dust.

One of the things that we are getting a little bit fed up with in the U.K. is the way we are being continually held up, or rather the way in which regulations and methods of control in Sweden and the United States are held up as the example of what we ought to be doing. We know very well that we ought to be held up as examples of what you ought to be doing.

Looking through the list of points which Dr. Selikoff kindly put out in response to Paul Kotin's request, I reckon that to a considerable extent, the British industry and many of our European colleagues have been meeting these. We in the U.K. certainly have been meeting most of these points very conscientiously. One of the worries, however, is that even when you've met and complied with those points, you still don't satisfy the pressures. It is one of our problems getting

a balanced perspective and judgment between heavy occupational exposures and the very uncertain, tentative, environmental exposures, where in my estimation, a great deal of misdirected effort is going.

We need to have more and more clarification between the "very high" past exposures in occupational situations and what we might call "para-occupational" exposures. You mentioned earlier, Dr. Newhouse's work. This was the factory which, Dr. Selikoff was delicate enough to refrain from mentioning, which I have known intimately since 1947. I know when I went there first I was told, "We used to have an occupational disease here, but it's now controlled; we have dust extraction equipment." Unhappily, this was not true. It was certainly very much better than it had been in previous years.

I've talked to people who never worked in the factory, but who remembered as children thinking that the people who were coming home from work had been in a snowstorm. Now, I suggest to you that people who lived on those streets where those men walked by and where there were no forms of dust extraction before 1930, those people were not living in the sort of environmental exposures we're talking about now. We have no measurements, we can't prove these figures, but I think it's very unlikely that they would not have been living 24 hours a day in exposures which we would not regard as acceptable in occupational situations. So when we talk about the occurrence of mesothelioma now, and Newhouse's work and many others have been covering people from the late '50s up to the present time, we're talking about people who, in the main, were exposed 30, 40 years to those sort of conditions. There's a great deal of difference, I suggest, between what we are now thinking of as environmental exposures and what were then.

I would commend to you, finally, two points in thinking in terms of our present day problem ... not the problems which have occurred in the past, about which we can do nothing other than observing and fulfilling our obligations with regard to those people. I think that the U.K. approach at the moment

is a constructive one. It's still one which is consciously aware of the fact that we still have a lot more knowledge to go on. We are still working to the two fiber standard, but our Health and Safety Executive recently introduced a requirement that, wherever it has been shown by practical experience that lower standards can be worked to, then this becomes the standard. In other words, we worked to the lowest practicable standard. I think they use the word "reasonably practicable".

Now, this is a good old British compromise. It is why in fact, our French friends call us "perfidious Albion", because we've always been evasive on compromises. It is "the best we can do." "Reasonably practicable" means that it has to be both technically feasible and within a reasonable expenditure of effort and money. In the regulations for dust extraction this has to be put in when it is practical, whether it is reasonable or not. If it's "engineeringly (sic) practical", then "reasonably practicable" is the criteria. This, I think, is not a bad way of going about it. Thank you, very much.

Dr. Mrak: Thank you very much. Is there anything that bothers you, Dr. Selikoff?

Dr. Selikoff: No, I thought it was very reasonably put.

Dr. Mrak: Mr. (Etienne) Van der Rest

Mr. Van der Rest: (Managing Director, Eternit, S.A.) Well, I should say that already I'm very long so I will try to be as short as possible.

I have only one question for the Dr. Selikoff. I don't know if in the States the reaction on the last meeting of the International Agency for Research on Cancer has had the same influence that it has in Europe. I should think in most of the newspapers, that the statement you made in front of the press, when you said that there was a risk that in the States I'm just quoting, "... there should be 200,000 deaths from lung cancer and 50 or more thousand deaths from mesothelioma bound directly or indirectly to asbestos disease", has had a

tremendous influence.

My question is very simple. Most of the figures you have given are related, of course, to people who have been working 20 or 25 years ago in the industry. Of course, the precautions were not what they are today, perhaps because not only the asbestos industrial but the medical world as well was not aware of how big the danger was. So your statistics are based on 25 years ago, and today, the situation is entirely different.

Secondly, most of the diseases you have observed have been made on people working with insulation. I was very grateful and very interested to see that you say that for asbestos-cement, for instance, the danger is very low, if non-existent. My question is very simple and very short. How can you extrapolate from results which are bound to work conditions which prevailed 20 years ago with people who were specifically involved in a particularly dangerous business?

The last question. You say, and I appreciate this too, that asbestos does not have to be banned. That's quite true. But due to the fact that you say that you don't want to ban asbestos, isn't it very dangerous, especially when you don't have firm figures, to estimate figures like 250,000 deaths possible from asbestos, which of course the press, which is always looking for sensational news, takes as fact?

Dr. Selikoff: Those are the facts. We've done five cohort studies and other researchers have done similar investigations. In virtually all of them, 20 percent or more deaths are due to lung cancer in these groups.

In our studies, five, six, seven percent of deaths are due to mesothelioma. Now, the British disagree with us and Newhouse and Berry have recently published a projection that there will be somewhere between nine and eleven percent of deaths due to mesothelioma. Our figures are lower, they're somewhere between five and seven percent.

The Public Health Service in this country has calculated that there are currently alive, and I can only talk about the United States, approximately 1 million men and women who either are now, "asbestos workers", or who in the past have regularly worked with asbestos and are retired or have gone to other trades, etcetera.

The statement was made that if our experience of the past holds, it will hold in the future. Now, I don't know if it will because somebody might develop a cure for lung cancer; in that case, we'll throw out the data. But if there is no cure for lung cancer and if the rates that have been established in the cohort study not only in insulation work, but in a very extensive study at the Manville factory of Johns-Manville, the amosite plant and others as well, if there is no change, that 20% figure will hold for the 1 million "currently alive, presently employed or previously employed" asbestos workers and there will be 200,000 deaths of lung cancer. It's a terrible figure. If our experience with mesothelioma holds, and it has so far for each cohort we've studied, and we apply it to the one million people who have in the past or are currently working with asbestos, there will be at a minimum 50,000 deaths of mesothelioma, as these people die somewhere in the next 40 years or so.

These are very unhappy figures, but unfortunately they're correct. If you have any additional or alternate figures, I certainly would like to see them because in Britain as well, lung cancer rates of those currently alive and employed or previously employed asbestos workers are exactly the same lung cancer rates and they say somewhat higher mesothelioma death rates. It will be the same in Britain and the same in the United States. These are terrible figures. I agree with you. I have made it perfectly clear that we're referring to the exposures of the past and hopefully they will never again exist in our country, in your country, in Britain, or anywhere in the world. But these are the facts.

Now, having answered that question, I would like to gratuitously add something else to this list. I would add point number 9. It is the responsibility, in my opinion, of the industry to develop appropriate surveillance mechanisms for currently employed or previously employed asbestos workers. Maybe we'll be able to save a few lives from lung cancer. I think it's possible we will. We certainly can save lives from asbestosis, and mind you, seven percent of asbestos workers in the past have died of asbestosis. It's a serious disease, and yet with what we now know, with antibiotics and so forth, these people need not die of acute pulmonary asbestosis. So surveillance of asbestos workers is another responsibility of the industry. How we do this will have to be worked out, whether it's along the lines of what Mr. Gabrielson has said, or what others like Koch is trying to do in San Francisco, I do not know, but we'll have to develop mechanisms.

Finally, if you ask me for a safe level, I know one. I'm not facetiously saying I know it's zero; zero is a safe level, sure. There is a safe level and it is the level below household contact exposure. Now, household contact is surely below any manufacturing facility. I think it's above neighborhood exposure, which we haven't very well measured. It exists. We know that there is and has been risk of mesothelioma among household contacts. So somewhere below the level of households we will have some knowledge, long term, of a safe level. I strongly urge the industry, we may even want to end it there, to determine what the levels of exposure are in households of asbestos workers.

Dr. Mrak: Thank you very much. I thank the panel, it's been a very stimulating and exciting one.

Dr. Kotin: Thank you, Emil. They saw that I really didn't oversell you in terms of your ability to handle the prima donas of the rostrum and the people in the audience, as well.

