Transactions of the

TWENTY-FOURTH ANNUAL MEETING

OF THE

AMERICAN CONFERENCE

OF

GOVERNMENTAL INDUSTRIAL HYGIENISTS

WASHINGTON, D. C.

May 12-15, 1962

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS

TWENTY-FOURTH ANNUAL MEETING

May 12-15, 1962

Washington, D. C.

May 12, 1962: Meeting of Executive Committee

May 13, 1962: Meeting of Standing Committees
Meeting of Executive Committee

May 14, 1962: Two general sessions, one business session, and meeting of directors of State and local industrial hygiene programs only, with staff members of Division of Occupational Health, Public Health Service

May 15, 1961: One general session, roundtable discussions, one business session, and joint session with American Industrial Hygiene Association
A.C.G.I.H. 24th Annual Dinner

ANNUAL MEETINGS AND OFFICERS

Annual Meetings			Chairman	Secretary-Treasurer
No.	Date	Place		
1	June 27-28,1938	Washington, D.C.	A.S. Gray, M.D.	J.J.Bloomfield
2	Apr. 26-28,1939	Washington, D.C.	W.S. Johnson	J.J.Bloomfield
3	Apr. 30-May 2,1940	Bethesda, Md.	M.H. Kronenberg,M.D.	J.J.Bloomfield
4	Feb. 17-18,1941	Washington, D.C.	C.L. Pool	J.J.Bloomfield
5	Apr. 9-10, 1942	Washington, D.C.	C.A. Nau, M.D.	J.J.Bloomfield
6	May 24, 1943	Rochester, N.Y.	M.F. Trice	J.J.Bloomfield
7	May 9, 1944	St. Louis, Mo.	P.A. Brehm, M.D.	J.J.Bloomfield
8	Apr. 7-13, 1946	Chicago, Ill.	P.A. Brehm, M.D.	J.J.Bloomfield
9	Apr. 26-29, 1947	Buffalo, N.Y.	K.M. Morse	J.J.Bloomfield
10	Mar. 27-30,1948	Boston, Mass.	L.W. Spolyar, M.D.	J.J.Bloomfield
11	Apr. 2-5, 1949	Detroit, Mich.	H.G. Dyktor	J.J.Bloomfield
12	Apr. 22-25,1950	Chicago, Ill.	K.E. Markuson,M.D.	L.J.Cralley
13	Apr. 21-25, 1951	Atlantic City,N.J.	J.J. Bloomfield	J.E.Flanagan,Jr.
14	Apr. 19-22,1952	Cincinnati, O.	L.M. Petrie, M.D.	J.E.Flanagan,Jr.
15	Apr. 18-21,1953	Los Angeles, Cal.	J.C. Soet	J.E.Flanagan,Jr.
16	Apr. 24-27,1954	Chicago, Ill.	J. Shilen, M.D.	J.E.Flanagan,Jr.
17	Apr. 23-26,1955	Buffalo, N.Y.	H.B. Ashe	J.E.Flanagan,Jr.
18	Apr. 21-24,1956	Philadelphia,Pa.	R.R. Sullivan,M.D.	C.D.Yaffe
19	Apr. 20-23,1957	St. Louis, Mo.	W.G.Fredrick, D.Sc.	C.D.Yaffe
20	Apr. 19-22,1958	Atlantic City,N.J.	T.F. Mancuso, M.D.	C.D.Yaffe
21	Apr. 25-28,1959	Chicago, Ill.	C.E. Couchman	C.D.Yaffe
22	Apr. 23-26,1960	Rochester, N.Y.	A.L. Coleman	C.D.Yaffe
23	Apr. 9-12,1961	Detroit, Mich.	A.L. Coleman	C.D.Yaffe
24	May 12-15,1962	Washington,D.C.	W.L.Wilson, M.D.	A.D.Hosey

Note: No meeting held in 1945.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS

Executive Committee 1962-63

June 1962

AMERICAN INDUSTRIAL HYGIENE CONFERENCE
COMMITTEES FOR 1963

Conference
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Mitchell R. Zavon, M.D., Vice-Chairman (ACGIH)
R. J. Beaman, Vice-Chairman (AIHA)

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Paul Woolrich, Chairman
Robert L. Harris, Jr. (ACGIH)

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Maurice F. Clay, Chairman
E. Elbridge Morrill, Jr. (ACGIH)

Commercial Exhibits
Robert H. Starkey, Chairman

Entertainment
Lee Miller, M.D., Chairman

Program
Harry Schulte, Chairman
Christine Einert, M.D. (ACGIH)

Publicity
Howard L. Kusnetz, Chairman
Jean J. Schueneman (ACGIH)

Scientific Exhibits
Jack Cholak, Chairman

ACGIH Silver Jubilee
Paul F. Woolrich, Chairman
Charles E. Couchman
Miss Victoria Trasko
Dr. Christine Einert

MEMBERS OF COMMITTEES 1962-63

Agricultural Health	*
Dr. Clyde M. Berry, State University of Iowa	'62
Mr. George J. Raschka, Minnesota Dept. of Health	'62
Mr. Donald Kurvink, South Dakota Dept. of Health	'62
Mr. Paul E. Caplan, California Dept. of Public Health	'62
Dr. Kingsley Kay, Occupational Health Lab., Ontario, Canada	'62
(Chairman to be selected)	