Joe, may I make a few comments? This is the second year I've had the

privilege of appearing before AACPP. Even if you had met in Denver, Dubuque, Iowa; Paducah, Kentucky, I hope I've affronted nobody, I think these discussions are invaluable. I certainly, with no portfolio at all, would like to recommend to your Board of Directors and I think the dramatis personnae can change annually, that this be an annual presentation; a day devoted to the issues of asbestos and health in general, and more particularly, the interests of the Asbestos-Cement Pipe Producers Association.

Let me thank each of you, my fellow panelists, for responding so graciously to my invitation that you participate. I can only say that we couldn't have programmed it better if we had tried. Thank you for your attention.

Chrysotile Fiber Supply - The Long Term Perspective
by
Dimitry Poutiatine

Mr. Poutiatine is Director of Marketing for the Asbestos Fiber Division of the Johns-Manville Corporation. Appointed to this position in 1976, he is responsible for the sale and marketing of asbestos fiber throughout the world.

Mr. Poutiatine joined J-M as a Sales Engineer in the International Division in 1955. In the ensuing years, he served as Supervisor, International Fiber Orders, Manager of Foreign Fiber Sales and in 1962 as Manager of the International Asbestos Fiber Department. In 1967, he was promoted to Product Marketing Manager of the Asbestos Fiber Division and in 1972 was named General Sales Manager for Asbestos Fiber, a position he held until his present appointment.

I wish to congratulate you on your organizing skills as well as on your choice of locale for this meeting. I also wish to thank you for inviting me today and for the added honor of letting me speak to you today about the asbestos industry as seen through the eyes of a supplier.

In this capacity, I find my assignment today most challenging because my first objective is to establish with you, the users of asbestos, a degree of credibility. And having done so, to warn you that my crystal ball is rather muddy and it presents the best educated opinion as of today.

Surprises have become so commonplace in our life, and the asbestos industry has been no exception, that one almost panics when asked to talk about a subject that he thinks he knows and understands.

One item I can talk about with some degree of confidence is the past. Herewith are our best estimates of asbestos fiber shipments from the several major producing areas of Canada for the year 1976.

Quebec shipped in 1976, 1,374,000 short tons. British Columbia and the Yukon 185,000 tons, Newfoundland, 98,000 tons and the others, mostly United Asbestos, 37,000 tons for a total of almost 1.7 million short tons of asbestos shipments from Canada in the past year.

Our estimate of the world production of asbestos in 1976, taking into consideration all the major producing areas, gives the following figures. I must say that I have seen other figures on the world production and there is some small disagreement here and there but the interesting thing is that the bottom line is remarkably in agreement throughout the world. So if you'll bear in mind that this is our Johns-Manville estimates and there may be some differences. Canada, as I mentioned, supplied 1.7 million tons; these are all in short tons: United States 123,000, South America 80,000, Europe,

excluding Russia but including the Nordenham Operation of Asbestos Corporation, 355,000, Asia in small mines here and there 35,000, Australia about 60,000, Africa about 600,000, Russia we estimate at three million and China 200,000 for a total of about 6,150,000 tons.

The Russian and the Chinese figures are mostly academic because the actual Russian production of asbestos has little to do, either with the world requirements or the Russian export policy.

We have included in these figures an estimate of Russian production of group seven asbestos which heretofore has been omitted from the usual statistics, and for which we believe there is little demand inside the Soviet Union. Their own internal demand is known to be huge and growing. Their exports have been fairly stable in the last five or six years on a total basis.

But their sales by country have fluctuated somewhat, depending on their own political and economic considerations. Another way of looking at the asbestos production statistics for 1976 is by imagining a pie cut up into the various sections described previously.

The interesting part here, in my opinion, is the role that Canada plays. It's really not all that big on the world basis, although Canada does supply almost every country of the world except Russia and China.

The last four years have witnessed an apparent balance between the supply and the demand for asbestos. The reason I say "apparent" balance is because during that period, the entire world production has been sold, and there were no major shutdowns of manufacturing facilities due to fiber shortages.

To be sure, there were many reformulations and realignments of suppliers ... but no catastrophic shutdowns. Under such conditions it is rather difficult to estimate the real demand, for obviously if it exceeds supply, something, somewhere has to give.

Furthermore, we always have to take into consideration the economic

cycles in some parts of the world. For example, as all of you know, we have been experiencing for the last few months a general worldwide recession in the asbestos-cement industry and this has certainly reduced the pressure on demand, and has allowed many companies to replenish their fiber inventories.

Therefore, if we can assume that the demand is partially dictated by the supply, do we see any signs of an increase in the supply of asbestos over the next five years and what conclusions can we draw from such an exercise?

If we go back to my original table and project it into 1982, we see the following. The shutting down of Clinton Creek will result in no net increase in Canadian production. We cannot seriously expect the development of new mines in Canada during this period.

The problems which arise in the United States as a result of environmental matters, could very easily lead to some reduction in production.

Central America may become a small producer of asbestos if the Pegasso Project in Mexico is ever put in operation.

By 1982, the expanded production of Cana-Brava in Brazil and the opening of the small Los Brisos deposit in Columbia, would account for the increase in production in South America if both were carried out on schedule.

The possibility of increasing production in Europe depends on the opening of the Zindani deposit in Northern Greece. It has been known for nearly 20 years during which it was thought to be started and stopped several times. Maybe this time it's for real.

The Soviet Union is scheduled to complete the development of the 500,000 ton Kiembayev deposit which is being financed jointly by Communist countries of Eastern Europe. This could result in substantial increases of exports of Russian asbestos, but we're not forecasting them because we are assuming that their own increased demand will not permit any major expansion in this direction.

Thus, at best, we expect that world production of asbestos will increase by 700,000 tons over the next five years, or an average increase of 2.3 percent per year. However, nearly all of this added production will come onstream at the end of the five year period if it is on schedule.

In the meantime, no losses of production can be tolerated, whether for political or technical reasons. In summary, I would have to say that the next five year period will show no more than a total of 12 percent increase in the world production of asbestos. Therefore, total demand can hardly grow by more than 12 percent over the same period. However, actual availability of fiber may well depend on the economic conditions in some of the larger consuming countries, or on environmental regulations in the more industrialized countries, or both. Arithmetically and logically we cannot expect a substantial growth in the asbestos industry over the next five years.

Now if the supply for asbestos is going to be fairly level, how can the industry survive if demand is not allowed to increase?

Well first of all, we talk of a rather short five year period during which new viable deposits may be discovered. These could result in an increase in supply by 1984 or 1985.

Secondly, we must be realistic and recognize that severe environmental restrictions in some countries could reduce the asbestos consumption in their area and make more of this fiber available to others. Sweden is one such example. If what I'm saying is true, then could there be in fact, a shortage of fiber and if so, in what grades and what can the users do to insure for themselves continuing and adequate fiber supplies?

Rather obviously, the longest grades such as grades four, most commonly used in the manufacture of pipes, would be those mostly likely to be affected first. However, all of you will probably agree that it is easier to substitute group four fiber in asbestos-cement sheets than in pipe, and yet a

great deal of group four fiber is still used in the production of sheets.

We like to think that greater efforts will go into research work to increase the use of shorter grades of fiber where it is possible to reduce the content of group four. On the other hand, we must assume that over the short term period of the next five years, the existing fiber stocks will permit most of the established manufacturers to obtain adequate supplies.

If any problem of supply does arise it will be for new plants which may come onstream without properly covering themselves from existing sources.

As another alternative, what would happen if business were to boom at once in all the major industrialized countries of the world, duplicating more or less events of 1974?

The answer is rather obvious. Asbestos would be in short supply along with dozens of other materials. Our consolation would be that asbestos containing products would contribute to a relief of shortages of other products.

Now from what I have said so far, one might get the impression that the suppliers of asbestos are in complete control of the situation with no problems and with customers lining up awaiting their meager allocation of fiber. If that is the case, then I owe you an apology and let me quickly correct any such misconception. Although I am sure that asbestos mining companies do not have a monopoly on problems, they do have a fair share of them and most of them are common to them as they are to the users of asbestos. However, one new concern which has developed in recent months and which was not of substantial magnitude in the past, is the excitement generated by the upset victory of the Parti Quebecois in Canada.

Speaking for my company and for our operations at the Jeffrey Mine in Asbestos, I can say that we have done as well as we possibly could in conducting our labor negotiations, in overcoming landslides, in controlling dust and meeting modern environmental standards. But now we must join others

as we watch the political developments in Quebec. We understand the government's concern for the high level of unemployment in that Province, but we're not sure what more we can do as good citizens to contribute to the solution of this problem.

In conjunction with other asbestos producers, we have undertaken a study to determine whether some added production of asbestos containing products in Quebec could be undertaken profitably and thereby create more jobs. We believe, and we have told this to the representatives of the government of Quebec, that nationalizing the industry will not create more jobs.

There is another interesting and important point that must be emphasized and that has generally been overlooked. As we saw earlier, Quebec produces nearly 1.4 million tons of asbestos per year and in the eyes of some people in Quebec, they resent that no more than four percent of this production, or about 65,000 tons, is consumed in Canada and even less than this in the Province itself.

However, there are today in Quebec sufficient facilities within the Province to use as much as 80 or 90,000 tons of asbestos, if all the existing manufacturing plants were to operate at full capacity.

For a population of some six million people this potential is the highest per capita consumption in the world, equivalent to about 26 pounds of asbestos per inhabitant. This compares to a figure of some ten pounds per capita for Australia and Denmark, which are generally considered to have the highest actual consumption in the world outside of the Soviet Union, about which we know very little.

The fact that Quebec does not have such a high rate of consumption is not because industry has not tried to build the necessary equipment to transfer raw asbestos into finished products within the Province. It is simply the fact that it has not been possible to find a sufficient market for all these

products within a competitive radius of Quebec.

I need not remind you that Johns-Manville operates six different pipe plants around the United States. Obviously, it is logical and less expensive to bring the asbestos closer to the market where it is converted into pipe and represents only 10 to 15 percent of the total weight of the pipe than to ship the finished product hundreds of miles to the market and expect it to compete against other materials which are manufactured locally.

We believe that these facts have escaped the representatives of the new government in Quebec, but once they are understood, they should convince all that asbestos is not intentionally being exported from Canada at the expense of Canadian jobs.

In summarizing, the general asbestos supply situation around the world as we see it has many problems, most of which are aggravated by doubt and uncertainty.

The lack of clear manufacturing standards, the political problems in Southern Africa and Quebec, the fact than no major new and rich deposits of asbestos have been found in recent years, all of these contribute to muddying our crystal ball and making it difficult to forecast the future.

On the other hand, in J. M. we have enough confidence in the future of asbestos to continue large investments in the development of existing mines and in the search for new and viable deposits.

I can only end this presentation by thanking you for your attention and by wishing you continued success in your efforts to promote the use of a wonderful natural product.

Thank you.

Crocidolite Supply - A South African Perspective

by

C. H. Walters

Mr. Walters is General Manager, Base Metals and Minerals Division, of General Mining and Finance Corporation, Ltd., Johannesburg, South Africa. He is Chairman of the Boards of Directors of: Griualand Exploration and Finance Company (crocidolite mines), Msauli Asbestos Limited (chrysotile mines), Transvaal Mining and Finance Company, Electrolytic Manganese Corporation and various other interests of General Mining and Finance Corporation.

I have been asked and am grateful for this opportunity to address this distinguished gathering representing the major consumers of a very important component of my division, that is, crocidolite, and in particular the supply thereof as seen by the South African producers. I will attempt to confine my comments to just that - the supply situation and will not abuse the opportunity granted me to advertise the commodity by expounding its virtues and the properties which make it indispensible to A/C pipe producers.

The answers to questions about supply in which you will be interested must basically be the reliability you can place on long-term availability and in the interests of brevity I should like to deal with these under the headings:

ORE RESERVES

THE INFRASTRUCTURE

HEALTH ASPECTS

THE SOCIO-ECONOMIC SCENE

ORE RESERVES

The Cape Crocidolite fibre occurs in general in smallish deposits that exist along a line that stretches practically uninterrupted from the Orange River in the Northern Cape Province to the border of Botswana some 400km to the north. Most of the deposits lie beneath varying thicknesses of sand and those currently being worked are concentrated around or very close to the outcrops or areas that were originally easily identified from surface features.

In the interests of economy prospecting work has and still is concentrated in reasonably close proximity to the earlier finds where the extraction plants have been erected. The significance here is that it has been possible over the years to continue finding additional ore-bodies within striking distance of the existing plants and thus economize.

Ample evidence exists of deposits more remote and should increased reserves become necessary as required by demand, an intensified programme of

drilling will be all that will be necessary. The general trend is to work on a 10 to 12 year ore reserve in sight; this is purely an arbitrary level and judged on demand patterns.

Our group has concentrated in recent years on increasing production by obtaining higher rates of recovery from the raw ore. This does result in shorter grades and more highly fiberized grades being produced, but it makes economic sense and we have been singularly successful in containing fibre degradation. Thus in addition to ample reserves, current lives have been extended significantly.

South Africa is at present the only significant producer of crocidolite. Of the total South African production, amounting to some 350,000 metric tons, about 50 percent would be crocidolite.

Since its first significant introduction in the world markets shortly after World War II, it has enjoyed a steady growth to present consumption of 200,000 tons per annum. In 1963, 1968 and again in the early seventies, the industry experienced dips in demand for various reasons; a quick reaction to either decreased or increased demand is a feature of the producers. The flexibility stems mainly from the geological nature of the field, a multiplicity of small deposits which can be closed down or re-opened as required. The area is generally dry and flooding of workings during dormant periods poses no problems, except of course, financial headaches.

We have a duty to be responsible and reliable suppliers to the pipe industry and this may be an ideal occasion to point out to what extent the producers are dependent on the consumer for timely feedback of consumption trends to enable forward planning. It amounts in fact to an appeal.

THE INFRASTRUCTURE

To many of you, the area in which crocidolite occurs is known. As I have mentioned before, it stretches over a distance of some 400 km N-S to the

Botswana border. The deposits underlie a range of hills which is the eastern-most of three parallel ranges some 40-60 km apart, the other two being respectively the major manganese and iron ore ranges of the entire country.

This huge concentration of minerals which has been actively mined for the last half century (in some cases longer) has been responsible for a sophisticated and fully integrated infrastructure with road, rail, civil and energy facilities adequate for any demand which may be placed on it.

The mining field is situated in a reasonably well-populated area, albeit a population of largely agriculturally oriented people. Provision for training facilities to equip the locals for a more industrially-oriented life has unfortunately been neglected to an extent in the past. The reasons for this can be sought in a very strong resistance to mining and milling work and also to a ready and steady supply of migrant labour who had received previous training in the other mining fields of South Africa and neighbouring countries.

These circumstances have changed dramatically in the past few years and while slow, progress is being made at ever-increasing rates. The policies which led to the changed circumstances will be touched on later.

Finally the area is equidistant from all the South African Ports of Saldanha, Cape Town, Port Elizabeth, East London, Durban and Richards Bay - also from Maputo in Mocambique. This feature lends flexibility in exporting.

HEALTH ASPECTS

The well-publicized dangers to health by exposure to blue asbestos have again received much attention by the news media in the recent past. We cannot and we do not ignore these admonitions. The threats in this market place are real. Our efforts for the external scene have been concentration on numerous methods of packing different materials, containerizing, etcetera. This search for the ideal is ongoing and enjoys top priority.

The internal scene is that South Africa has a very long history

of mining and milling with all its attendant dangers, not the least being the industrial dust hazards and consequential impairments to health. We maintain a policy of full awareness that any industrial dust is potentially injurious to health and close attention is constantly paid to all aspects of dust suppression and prevention to our workforce in general; this is second nature. In the case of asbestos we recognize the additional responsibility of having to constantly expend efforts to maintain realistic perspective to the world outside the industry. Without in any way minimizing dangers, we recognize that alarmistic reporting and erroneous interpretation of facts tend to induce a loss of perspective and common good sense in otherwise perfectly rational people in all walks of life.

We applaud and subscribe to the efforts by the many eminent people of the asbestos world to maintain a sense of realism through the various asbestos information councils; we attempt to add to what they preach and we practice what they preach.

South African efforts in these campaigns include among others:

(1) Maintenance of an internal committee of engineers to monitor and promote self-discipline in production hygiene.

(2) Research by the National Research Institute for occupational health with specific emphasis on crocidolite research.