Air Pollution	
Mr. Bernard D. Bloomfield, Michigan Dept. of Health, Chairman	'62
Mr. Jack A. Wunderle, Ohio Dept. of Health	'62
Mr. Jean J. Schueneman, U.S.P.H.S.	'62
Mr. Otto Paganini, Texas Dept. of Health	'62
Mr. Martin L. Sanvito, N.J. Dept. of Health	'62
Mr. George L. Wyatt, Jr., Redstone Arsenal, Alabama	'62
Mr. C. Fred Berghout, Army Chemical Center, Md.	'62

*Year of appointment

Air Sampling Instruments

Mr. Morton Lippmann, A.E.C., Chairman	'62
Mr. Robert L. Mitchell, Los Alamos Scientific Lab.	'62
Mr. Irving H. Davis, Michigan Dept. of Health	'62
Mr. Francis P. Jung, Tennessee Dept. of Public Health	'62
Mr. Howard L. Kusnetz, U.S.P.H.S.	'61
Dr. Bernard E. Saltzman, U.S.P.H.S.	'62
Mr. Herbert H. Jones, NIH, U.S.P.H.S.	'61
Mr. Victor Lavetter, Detroit Dept. of Health	'62
Mr. Paul E. Caplan, California Dept. of Public Health	'61
Mr. Grant H. Vance, Conn. Dept. of Health	'61

Awards

Mr. Jack Baliff, N. Y. Dept. of Labor, Chairman	'62
Miss Victoria M. Trasko, U.S.P.H.S.	'61
Mr. Louis F. Weller, N.J. Dept. of Health	'61
Miss Elizabeth A. Neubert, Tennessee Dept. of Public Health	'61
Dr. Irma West, California Dept. of Public Health	'62

Constitution and By-Laws

Dr. William L. Wilson, N.C. State Board of Health, Chairman	'62
Dr. H. K. Sessions, Georgia Dept. of Public Health	'62
Mr. Joseph E. Flanagan, Jr., U.S.P.H.S.	'62
Mr. George E. Tubich, Michigan Dept. of Health	'62
Dr. Ralph R. Sullivan, Oregon State Board of Health	'62
Miss Edna May Klutas, University of Washington	'62
Dr. Samuel Moskowitz, New York State Dept. of Labor	'62

Epidemiology of Occupational Disease

Dr. R. B. Sutherland, Dept. of Health for Ontario, Chairman	'62
Dr. Robert H. Flinn, U.S.P.H.S.	'62
Dr. Jan Lieben, Pennsylvania Dept. of Health	'62
Dr. Thomas F. Mancuso, Ohio Dept. of Health	'62
Dr. Curtis McCammon, Tennessee Dept. of Public Health	'61
Dr. Warren R. Lawson, Minnesota Dept. of Health	'61

Evaluation of Dust Exposures and Effects Upon Exposed Workers

Mr. Harry Ashe, Vermont Dept. of Health, Chairman	'62
Mr. John Soet, Michigan Dept. of Health	'62
Dr. Hervey Elkins, Massachusetts Dept. of Labor and Industries	'62
Mr. William McQuary, U.S.P.H.S.	'62
Mr. E. J. Baier, Pennsylvania Dept. of Health	'62
Mr. Allan L. Coleman, Connecticut Dept. of Health	'62

Industrial Hygiene Codes and Regulations

Mr. E. J. Baier, Pennsylvania Dept. of Health, Chairman	'62
Mr. C. Fred Berghout, Army Chemical Center, Md.	'62
Mr. Louis J. Proulx, Connecticut Dept. of Health	'62
Mr. Carl Jensen, New Mexico Dept. of Public Health	'61
Mr. Robert L. Harris, Jr., U.S.P.H.S.	'61

Industrial Hygiene Records and Reports

Dr. Robert H. Duguid, Army Chemical Center, Md., Chairman	'62
Mrs. Jane W. Voscek, New Jersey Dept. of Health	'62
Mrs. Eloise T. Worden, U.S.P.H.S.	'61
Mr. Philip C. Hill, Pennsylvania Dept. of Health	'62
Dr. Ralph Sullivan, Oregon State Board of Health	'61

Industrial Ventilation

Mr. Benjamin Feiner, New York Dept. of Labor, Chairman	'61
Mr. Howard E. Ayer, U.S.P.H.S.	'62
Mr. Jose Luis Beltran, Q., Ministerio de Sanidad y Assistencia Socia, Venezuela	'62
Mr. George Hama, Detroit Dept. of Health	'61
Mr. John Lumsden, North Carolina State Board of Health	'61
Mr. Marvin M. Schuman, Michigan Dept. of Health	'61