(3) Initiating at an early date, a symposium of world-renowned medical and engineering scientists in an attempt to standardize ideas on monitoring equipment, toxicity of mineral dusts and related uncertainties. Hopefully this symposium will lead to a more uniform pattern of thinking and a better

understanding of the problems we as an industry are facing.

THE SOCIO-ECONOMIC SCENE

My comments on the supply of crocidolite from South Africa would be incomplete if I did not sketch the paths being followed in the socio-economic structure of that country. I am no politician and I am not going to criticize, nor am I going to defend the political situation as it exists there, nor even the future situation as seen by people of various views. My comments are confined to the job in hand and to sketch the reliability of supply, the thoughts, views and actions of someone who is active in industry, particularly an industry which, like mine, caters nearly one hundred percent for the export market. We are perfectly aware that socio-economic adjustments are necessary and at an ever increasing pace to maintain external confidences where we do enjoy that luxury article and to restore these confidences where these have ceased to exist.

Our approach to the problem consists of a massive and ongoing training and development programme of all employees and at all levels from labourer to top management. Our group controls a total manpower of 210,000 employees and the task is huge. The method adopted has been to train the leader group, top management down to supervisor levels, over the past 5 to 6 years in a philosophy of management and the effective utilization of the human resources of the Republic of South Africa. We are fortunate in that our chief executive, Dr. W. J. de Villiers, has been an ardent student of management throughout his life.

This exercise, has been completed for some 75 percent of the leader group. The additional stages required to reach the ultimate goals spelled out in the following quotation, are well underway. The quotation I am referring to is from the Introduction of a book titled "The Effective Utilization of Human Resources in the Republic of South Africa." This has formed the basis

on which our training and development programme has been fashioned. I quote:

"South Africa possesses a number of particular assets which place the Republic in favourable position relative to other countries. It has cheap energy, wide open spaces, sources of labour and a favourable strategic position, but perhaps it's most important 'comparative advantage' is its rich treasures of natural resources: gold, uranium, coal and base metals and minerals.

However, to put these natural resources - in particular its vast reserves of base metals and minerals - to the best possible national use, South Africa will need a highly sophisticated technology and a high general level of managerial skill.

We therefore must raise our most important resource - our people - to a level of technological and managerial skill sufficient to give South Africa an advantage in the international economy.

These favourable factors should, however be considered against the following features of the socio-economic circumstances in South Africa:

- In the Republic, the White population with its western thought processes and economic systems, along with the Coloureds, - Asiatics and a number of Bantu peoples, each with its own culture, history and values, together face the challenges of economic and constitutional development under circumstances necessitating a solution to the problems of peaceful co-existence and improved race relations.
- There are large differences between the average levels of training and development and individual annual income of the various racial groups.

- The principal points of contact between the White and Non-white population group exist in industry, in mining and in commerce, so that the potential for friction inherent in the country's racial composition assumes critical significance in the field of labour relations.
- A high rate of economic growth, high real investment - particularly in the private industrial sector - and a high rate of increase in productivity are necessary in order to generate enough jobs for the rapidly growing population, to bring about a significant improvement in the material standard of living of the Republic's population (particularly the Non-white), and to dispel the impression that the Non-white is deliberately being denied a higher standard of living.

The South African situation accordingly offers exceptional opportunities for entrepreneurs and managers but also presents specific responsibilities.

Under these circumstances, professional management has a responsibility towards the Republic and its people for the maintenance of high levels of increase in productivity and economic growth as well as for the improvement of the material standard of living of the less privileged sections of the population without prejudice to the position of any other population group."

The treatise concluded with the conditions under which Blacks can be absorbed into spheres of employment formerly regarded as the prerogative of the Whites, as well as with the requirements for such absorption and the training and development required by the Blacks. A model for a policy in regard to the utilization of human resources is outlined in detail.

The rationale for this pattern is the belief that the optimal utilization of the leader group, coupled with a high rate of economic growth and increased productivity, will in itself create the opportunities and the possibilities for the non-white to advance to employment opportunities previously within the employment sphere of the white.

I conclude by assuring this distinguished gathering that there need be no concern about the sincerity and the ability of the South African crocidolite producers to supply the demands made on them and finally to invite anyone present who may feel so inclined to discuss with me in greater detail any of the aspects which I have been very happy and honoured to comment on at this time.

Energy and Climate - A Changing Perspective

by

Melvin A. Conant

Mr. Conant is a consultant to the energy industry and governments on international oil and nuclear supply. He is the former Assistant Administrator for International Energy Affairs of the United States Federal Energy Administration. In this position, he was responsible for policy recommendations affecting access to overseas oil and relations with consumer and producer nations. Prior to his government career, Mr. Conant was, from 1962-73, Senior Government Relations Counselor for EXXON Corporation on political and inter-governmental relations with regards to energy supplies.

Mr. Jackson, Mr. Welch, when you first asked me if I would come down to Mexico to meet your group, I thought how appropriate. We're going to be talking for the next few minutes about some very profound changes in international oil supply and many of these changes were first brought about by actions taken within this country nearly 40 years ago; changes which resulted in a very different political relationship between international oil and the sovereign rights of the people over the disposition of their own resources. So today it is fitting to be in a place which again is so much a part of this process of change.

A word as to why I'm going to concentrate so much on the North American or United States' energy picture.

First of all it is a fact that the United States per capita consumption of energy is far higher than that of virtually every other nation on the face of the earth and the volumes which we consume daily make us far and away the largest single nation in the world's energy trade.

Secondly, as a result of North American declining resources, the United States is today the single largest importer of petroleum, both crude and product.

We are so large in the world oil market that whether our imports go up and we take an ever increasing-share or whether they do go down, which hopefully will be the case, the impact of the United States energy market on world supply knows no equal.

In energy R & D we are interested in what is going on in the United States because if you add up the public or governmental sector in energy R & D, plus that of the private sector, you reach a level of expenditure which is greater than the rest of the entire free world combined in energy R & D.

Finally, as a provider of capital for a great many of the major develop-

ment fields worldwide, at least until very recent date, the United States helped finance the growth of petroleum worldwide.

But I guess we've got to say also that the United States is particularly favored with regard to the energy options which lie ahead of us.

Europe, Japan, most of the developing world - virtually all other countries - have no ready energy options at present that are really worth speaking about.

They cannot divert their economies easily or really within the next ten or twenty years from anything other than oil, while in the United States, a very massive effort could begin.

And for all of those reasons I think the eyes of the energy world are very much on the messages that are coming from the President on three occasions this week.

Like you, I was not in Washington last night or in a place where I could hear the President's message. But shortly before I left Washington I called a friend in the White House and explained that I was coming down and that I would miss the broadcast because I'd be in the air.

And while I knew that it was a document that was going to be highly classified, parts of it had been well-leaked in the past months, but still generally classified, could I, a private citizen, get an advance copy of his principal points?

And the answer, quite typical for Washington, was, "of course." I played that game myself once or twice, so I'm always hopeful when I go to a Washington contact that he will say "of course".

Let's take a look at the scene as the President is describing it. It is accurate. It is not new. It is not necessarily a case of where his own education has begun because this information has been around for a long while, but it is, I think, obvious that the President chose early on to make energy

policy the first contribution out of his administration.

And he has chosen to emphasize the facts of energy as no previous President has ever done. The basic situation is that world energy demand is almost certainly going to outstrip available supply.

It will begin to do so in the early part of the '80s, will accelerate in its rate by the middle of that decade, and unless all of us make serious commitments to the exploitation of the other options we face, our industries and our private lives are going to face not sporadic shortages by the end of the '80s but some really quite deep-seated shortages which cannot be easily overcome.

For example, in the case of oil, and if we look over the next ten or fifteen years there is no conceivable way in which our primary dependence upon oil can be shifted significantly to some other energy resource, the world energy demand today is about 46 million barrels a day. That is about 53 percent of the energy consumed worldwide.

Unless quite drastic measures are taken in conservation, in nuclear and in every other direction we can conceive of, we will be consuming thirteen years from now, some 76 million barrels a day, and the proportion which oil represents in the energy budget of most countries will not be very significantly different. Which means that the volume of oil we consume is going to go up even if we are moderately successful in conservation and other measures.

The importance of the Middle East in this picture is that under present forecast trends, by 1990, out of that 76 million barrels a day, the Middle East alone will be supplying some 46 or as much oil as the world consumes today.