Ionizing Radiation

Dr. Dade W. Moeller, Northeastern Rad. Health Lab., Chairman	'62
Mr. Howard E. Chaney, Maryland State Dept. of Health	'62
Mr. Julian Olishifski, Illinois Dept. of Labor	'62
Mr. Charles L. Cheever, Argonne Nat'l Lab.	'62
Mr. Donald P. Roberts, Tennessee Dept. of Public Health	'62
Mr. P. W. Jacoe, Colorado Board of Health	'61
Mr. Byron Keene, New Jersey Dept. of Health	'61
Col. Francis W. Lanard, Army Chemical Center, Md.	'61

Membership Screening

Mr. John Soet, Michigan Dept. of Health, Chairman	'62
Dr. William G. Fredrick, Detroit Dept. of Health	'62
Mr. Robert G. Keenan, U.S.P.H.S.	'62
Miss Victoria M. Trasko, U.S.P.H.S.	'62
Col. Edward J. Dehne, Fort Sam Houston, Texas	'62

Recommended Analytical Methods

Mr. Robert G. Keenan, U.S.P.H.S., Chairman	'61
Mr. Leonard Pagnotto, Massachusetts Dept. of Labor & Industries	'62
Mr. Harry E. Jaworski, Detroit Health Department	'62
Mr. Martin W. Jeremias, New York State Dept. of Labor	'62
Mr. John L. Monkman, Dept. of Nat'l Health & Welfare, Ontario	'62

Standard Labeling Procedures

Dr. Samuel Moskowitz, New York Dept. of Labor, Chairman	'62
Dr. Hervey B. Elkins, Massachusetts Dept. of Labor & Industries	'62
Dr. Kingsley Kay, Occupational Health Lab., Ontario	'62
Mr. John Soet, Michigan Dept. of Health	'62
Dr. Herbert E. Stokinger, U.S.P.H.S.	'62
Mr. Joseph E. Flanagan, Jr., U.S.P.H.S.	'61

Threshold Limits

Dr. Herbert E. Stokinger, U.S.P.H.S., Chairman	'61
Mr. Harry B. Ashe, Vermont Dept. of Health	'62
Mr. E. J. Baier, Pennsylvania Dept. of Health	'62
Mr. Allan L. Coleman, Connecticut Dept. of Health	'61
Dr. Hervey B. Elkins, Massachusetts Dept. of Labor & Industries	'61
Mr. Bernard Grabois, New York State Dept. of Labor	'62
Dr. Wayland J. Hayes, Jr., Communicable Disease Center, Atlanta	'62
Dr. Keith Jacobson, Army Chemical Center, Md.	'61
Dr. Harold N. MacFarland, Dept. of Nat'l Health & Welfare, Ontario	'62
Dr. William F. Reindollar, Maryland Dept. of Health	'61
Mr. Russell G. Scovill, Michigan Dept. of Health	'62
Dr. Ralph G. Smith, Wayne State University	'62
Dr. Mitchell R. Zavon, Kettering Lab., Univ. of Cincinnati	'62

Trade Names Index

Mr. E. Elbridge Morrill, Jr., U.S.P.H.S., Chairman	'62
Miss Frances Hyslop, U.S.P.H.S.	'62
Mr. Evan Campbell, Los Alamos Scientific Lab.	'62
Mr. John Vaden, AEC, Washington, D.C.	'62

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Dr. Edwin G. Williams, Florida State Board of Health
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Ad Hoc Committee on Occupational Health in the Future

Mr. Henry N. Doyle, U.S.P.H.S., Chairman
Dr. Howard W. Mitchell, California Dept. of Public Health
Mr. John C. Soet, Michigan Dept. of Health
Col. Edward J. Dehne, Fort Sam Houston, Texas

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Representatives on Committees of American Standards Association

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N3 - Mr. Jesse Lieberman (nuclear instrumentation)
N5 - Mr. John P. Lambert (chemical processing)
N6 - Dr. Dade Moeller (nuclear reactors)
S3 - Dr. Al Cohen (bioacoustics)
Z2 - Mr. Harry S. Jordon (head, eye & respiratory protection)
Z4 - Mr. Carl Jensen (industrial sanitation)
Z8 - Mr. Irving Davis (laundry & dry cleaning)
Z9 - Mr. Jack Baliff (safety code for exhaust systems)
Z37 - Dr. Herbert E. Stokinger (threshold limits)
Z49 - Dr. Lewis J. Cralley (welding)
Z54 - Dr. D. E. VanFarowe (radiation)
Z62 - Mr. Charles D. Yaffe (industrial hygiene standards)
Z82 - Mr. Martin Jeremias (cleaning solvents in graphic arts)
Z84 - Dr. William G. Fredrick (glossary on environmental terms)

Representatives on Committees of American Society for Testing and Materials

ASTM D-26 - Mr. Howard Kusnetz (halogenated organic solvents)
ASTM D-22 - Dr. Ralph Smith (atmospheric sampling and analysis)

Representative on APHA Intersociety Committee on Air Sampling & Analysis

Mr. Robert G. Keenan

GENERAL SESSION

May 14, 1962 - 9:00 A.M.