Which illustrates once more the extraordinary importance of the reserves of the Middle East. If we do reasonably well on coal, especially in the United States, we could find in terms of barrels of oil equivalent that our coal which is now about 16 million barrels a day could be 30 in 13 years.

Nuclear which supplies the equivalent today of about two million

barrels a day, under present commitments for nuclear reactors could supply some 17 million barrels a day worldwide or about 11 percent.

The trend then is for ever-increasing amounts of oil to be consumed; hopefully coal, nuclear and even gas play some marginal role.

But over this period that we're talking about, because of the lead times involved in bringing on nuclear and bringing new fields of petroleum for development, providing the marketing structure, the logistic system, we can really say today that we know now the resources that we are going to be able to draw on over this next decade, decade and a half.

If at the end of that period we are to be measurably better off in oil than we are right now, it will be necessary for us to have created an exploration and development program which will increase our known reserves in the world by some 35 billion barrels a year.

If we were to achieve that, then by 1990 we would have a reserve production ratio for about 25 more years. Thirty-five billion barrels of oil worldwide is a very large amount. Especially when we contrast it with our rate of discovery, over the past two decades. How well have we done and does the past record give us some clue as to whether we can meet a goal of that sort?

Well, over the past 20 years we have discovered in the category of proven and probable reserves an annual average of about 15 billion barrels. So our record doesn't even begin to approach the annual averages which we should have as our goal, for the next decade, decade and a half.

But if you look at what has been our rate of discovery, about 15 billion barrels a year, most of that has been found in the Middle East and in the Soviet Union, and it is therefore not the source which most of us, I think, in this room would feel provides a reliable, reasonably secure reserve.

So if you exclude the successes within the Middle East and within the Soviet Union, you then discover that for all of the rest of the world over

the past 20 years, our annual discovery rate has been between four and five billion barrels of oil.

So we have a monstrous effort ahead of us. Our geologists, probably as competent as any in the world, differ amongst themselves as to whether this is in any way a realistic target.

Those geologists who persuaded one enterprise that there would be nothing found in Nigeria, were of course, proven totally wrong by Shell, B.P., and Mobile. Other Geologists -- you will excuse me if I keep referring to a company I used to belong to because I know them better -- Exxon dropped $600 million last year off the coast of Florida because the estimate of geologists didn't work out. Pruedhoe Bay in Alaska came in really because ARCO decided at the last minute, despite a kind of hapless record on the North Slope, there was just enough time for one more drilling before the winter season truly set in and they drilled and brought in North Slope.

So we cannot rely totally upon the judgement of the geologists. A very great deal of luck is involved in these matters. Other factors intervene. The cost of exploration is a comparatively small item in the corporate budget of large oil companies. It's the cost of development that can become so staggering. And if it is proven to be true that the Arctic latitudes and the offshore regions may be the more prolific over the next generation of exploration effort, then the cost of developing those fields will be gigantic.

So the money has to be found. The managerial talents have to be coordinated. Governments have to help create the environment that spurs that kind of search. All of these things have to happen more or less in concert if the end-result is to be the target that we seek. The chances are good it won't work out that well. And so let's turn our attention for a few minutes to what is going to be our most acute problem in obtaining oil placed in world trade.

I mentioned earlier that forecasts of demand of available supply based

on reserves that are now being produced tells us that by the early '80s we begin to have trouble, by the middle '80s more serious trouble, by the end of the decade some of us will be having real difficulties.

The competition between the industrial world, primarily for the oil in world trade, will zero in on the Middle East. In a way that we have never known before.

Where the competition was between companies for concessions in the Middle East, now the ballgame is changing rapidly and it's going to be competition between governments for access to that oil.

I'm involved in some of this now, it's requiring many trips, many long and quiet conversations but, I can say with all frankness that I don't know of any issue so potentially divisive amongst the nations of the free world than this coming crunch on access to energy.

I leave tomorrow to meet again with Japanese, Germans, British, French, Italians and Americans who are trying to think this thing through before the competition takes on a character which could find us dealing with each other in ways that we have not known for a great, great many years.

This competition is presently moving in the direction of arms sales, barter, food and even bringing about thoughts of military actions which in the years to come might be taken by one or another. It is as if we were now placing energy on the same level as food, water and shelter. The competition is going to be between Europe, which has no energy option except the nuclear and that is as far down the road to them as it is for us, and with Japan, and with the United States' seemingly insatiable capacity to consume increasing amounts of oil; but there will be another actor in this scene as well, and for the first time the Soviet Union in this period will be competing for Middle East oil.

Up until now, but probably only for the next five years, the Soviet Union has been energy independent. They have treasured their invulnerability to cut off from overseas supply.

Their present fields are being produced at a rate which some of us think is imprudent. They are pulling the oil out too fast. It exhausts a field prematurely and there is a lengthening gap between that moment, which will be in the next several years, when production peaks and perhaps ten to fifteen years before their new gigantic reserves of oil can be brought into play on an adequate enough volume to make up for the loss in the older fields.

The argument between those who are watching this in the Soviet case, either think that the Soviets will be into Middle Eastern oil for one or two million barrels a day in the next five to six years, which is where I find myself, to those who are at the other end of the spectrum and they say the Soviets are facing such a crunch that absent very substantial Western technology, capital assistance and above all pipe, the Soviets will be into Middle East oil for something between seven and nine million barrels a day. And I think that is not feasible.

I can't imagine that the Soviet leadership, knowing that situation was coming towards them, would ever permit their vulnerability to reach such a level. And they can do things that we cannot do which could halt the growth of the petroleum sector, which could force a return and a greater exploitation of coal and so on. But whatever the volume may be, they are going to be in the Middle East and they have never before been there as a competitor for that source of supply.

In this situation, still zeroing in on the Middle East, the United States' presence in Saudi Arabia is going to be of extraordinary importance.

Saudi Arabia, as we know, is the swing producer for as far ahead as we can see. In fact, if the Saudis make the decision to install greater producing capacity, they could alone supply all of the increased oil consumption for the next 10 years, assuming we did nothing to conserve. Obviously, whether they do make such an investment is of interest to us, it's of profound concern

to the Europeans and to the Jananese, who are going to be into Middle East oil for a far higher percentage of their national supply than we.

Today, we (United States) get between 25 and 28 percent of our petroleum imports from the Persian Gulf. Europe gets 70, Japan gets 75 percent. Europe is now importing about 12 million barrels a day, almost all of that from the Middle East. The balance of it coming from African countries and now some more from Venezuela. The Japanese are really dependent totally upon the Middle East and they are pulling out between four and five million barrels a day.

So the United States, which on the one hand has a preferential position in Saudi Arabia, has a smaller petroleum stake in the resources of that country.

And this is the nub of the energy diplomatic problem that we're going to have. The question that is being asked abroad of us is the following: How are we going to influence Saudi decisions in the supply of oil? Will the American companies which continue to have a virtual monoply over the disposition of this fantastic resource act as commercial enterprises or will they be instruments of our government, and if they're the latter, towards what end? Are we going to fail to create a national energy purpose? In which case, our imports will go up and we will need all that Saudi Arabia can produce. And are Europe and Japan then going to accept a situation in which their supply is diminished?

These are serious questions. They have not been discussed in public. They've not really been discussed within our government. They are about to be.

Mr. Welch suggested that the question of climate would be of interest to you. Two quick comments on this. Over the very long range, whether the continental masses are getting warmer or cooler, will not in my view have an appreciable effect upon the key energy resource of oil. Even a difference over say the next ten to fifteen years, which we might feel and respond to in our dress, in our sports and so on, is going to come at a time when increasing amounts of higher quality oil are moving more properly into the petrochemical industry.

However, where the consequence of climate on energy could be really very acute would come in a repeat performance next winter of what we went through and what Europe went through, an experience reminiscent of 1963 when the depth of the cold winter in Europe was such that it was impossible to supply the barge traffic which many of you well know is the principal logistic stream for providing crude and product into western and central Europe.

If that should happen again, we will be faced with several crises. One between the United States and Canada to do what we can to convince the Canadians to increase the volume of supply they make to our northern tier.

A comparable winter in Europe would bring front and center the kinds of questions that will otherwise be delayed a few more years with regard to the divvying up of supplies from the Middle East.