Dr. William L. Wilson, Chairman, Presiding

THE STATE OF THE UNION

William L. Wilson, M.D.
North Carolina State Board of Health

Ladies and gentlemen, you are welcome indeed as you join us in this Twenty-Fourth Annual Meeting of the American Conference of Governmental Hygienists. I particularly greet and salute Pete (Mr. Charles D.) Yaffe. This is Pete's twenty-first consecutive attendance at an annual ACGIH meeting. Is there any one else here who equals or beats this record of Pete's, so that proper recognition may be given at this time? Doctor Sayers, (R.R. Sayers, M.D.) I know you told me you have never missed even one of the 24 annual meetings, so will you, please sir, take a bow? I see no others now to equal these two wonderful records.

My subject could lead us anywhere, or nowhere. On the other hand it permits no standing still. ACGIH is at a turning point in its future. Let me explain. Webster lists 23 meanings for "state", and 16 for "union." Therefore, how brave, or foolish, in this situation, need one be to examine "the state of the union?"

While the "state" may be a condition of being, position or nature, I was bemused by another meaning: "Condition of mind, especially an abnormal or unusual condition of mind as anger, fear, or any excitement." Of course none of these fit ME, so I searched on: "Standing, rank, eminence, quality", "dignity of bearing, stateliness", "highest condition; acme, height." Now we are improving! Don't these fit us a little more properly?

As for "union" I find many kinds: spiritual, marital, political, economic, trade, to list only a few; an act or instance of uniting or joining two or more things into one; state of being so united; juntion; coalition; combination. Thus "Union" implies some action!

Now one synonym for "state" is "predicament" and for "union" one is "unity". Are we in a predicament, and do we stand still for unity? Is not unity a result? We need not be in a predicament if we seek and attain satisfactory "union", which denotes considerably more active a process than does the passive term "unity". We can have gratifying progress without inevitable unity, but can we without union?

This past year I have served you, as well as I could as your Chairman, has been instructive, tiring at times, discouraging only occasionally, gratifying most of all. I appreciate this privilege that you gave me. However, it obligates me to an accounting, and a reporting to you, if the year has justified any facts or fancies you deserve to hear. My best approach may well be to go back now to define the state of the union.

Number 22 definition of "state" (Webster) is remarkable for my purpose here: "One of an infinite number of conditions in which an atomic system exists, characterized by definite amounts of energy, angular momentum, magnetic moment, etc., and separated from neighboring states by finite differences in these qualities." How about that? Next, my medical heritage got the better of me so I shall dwell upon the surgical definition for "union" which is "the growing together of several parts." Here again, growing is an active process.

As Chairman of this Conference, one of you, I emphasize that this Conference exists in an atomic system; some of its particles have demonstrated definite amounts of energy, large and small it is true! Some angular momentum has been astonishing at times; and let me recall that nuclei with zero spin have no magnetic moments! Well, those who want to, can ponder all of this. But can WE ponder too long? Your Chairman is a very average member. As such, he has had the privilege and gratification of simultaneous membership also in four other closely related organizations, "neighboring states." Each "state" is characterized by many desirable qualities of energy, etc. If any one of the five periodically develops undesirable "finite differences", every member should understand them. Our Conference, in this "system" as characterized above, is and should continue "separated from neighboring states by finite differences in these qualities." We should cherish and magnify the finite differences in qualities which are peculiar to this Conference, and are not reasonably indentifiable elsewhere.

Four years ago a Conference founder travelled some four thousand miles to meet with the rest of us at our Twentieth Session in Atlantic City. In discussing "What the ACGIH Has Done for Industrial Hygiene"(1) he included a challenging opinion that "the State and local industrial hygiene units do not appear to be as strong and as vigorous as they were at the end of the war." He pointed out that these units had lost much valuable personnel to industry, Federal Agencies, and other related programs. Why would they have so lost so much personnel? More importantly, he emphasized that we were deviating from our Conference objectives when we devoted most of our Conference time to strictly scientific matters more properly available to all of us readily enough elsewhere, failing thus in "giving our Conference more time for the discussion of solutions to some pressing administrative problems." Why do we so deviate? Unless we can refute these opinions, or unless we negate them by corrective actions where indicated, or unless we plan to accept dissatisfied members who are all the more hazardous the longer we neglect this question, careful analysis hardly could result in any opinion except that "the state of the union" is unsatisfactory to the thinking members of this Conference. This is the real challenge, I urge every member of this Conference to read Bloomfield's whole address. Just try to relate its contents to our Conference's Constitution and our stated objectives! Before anyone gets mad, or differs with me, let me state that I have no fear of later debates, if first his or her intellectual honesty will be applied as I shall recommend hereafter.

Can we be strong individually, or as an organization, if we profess one thing and practice another? Can we recruit or keep good personnel in State and local industrial hygiene units if we have not integrity of purpose? Why cannot we propose confidently those services and activities which a State and a local industrial hygiene unit should provide? Can we, singly, solve our problems of personnel, equipment, training, travel, SALARIES, sense of professional achievement, if we are unnecessarily failing at administration of our own programs? Can we be anything but weak, or even failures, if we reject valid and valuable opportunities to benefit ourselves, our programs, and our communities, by learning about them and then actively applying methods others have utilized in successful administration of similar programs? But what standards should be applied, and how uniformly? Who but our members can honestly establish the standards, and at the same time continue receiving their pay? There is no alternate organization, or method, available to us up to this time for the stated purposes, because most of each other organization's membership works for bosses they are obliged to please.

This brings me to a philosophical diversion before insisting that the membership of this Conference deserves adherence to our stated objectives and Constitution. If our Constitutional leadership will not reassure and implement such adherence, the least it should do is to revise promptly the Constitution, the statement of objectives, the programming of the annual conferences, and the guidance given permanent and ad hoc committees upon which the membership depends. Then a member can know whether he wants to continue his membership. I should like to be one voluble member insisting upon an honest try, consistent with our present Constitution, backed up by study of our successes and failures in twenty-four years of experience, before we tolerate any future deviation from our stated objectives. Naturally, in the long run the majority of the membership should determine our decision. For that reason it is my opinion that the membership deserves an early chance to consider and vote upon either adherence to our present Constitution or to some specifically proposed amendments. Furthermore, the members deserve to have sufficient facts developed by careful study, and the resulting facts and reports furnished to them at the same time, thus permitting them a basis for sound choice and voting.

No reasonable person can truthfully interpret my statements as meaning that any of us can neglect, or can properly lack interest in, all scientific, professional and procedural knowledge related to our work. No one of us would be adequate without membership and effective participation in the appropriate other organizations engaged in and related to occupational health. On the other hand this Conference's future demands active, loyal, and consistent participation by its members. No act or circumstance which would prevent all of these at any future time should be tolerated. I predict, quite confidently, that if we allow future interferences with our activities, especially with a successful annual meeting, from within or without the Conference, the organization has no future. It would deserve none! However, it faces no future prospect of such a problem, provided all with whom we shall plan and work, and WE, shall henceforth act in good faith.

What is the current and future state of our union, how effective is "the growing together of several parts?" This depends more upon the members of this Conference and their future activities than upon anything or anybody else. This may have had some expression in a recent statement by the Associate Editor of one of our good journals entitled "Lip Service is Not Enough"(2). I commend it to you but more particularly one statement "The noble talk about exchange of information for the benefit of all becomes a parody when, in practice, ..." What do WE practice? How aggressively? What is our real score in mutual, beneficial interchange of information, knowledge, experiences, results, administratively and technically? Have we devoted more attention to massing data and preparing papers upon scientific matters, or to well-planned and effective administration, the latter being Governmental? How much "lip service" is ours, how much other's? Do we know, honestly, where we are, or should be, headed? Do we evaluate properly how advantageous, or how detrimental, are the program activities of the Conference? And then, do we do something about it, other than gripe or condemn "the organization", ours, or others? How much could one or more such activities be delayed by an unfriendly attitude or act by one of our own members, or by others? You and I, individually, cannot obtain satisfactory answers to these questions. Permanent Committee Reports reflect only the past, they document the experience factors. Unless our Executive Committee projects the future, there is no future progress in view under our current Constitution. For that reason six of your seven Executive Committee members, four Conference Past-Chairmen still engaging in industrial hygiene, two former Conference Secretary-Treasurers, and a long-time staunch proponent, Mr. Henry N. Doyle, were invited and met last September to analyze some of our problems, and to seek energetically methods for their satisfactory solution. I propose to give you my "impressions" as of this date which have resulted. At the same time I shall try to avoid duplicating reports you should have from our Commitees, and from the Secretary-Treasurer. I shall not burden you with questions as to how to achieve our Constitutional Objectives. This is an Executive Committee responsibility.

Most of the deliberations last September, and since, not readily relatable to one or more of our five published objectives could be grouped into seven categories:

1. What are and should be the relationships between this Conference and other organizations showing varying degrees of interest in occupational health?

2. What specific portions of our Constitution could be deleted or revised beneficially, or what should be added to the Constitution.

3. What can we do to define and achieve more uniformly acceptable concepts pertaining to our legitimate responsibilities as governmental employees interested primarily in the health of working people?

4. What can we do to establish and propose additional standards we need, which we would recommend to be applied, and which we could justify by experience factors, professional prestige, scientific facts?

5. What can we do to mobilize effective attention to and support of that legislation, those regulatory measures, the standards and guides, and the uniform policies, we believe to be generally beneficial to our respective programs?

6. What can be done to stimulate fuller, more active, more enlightened, participation by members of this Conference in our stated business?

7. What can we do to define services which State and local industrial hygiene units should provide?

Ad hoc committees were established by your Chairman to analyze these problems and recommend their solutions. Our Secretary-Treasurer has promised to record them in his annual report. The continuance of these Committees is for decision by your new Chairman and your next Executive Committee. Now to discuss these subjects.

The first category - relationships with others.