It's a factor which is not controllable. It's one which is extremely difficult even to anticipate. The inability of the energy industry, especially of course the oil, to create substantial reserve stocks beyond those maintained for their commercial inventory, is now well-known.

We're gambling and while we're gambling we're still delaying the creation, within the United States at least, of the logistic system so essential to adequate supply to the northern tier of our country.

Let me run down a few quick points that I try to keep in mind when I am talking about the security of supply. We now have an International Energy Agency in Paris which provides an umbrella agreement whereby whatever oil is available in time of embargo will be equitably shared among the member nations. That's good. The same International Energy Agency and other organizations are beginning at long last to stimulate the search for new sources of supply. And my guess is that these will come primarily in the Arctic latitudes.

We have not begun, anyone of us, to consider conservation in a serious manner. We cannot yet say we're going to do so in the United States. We have

failed in recent years, but so has virtually every other country. No one's record is particularly good in this regard. South Africa, incidentally, may be one of the very best. Long ago they looked at the strategic consequences of their vulnerability and they made conscious decisions to be certain that situation never visited on them.

But we have not been able to handle the financial burden on most of the importing countries who are having to pay the very high OPEC price. And while bankers keep telling me as I meet with them that the system is working, I'm not at all sure that it is. I'm not at all sure that we can go on year after year, rolling over everybody's debts and not be confronted at some point with a major crisis of confidence. I'm sure this is coming and Arthur Burns is the one who speaks most strongly about it and in public. The capacity to pay for oil is an argument which must now be brought into the discussions with OPEC. We cannot continue to tinker with people's -- with countries' debt structure, their obligations to pay a price which is far beyond the means of virtually all of them. They've been able to pay because our private banks and our government, along with that of Germany and to some extent Japan, have stepped in.

Finally, we have not addressed the problem of how we are going to persuade the few swing producers who are already earning revenue far beyond their present needs and are asking consistently why in God's name should they continue to pump out more and more?

Would it not be in their longer run interest to leave it in the ground? I don't know how we're going to meet the demands that they are making. They are asking for an indexation of oil price based on the import commodities they buy. Some are asking that the price of oil be indexed to some world commodity scale. Others are saying it should be indexed to the military hardware that the Western World is selling them, primarily the United States. Others are asking that

their surplus revenues be given a guaranteed hedge against inflation and a guaranteed rate of return.

I don't know how many of you have often wished in our stock market that we had a procedure which kept you whole if you lost and didn't take it all away from you if you gained. But this is what the producers, especially Saudi Arabia, the Kuwaits and the Emirates are asking as well; our system does not permit this kind of an accommodation but we're going to have to face up to it.

In effect, because of the lead times involved we're hooked on oil. The oil to meet our increased consumption is coming from the Middle East and it will come progressively from that region, probably for the rest of our professional lives.

We're going to have to do the kinds of things that the President is going to ask and we're going to have to do other things as well.

We're going to have to reach some kind of understanding with other governments so that the competition for available oil in the Middle East does not lead us into war.

Water and Sewer Construction - An International Perspective
by
Charles Pinyan

Charles Pinyan for more than 15 years has gathered, edited and analyzed information on future construction plans in both domestic and international markets. In 1965, after 5 years with Engineering News-Record became Founding Editor and Manager of National Building News Service, a weekly newsletter on proposed million dollar plus buildings in the United States and Canada.

He returned to McGraw-Hill in 1975 to help develop and launch International Construction Week, Engineering News-Record's newsletter of international construction, planning, finance and design.

As Assistant to the Chief Editor, he manages field research for construction news and project reports by the global news of McGraw-Hill's World News Bureau and correspondents. He has editing responsibility for the weekly newsletter including special reports on individual markets, a situation which affects the international construction outlook.

Well gentlemen, most of the news that you've been getting these last couple of days hasn't been too encouraging, so I will try to bring you up to lunch on an up note.

I have some good news. Water supply and sewerage construction projects, until recently, the stepchildren of investment, are in for marked increase in the immediate years ahead, particularly in rural and urban slum areas.

Governments will do more because of the growing recognition of the importance of this kind of investment for the general health and well-being of the population, and therefore for overall productivity.

This is the viewpoint of Dr. Bernt H. Deiterich, Director of the World Health Organization's Environmental Health Division. It's a view that's backed up by data gathered by the field editors of "Engineering News-Record," McGraw-Hill's weekly construction magazine, and "International Construction Week," the newsletter of construction, planning, finance and design.

The United Nation's Water Conference last month at Mar Del Plata helped focus attention on the world's water supply problems. Indeed,scarcely any part of our world is free from troubles brought on by either too much or too little water.

Of the world's water supply, less than one percent is available for human use in rivers, lakes or from wells. The U.N. Children's Fund estimates that one billion people in rural Latin America, Asia and Africa, and another two hundred million in urban slums must use unsafe water sources. Eighty percent of the world's population doesn't have access to tap water, and must rely on streams and wells often contaminated by human wastes. Public health experts maintain that the single most effective measure to improve health in developing countries would be to provide safe sources of drinking water.

Agriculture is another area where the shortage of water is critical. Eighty to 90 percent of man's water supply, discounting direct rainfall, is being

used to irrigate 15 percent of the world's cropland, to produce 30 to 40 percent of the world's food. With nearly all the usable land that gets adequate rainfall under cultivation now, any substantial increase in food production must come from irrigating more land. The U.N. Food and Agricultural Organization estimates we will have to double the amount of water used for irrigation to be able to feed the world's population in the year 2000.

Industrial development creates an additional burden on already overtaxed supplies of clean water. Because industries have traditionally dumped their wastewater untreated into nearby rivers and lakes, many natural waterways can no longer be used to supply clean water. Developing countries rushing to build their industrial capacities often are ignorant of the importance of pollution control or consider it a luxury they cannot afford. Many have such small waterways, especially during the dry season, that small amounts of pollution can cause great damage.

What might be the most significant action taken at the Mar del Plata Conference was a strong recommendation to participating governments that they establish targets and prepare plans by 1980 to make safe water available to everyone.

John Kalbermatten, Water Supply Advisor for the World Bank's Energy, Water and Telecommunications Department, sees this proposal as having a definite positive impact on water and sanitation construction over the next decade. Although he is quick to point out that the World Bank reviews projects on an individual basis and does not establish quotas for types of work, Kalbermatten expects World Bank funding for water and sanitation projects to increase by 30 to 40 percent over the next two years and to double over the next five years.

Other international financial institutions and bilateral assistance programs are also expected to earmark a larger share of available funds, perhaps

twice as much for such work. And every dollar of it will be needed. Dr. Deiterich tells us that studies by the World Health Organization show that to provide reasonable access to safe water and waste disposal for everyone by 1990, developing countries will have to spend about four times their current annual rate of investment of $830 million in rural areas, while a 50 percent increase will be needed in the present annual average of 3.9 billion in urban areas. Whether these targets are feasible is another matter according to Dr. Deiterich, and how close they come to being realized depends on the individual governments.

In compiling our list of major water and sewerage projects in the study, planning and bidding stages, our researchers interviewed consultants from the major industrial nations who were planning billions of dollars in water supply and sewerage projects and contractors working in most of the developing nations. In a few minutes we will take a tour of the globe, pinpointing the areas and some of the specific projects which offer the greatest potential. But first a few of their overall comments should be of interest ot you.

They see lack of financial resources in the developing countries as the greatest limitation, but labor is also a considerable problem.

One consultant decries the shortage of good local engineers, saying that the best usually leave to work elsewhere. An engineer at French consultant BCEOM, which does most of its water supply work in West Africa, comments, "Developing countries often have engineers and labors and nothing in between, no technicians, no mechanics, no electricians, only engineers, and they don't know what to do with them. Put an engineer in front of a diesel engine that's not running and he won't do you any good." He terms the failure to maintain equipment catastrophic.

Lack of adequate infrastructure is another limiting factor, particularly in the countries where petro dollars are importing more than ports and inland

transportation systems can handle.

In Nigeria, for instance, asbestos-cement has been shut out of one large potential market. German consultant Lahmayer reported that the Nigerian government requested all future piping be ductile iron after 15 to 20 percent of installed A/C piping was affected by cracks or breakage. Lahmayer puts most of the blame on damage during offloading at Nigeria's congested ports and BCEOM reports a 20 to 30 percent breakage rate for A/C when transported to the interior of Africa.