I have already indicated my opinion as to where we should stand in seeking sound relationships with other organizations. We should go to every end of trouble to obtain good, effective, friendly cooperation with all others. We should assure coordination of our efforts where and when this would be acceptable to others. However, we should not wait on others who are unwilling to proceed with reasonable promptness, who do not demonstrate active interest in working with us, who would delay or defeat successful projection of our approved programs, whether or not deliberately. While there is proportionately very little of this, the prestige, influence and integrity of this Conference which have been achieved up to now will fade rapidly if we wait on those others who may care too little about our objectives. We can ask ourselves "Why not stay friends with them but push onward without them" as we appreciate Sheridan's opinion "This medieval attitude in a scientific age can only slow down progress"(2). To date, among our files we find no tangible progress during the year on important proposals we have made to certain other influential national organizations. We, and they would benefit by their acting jointly with us on behalf of the health of working people. We can succeed without their taking part, but only if we proceed more actively without them now. This will depend upon our own leadership. These recent incidents have no relation to some later reference I shall make to other organizations.

The second category - any Constitutional changes.

My own opinion that our Constitution requires few changes does not prevent an "occupational hazard" to the Chairman in suggesting three possible improvements. Their consideration does not dictate their approval, of course. The last sentence of Article V, Section 3 and last sentence of Article VII, Section 4 should be either amended or deleted. This would then place positive responsibility upon the Executive Committee alone to ensure an annual program for the Conference meeting which is consistent with Conference objectives. Is there any wonder that little continuity or integrity of objectives is reflected in our annual meetings when, in effect, the Chairman-Elect each year is left all of the responsibility and the rest of us accept none? Such a Constitutional amendment does not necessarily preclude our still having the Chairman-Elect as our Program Committee Chairman. This is, of course, as critical of myself for last year's program, as it could possibly be applied to any other person, for any year. If the shoe pinches, see me, a recent victim, for your "soothing ointment!"

My second suggested change has an objective of attaining more continuity in the direction of the organization. The Executive Committee should be required to submit to the membership in the annual meeting a brief written listing of the detailed activities which have been undertaken during the year to achieve each objective of the Conference. How else can a member know what has been done? For that matter how else can the Executive Committee systematically review our programs?

Thirdly, for equally evident reason the Executive Committee should transmit to the membership within 60 days after the last day of the annual Conference Meeting, the activities of the Conference for the ensuing year which will have been approved to meet each of our objectives during the ensuing year.

The third category - defining our specialty effectively.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS

PUBLICATIONS
(July 1962)

Industrial Ventilation -- A Manual of Recommended Practice.

Paper cover	$4.00 per copy	
	3.00 per copy in quantities of 25 or more	
Calculation Sheets	.10 per copy	
	2.00 - 25 copies	
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(The above should be ordered from the Committee on Industrial Ventilation, P.O.Box 453, Lansing, Michigan.)

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The following publications should be ordered from Andrew D. Hosey, Secretary-Treasurer, ACGIH, 1014 Broadway, Cincinnati 2, Ohio.

TITLE	PRICE
1. Air Sampling Instruments Manual - Hard back cover	$ 9.50
- Paper back cover	8.00
2. Guide for Uniform Industrial Hygiene Codes or Regulations. . .	(Out of print)
a. Supplement #1 - For Dry Cleaning Operations, 1951 (Mimeographed, 7 p.)	.25
b. Supplement #2 - For the Use of Fluoroscopic Shoe Fitting Devices, 1957	(Discontinued)
c. Supplement #3 - For the Use of Radioactive Static Eliminators, 1953 (Mimeographed, 6 p.)	.25
d. Supplement #4 - For Industrial Spray Coating, 1958 (Mimeographed, Illustrated, 25 p.)	.25
e. Supplement #5 - Proposed for Coin-Operated Dry Cleaning Establishments, 1962 (Multilithed, 4 p.)	.25
3. Guide to Records for Health Services in Small Industries . . .	1.00
4. Manual of Analytical Methods (Looseleaf. 12 methods plus 8 when printed)	5.00
5. Threshold Limit Values (latest edition)	
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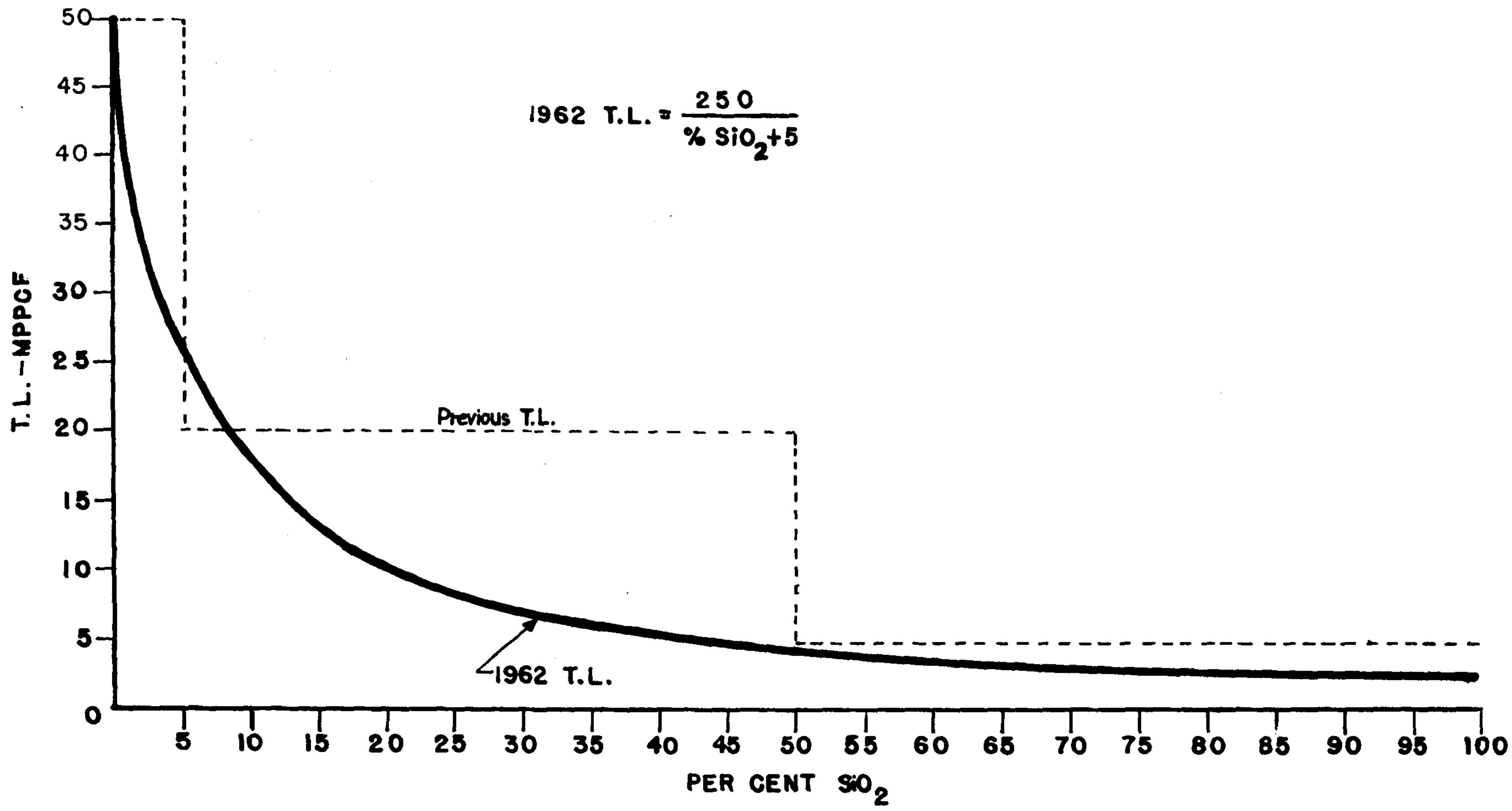

Today we could have fantastically increasing fragmentation of our work as governmental employees predominantly assigned responsibilities for working people's health. Physicians have their own definition of occupational health[3]. While it reflects well many personal health points of significance to industrial and other physicians, does it ignore the essential part which is played by governmental agencies, and few others, in the evaluation, control, and correction of the health hazards in or created by most of the work environments of millions of employees? The American Industrial Hygiene Association, on the other hand, has defined industrial hygiene as that science and art devoted to recognition, evaluation and control of environmental factors or stresses which may cause sickness, impaired health and well-being, or significant discomfort and inefficiency[5]. Does industrial hygiene thus become only physical minimizing, by ignoring, the significance of the working person's physiology and pathology? With these exclusive concepts in our minds, where do we find some one influential person or organization, that has placed as much value upon the individual employee as is placed upon each professional specialty? Several Board certifications will not do this job! No segment of the population today has more thorough, almost studied personal neglect, than do most adult working persons, insofar as their health is concerned. It is difficult to visualize any emotional or administrative appeal on behalf of this population which will bring public or voluntary finances forward as readily as do emotionally inspired programs for all non-productive segments of the population. Unless it shall be the membership of this Conference there is no "champion" in sight. Alas, it is not popular nor financially remunerative! However, any proponent for more comprehensive attention to this problem must eliminate emotional and altruistic motivation and calmly but persistently appreciate adequately the fact that all the income made, all the taxes paid, and all the voting done, is by these people who work and who up to now have been so usually neglected. There are exceptions, of course. This is a public health matter as well as a private professional practice matter, a public or governmental responsibility as well as an employer's legal obligation. The excellent Association of State and Territorial Health Officers' Resolution (No.6) of 1957[4], on occupational health, has had no later consideration, active implementation, or productive recommendations for successful evaluation separately or jointly with this Conference, so far as I can determine in friendly explorations with some of its members.

But what about others? What program of the Industrial Medical Association can be identified successfully enough to coordinate our objectives with theirs? Or that of the American Public Health Association? Or American Academy of Occupational Medicine? Or at least three nursing organizations, physicists, and others.

By now you may find it as difficult as I to find any one else for me to "make mad!" Nevertheless, I mean well, I am a loyal member of every organization mentioned, except the nurses and Health Officers'. As such I can challenge each to refute effectively the premise advanced, namely, that they as well as we should jointly define and help to achieve more uniformly acceptable concepts of our legitimate responsibilities as governmental employees, interested in the health of working people, and theirs. For this purpose I propose that this Conference promptl invite each organization named, and several obvious ones not named, to designate an enthusiastic, energetic representative to join a working committee whose cooperative objective shall be to define accurately for the first time occupational health, industrial hygiene, industrial medicine, industrial nursing, and many other related terms, and to delineate their scopes and purposes in a manner that can be accepted and applied consistently by all concerned. Surely the mature and thinking members of our several organizations could lose little by such wholesome participation.