Political factors are another often mentioned problem. One consultant who's worked widely in developing countries complains that many of the governments exist for the benefit of government officials rather than those governed and outside money which could finance needed projects often seems to disappear. Another hurdle frequently mentioned is the inexperience of government officials with tender calls, bidding procedures and other normal commercial dealings.

Cost inflation may cut back the size or lengthen the construction schedules of some proposed projects, but failure to supply adequate water supply systems would cause political unrest so they will go ahead, "whatever the cost", according to one consultant. We say "maybe!" Last month, Saudi Arabia's Ministry of Municipal and Rural Affairs threw out low bids totalling 1.3 billion dollars for major water supply and sewerage projects designed by American and Swedish consultants. The Saudis charged the contractors with exaggerated bids in an attempt to reap large profits. The contractors involved defend their prices as realistic because the Saudis do not officially admit inflation exists and will not permit escalation clauses to be included in their contracts. Contractors must allow for inflation in figuring their lump-sum bids.

Although the volume of water and sewerage construction is to expand substantially, work available to foreign contractors will not expand at the same rate. Our interviews with officials of the World Health Organization and

international monetary agencies confirm an increasing emphasis on water and sewerage projects to benefit rural areas and the urban poor.

Prescott Stevens, head of the Pre-investment Planning Section of WHO's Environmental Health Division, points out that the small size and relatively simple basic nature of these projects will enable local industry to assume most of the civil engineering work. In countries with an adequate technological base, local industries can be developed to supply pumps, pipe and other equipment required. Maintenance requirements increase the need for more and better training. This translates into increased opportunities for foreign firms to provide technical assistance such as local training of manpower to execute and maintain local supply and treatment facilities, improving capabilities of local contractors, and helping to set up low technology plants to utilize or adapt local material.

PVC pipe production, for example, lends itself to local manufacture because it requires relatively simple technology. This is the reason for Egypt adapting PVC pipe for use in its $280 million Nile drainage programs. An American firm is preparing specifications and equipment requirements for a series of plants to produce this piping and the World Bank will advance the Egyptians $50 million for pipe laying contracts.

Even though our field surveys point to an increasing emphasis on smaller projects, which have less appeal to large contractors and suppliers, the number of large projects in the planning stages can support a growing market for years to come.

It's time we took that quick-trip around the globe and looked at some of the more promising prospects. The logical place for us to start is the Mideast where oil dollars are available to transform to reality many projects which developing countries in other parts of the world can only dream about.

The largest market here is Saudi Arabia which has turned to desalination of sea water as its main source for supplying urban areas on its east and west coasts, including multi-billion dollar industrial complexes to be built at Jubail and Yenbo. The Saline Water Conversion Corporation, which has responsibility for developing this supply, last month received low bids totaling 1.3 billion dollars for Jeddah Four and Jubail One, two combined desalination and power plants which will produce 80 million gallons per day of desalinated water and 800 megawatts of power. These are but two of the many desalt power plants which are scheduled to produce more than 500 million gallons per day of desalinated water for the Saudis by the mid-1980s.

Tenders will be called in mid-1977 for complete water and sewerage systems for Rafha, Arar and Turraif, three towns along the Trans-Arabian Pipeline. British consultant, Howard Humphreys & Sons is planning these networks. Studies are to be completed in early 1978 by another British consultant, Sir M. MacDonald & Partners, for more than $500 million in additional water resources for Riyadh. MacDonald, in conjunction with Hunting Technical Services, shares a three and a half year contract to study ground water development for 350,000 square kilometers in Eastern Saudi Arabia. And France's BRGM is doing similar studies for a 60,000 square kilometer area along the Arabian Gulf Coast.

Kuwait must also rely heavily upon desalination. Water supply projects will get a hefty share of the four and a half billion dollars Kuwait has budgeted for the next five years to develop its power, water, communication and transportation networks.

Elsewhere on the Arabian peninsula, Abu Dhabi has a $200 million sewerage system in Al Ain due out for tenders next month. Already out for bids are a $100 million sewerage system for Mafrag and a $50 to $75 million contract to build four underground reservoirs for Al Ain. The United Arab Emirates Ministry of

Public Works has invited proposals for general survey of underground water for Al Ain and has awarded a contract to a British consultant to prepare drainage scheme plans for the Emirates of Ajman, Fujairah and Umm al Quwain.

Oman has invited proposals from consultants for a study of its water and power needs for the next five and ten year periods.

Yemen will take bids next month for 210 kilometers of water supply lines for Hodeida. American consultants, Hazen & Sawyer, are on preliminary engineering studies for water system improvements and a new sewerage system to serve 100,000 residents for another Yemeni city, Taiz.

Bahrain has one British consultant planning $250 million in sewerage schemes for its urban areas and another working on a $25 million water distribution scheme to be built in stages through 1985.

Moving on to Iran, Teheran, the largest city in the world without a sewerage system has finally completed a master plan to build a $10 billion network over the next 50 years. The first eight year phase calls for sewerage systems for the northern and southern parts of the city with treatment in the southern and eastern sections. Also included will be service for Ara, a satellite town. Portions of this work will probably go ahead in conjunction with work on its subway system. Local consultants have been appointed to plan sewerage systems for other Iranian population centers, Shiraz and Tabriz.

Major tenders for water distribution for Tehran and Isfahan will follow when work is further along on transmission line phases of long-range water supply projects for these two cities.

In Iraq, work is to begin later this year on a $400 million sewerage and drainage scheme for five cities. British consultant, John Haiste, has tenders ready for extending the surface water system in building sewage treatment plants for Ramadi.

Contracts were awarded late last year and early this year to Turkish and Pakistani firms for two parts of the Khalis scheme, which will irrigate 65,000 hectares north of Baghdad.

Israel utilizes about 90 percent of its available water, with a national grid which permits transfer of water from one region to another as it's needed. It will take equipment bids in June and construction bids later this year for a $65 million plant to recycle 150 million cubic meters a year of wastewater for agricultural use.

In Southern Jordan, near the Israeli border, the Japanese are working on studies for a $30 million irrigation scheme. Jordan and Syria will share water impounded by a $100 million dam planned on the Yarmuk River, for which construction is to get underway later this year. Elsewhere in Syria, American consultant Gilbert Associates is ready to start engineering work for 370 kilometers of water supply lines to extend the Damascus system. Howard Humphreys has a contract for feasibility and pre-investment studies and sewerage master planning for Damascus, Homs, and Hama. And a consortium of Irish consultants is designing a $45 million irrigation scheme which will include three dams.

Lebanon has asked the U.N.'s Food and Agricultural Organization to study dams for Beruit's water needs for the next ten years and reservoirs in southern Lebanon for irrigation.

Cyprus has taken bids for a 100 mile underseas pipeline to bring water from Turkey's Anotolian coast. Turkish and Arab financing are expected to pay for the $70 million line.

Turkey's two largest cities, Istanbul and Ankara, are in early construction stages of water supply expansions. Greater Istanbul's plan calls for two supply lines to cross the Bosporus Strait.

Moving across North Africa, our first stop is Egypt, which plans billion

dollar-plus water and sewerage programs for its urban areas. The U.S. Agency for International Development is funding contracts to prepare a 25-year sewage master plan and to identify and to prepare specs for top priority short-range projects for Alexandria, Cairo and Helwan. These have been awarded to American British, and German consultants, respectively. Similar water supply and distribution master plans for Alexandria and Cairo have also been awarded. Combined water and sewerage projects are to be awarded soon for three other Egyptian cities, Ismailia, Port Said, and Suez City. Egypt will also be constructing satellite towns to relieve crowding in Cairo. These will necessitate large investments in water and sewerage.

Next door, Libya started planning last year for 15 urban sewerage projects. More than 12 million meters of sewers are to be built in the next five years. Included are major extensions to the Benghazi, Tripoli, Tobruk systems, being planned by Howard Humphreys. Another British consultant, White Young and Partners, completed surveys last year for a 15 inch water line, 300 kilometers from Gialo to Agadabia on the Mediterranean Coast.

Algeria's water supply agency is pre-qualifying foreign consultants for feasibility studies for 50 dams, and contractors to build for irrigation schemes. Bids have been invited for the first stages of its $500 million national program to catch and recycle used wastewater and rain water for agriculture, and to end pollution in the Bay of Algiers. The Hungarian Government has signed an agreement to train Algerians in modern irrigation methods and to study the feasibility of a plant to produce irrigation systems.

Morocco awarded a two-year contract to British consultants last year for a study of ground and water surface sources for eight towns serving populations between 30,000 and 400,000. These include Rabat, Fes, and Meknes. And consultants were invited early this year to submit proposals to study and plan water supply

and distribution systems for four rural centers in the Bani Amir irrigation area. Morocco has many other irrigation projects under study by the Ministry of Agriculture and Agrarian Reform in Rabat.

The balance of Africa contrasts wealthy nations, such as Nigeria, with some of the poorest countries in the world. One French consultant reports that the great underground water resources in the Sahel, extending for hundreds of thousands of square kilometers in Mali, Chad, Senegal and Niger, are sometimes accessible by wells of no more than 20 to 60 meters deep. The desert may begin to bloom in some of these countries, if the $1.5 billion in aid to African countries pledged by the Arabs at the recent Afro-Arab summit is forthcoming.

Nigeria doesn't have the money problems which confront many African nations. Its five year plan for 1975 to 1980 called for spending $2.2 billion for modern water and sewage systems. About $700 million of this is for sewerage systems, $225 million in the major urban centers. American consultants are now updating a master plan and doing preliminary design for a sewage system for Lagos, which has 2 million residents and no sewerage system. German consultants will manage the Lagos water supply scheme, a 20-year project which will require a $600 million investment.

Turning to Asia, the countries most deserving of our attention are Malaysia, Singapore, Thailand, Hong Kong and the Philippines.

Malaysia has pre-qualified bidders for a $50 million expansion of Kuala Lumpur's sewerage system. Plans prepared by American consultants call for 70 miles of sewers and laterals, and four treatment plants. Tenders will be called about mid-year for a $25 million water supply improvement project for four areas in Johore and Kelantan states. Master planning is underway for a sewage system for Penang, and the government is seeking funds to supply water

and sewerage systems for Sabah State, and to plan water supply improvements for Selangor State.

Singapore will have to double the capacity of its wastewater treatment plant over the next 15 years, just to keep up with the demands of new housing and industrial plant construction. It has French consultants at work planning a $60 million expansion of the waterworks in the western part of Singapore Island to produce capacity by 50 percent.

In Indonesia, Jakarta's water supply expansion program is well underway, and the World Health Organization has completed master plans for sewerage improvements. Design is also underway by American and Australian consultants for the World Bank's second package of local, municipal water supply projects.

Thailand will invite tenders soon for water lines for Bankok's water supply expansion, planned and being supervised by American consultants. The World Bank has committed $95 million towards contracts to be awarded this year for two dams, and more than 850 kilometers of canals and laterals for the Phitsanulok irrigation scheme.

Hong Kong's demand for sewerage construction will rise sharply, pushed by the construction of three new towns to house 600,000. Tenders will be invited soon for a $50 million treatment plant for Sha-Tin, the first of these new towns.

Water and sewerage projects for Manila share the spotlight on the Philippines. The $168 million water supply scheme designed by a consortium of American consultants will include a new 200 million gallon per day treatment plant, a 25 million gallon concrete reservoir, and a $35 million aqueduct to be tendered soon. Bids were taken earlier this year for 26 kilometers of mains and 27 kilometers more will be out for bid soon.

Consultants applications are being reviewed prior to awarding a contract to update the 1969 master plan and design the first stage of a $150 million expansion for Manila's 70 year old sewerage systems. Tenders are to be invited mid-77 for a $100 million water supply scheme for Cebu. Danish engineers, Kampsox-Kruger are in final design, with Germany's Lahmayer International as consultants. These plans call for 12 to 15 kilometers of mains, and 400 kilometers of distribution lines.

Pakistan plans a $35 million water and sewage project for Hyderabad, its fourth largest city. The plan includes a 36 million gallon per day treatment plant, 50 kilometers of sewers, eight pumping stations and oxidation ponds. A study commissioned last year by Karachi Development Authority is looking into recycling wastewater for industrial and agricultural use in the Karachi area.

Taiwan will invite equipment bids soon for its first sewage treatment plant. This 75 million gallon per day facility is the first stage of a six-year, $684 million sewerage construction program, which is being planned by American and Taiwan consultants.

Korea plans to spend $200 million to clean up the Han River flowing through Seoul. Its plan calls for a 23 kilometer and 44 kilometer tunnels and 2.2 and 2.3 million gallon per day sewage treatment plants. The World Bank is partially funding river basin development schemes for the Youngsan, Miho and Nam River areas.

Other Asian projects of significance are a $34 million project to double Rangoon's water supply to 95 million gallons per day, an AID-financed feasibility study of water and related land resources as a basis for development in Bangladesh, and tenders coming up soon for ocean outfalls to handle up to 600 million gallons per day of wastewater in Greater Bombay.

The Latin American countries have great potential for water and sewerage

construction, but many are almost totally dependent on foreign financing.

Bolivia has completed designs for a $15 million sewerage and drainage scheme for Oruro, but waits for an Inter-American Development Bank loan. Feasibility studies for its $500 million Misicuni water resource project will be financed by Canada. Misicuni will produce potable water for 600,000 people, and irrigate 20,000 hectares in Cochabamba Department. Other water and sewerage schemes are in planning stages for Trinidad and Tarija, the mountain towns of Potosi and Sucre, and 70 Bolivian villages with a combined population of 100,000.

Brazil has a World Bank loan for part of a $92 million project for new or improved water and sewage facilities for 31 cities in Minas Gerais State. This project is part of the national sanitation plan which is administered by COPASA of Belo Horizonte.

Chile has invited construction bids for a 180 mile water pipe line across the Andes.

Colombia will call for bids in June for two water works projects which are part of a plan to divert Rio Piedras for expansion of Medellin's water and sewerage systems.

Costa Rica will put the $25 million second stage of San Jose's sewage system out for bids early next year.

Ecuador has completed feasibility studies for a sewerage system for 50,000 residents of Chone, and has a $40 million expansion of Guayaquil's water supply system underway.

Nicaragua's National Bank has called for bids for 75 to 100 irrigation systems for large private farms in the Léon area, and may soon invite additional tenders for two or three times as many.

Panama pre-qualified consultants last fall to plan a $45 million water supply expansion for Colon, Arraijan and Chorrera.

Paraguay will invite bids about mid-year for a $15 million second stage for Asunción's storm sewer network.

Peru has studies submitted late last year by Britains Binnie and Partners for a $126 million system of pumps and tunnels to carry water from the Montaro River across the Andes to Lima.

Trinidad will rebid this month a contract for 50 miles of water supply pipeline, part of the Caroni-Arena water project. This $150 million scheme is to double Trinidad's water supply to 125 million gallons per day. A 60 million gallon per day treatment plant, and 15 million gallon per day booster pump station are included.

Uruguay will meet Montevideo's future water needs by pumping water from the $38 million Paso Severino dam. Tenders for that project are expected by mid-year.

In concentrating on the developing countries, I've overlooked until now the United States and Europe. For the most part water and sewage projects in these areas are handled by domestic consultants, and receive little attention from foreign contractors and suppliers. A few notable exceptions in Southern Europe bear mentioning. British consultants J. D. and D. M. Watson have a contract for feasibility studies, masterplanning, and preliminary engineering for industrial and sewage waste disposal plant for greater Athens.

Italy recently awarded nearly $50 million in sewage treatment plant contracts as the first stage of a $150 million project to clean up pollution in the Bay of Naples. And feasibility study results are due in June from the British and Spanish consultants for the $300 million Bilbao sewerage system.

Even in the U.S., the forecast for sewerage and water supply construction is "growth". Last October, Engineering News-Record surveyed 88 major urban sanitary districts which account for 45 percent of U.S. sewerage contracts. They indicated they would spend twice as much in 1977 as they did in 1976. Projected spending for fiscal '78 is about 2.8 billion. Water projects in ENR's backlog of planned construction rose 16 percent last year, to 2.1 billion. And water works contracts awarded in the first quarter of this year are up 78 percent.