The fourth category - establishment of additional standards.

This could lead to cooperative establishment of standards we need but do not now have. We have established some recognized and highly appreciated standards in a few realms e.g., our Threshold Limit Values, Industrial Ventilation, Air Sampling Instruments, Records for Health Services, Analytical Methods. All of these have proven their value enough to be widely accepted and appropriately applied by many, to be imitated or their substitution attempted by others, and to be referred to for promotional purposes, whether or not properly. All of this is complimentary!

We need standards in at least three additional realms at this time which we could publish in advisory form:

First, we need standards of qualifications, training, and experience for every person who will undertake or profess to perform duties as an "industrial hygienist", but who either is ineligible for or will never seek or wish to qualify for certification by one of the pertinent American Boards. This is significant to the prestige of the governmental agency and its acceptance and respect by and from all others concerned. It is even more essential to an employer whose operations are subject to governmental investigation, study, and enforcement activities. The employer has every right to know the level of competence of the governmental person armed with authorities over the employer's activities. He deserves also specific recommendations from governmental agencies as to standards they approve and which the employer can apply.

Secondly, we need minimal standards of all on-the-job medical attendance, including "first aid." Many State and recent Federal requirements in this regard are long since out-dated, some are admittedly harmful or useless therapeutically. This would be ludicrous were it not so seriously neglected. Such standards, as is true with others already promulgated by this Conference, will require continuing study, evaluation, improvement and up-dating. No other organization has memberships so widely experienced as this Conference to take active leadership in this realm.

Thirdly, we need minimal standards of personal physical condition for continuing on particularly hazardous jobs. While much of this is medical, much also is related to and dependent upon compensation and insurance laws and regulations, other "health" standards already established, and their likes, understood and dealt with daily by our membership more than any other persons.

Since October, 1961, we have had an ad-hoc committee working at the "industrial hygienists' standards." Recently the American Industrial Hygiene Association fortunately informed us that they are ready to undertake jointly the development of these standards. I recommend that this Conference approve and lend every feasible support to all work leading to the early initial publication of these standards.

Your Chairman has been unable to designate a chairman capable enough and willing to undertake leadership of an ad-hoc committee to develop the second group of minimal standards, those of acceptable on-the-job medical attendance. Nevertheless, I recommend that this Conference give high priority to this project. Others considerably less qualified by experience, training, and knowledge are likely to undertake it soon. They have done so already. Hence, we should not delay, then have little justification to complain about the future standards which may result.

I propose that an early ad-hoc committee explore the possibilities of developing the third group of minimal standards, those of personal physical condition for work on specified jobs. Such standards initially might be established consistently with our Threshold Limit Values.

The fifth category - legislation and regulatory measures.

Since we have only recently established an ad-hoc committee on legislation and regulatory activities we shall not dwell upon this subject.

The sixth category - membership non-participation.

In my opinion one of our greatest occupational hazards is non-participation in our business by enough of our members who are qualified for it. There is an old saying that to get a job done give it to a busy man. This reaches saturation eventually! Several important assignments have been accepted by admittedly very busy members, and then little if any progress has been made. Several members have declined to accept certain responsibilities, undoubtedly with considerable justification. My careful estimate is that at least 60 per cent of our membership have no significant Conference assignment. Are we saddest over the first, the second, or the third group I have mentioned? The end result is the same.

If one professional discipline of our membership is all too perceptibly missing from our Conference meetings even though they could show conflicting meetings of value to them, it still is true also that the Conference suffers by their absence and non-participation. Else, why are they members at all? All diciplines are essential to success in industrial hygiene or occupational health. If some of the team may be absent, team work is missing. No segment of industrial hygiene feels this more than the governmental. Frequently the dates of our meetings have been set first! We need to ask ourselves why we cannot achieve full participation by all disciplines. Frankly, I do not know, and I don't know what it would take to interest all concerned. This should be a positive objective for our early study and solution. Else, membership in the Conference is not fully enough productive for any discipline.

The seventh category - energizing State and local industrial hygiene units.

I propose that an ad-hoc committee be established to propose a listing of appropriate services which State and local industrial hygiene units should provide.[6]

By now you, too, can evaluate the "state of the union." I hope you are as optimistic as I am about what the future of this Conference can be. But, what will it be? Surely you and others will agree that this organization has a destiny, one not at all attainable by any other. Past failures or past lethargy need not discourage us. Every year new opportunities are sure to arise. We must grab onto them. But, also, we must produce effective and desirable results and we must not surge and wane.

The forgotten man in public health is the adult, working person. The number and types of his occupational diseases, and the massing of scientific data and statistics related to them, are far less significant than his "non-effective rate." This latter involves administration. Let us not only concentrate upon continuing improvement in and reduction of our "non-effective rates", but let us also work in such close and coordinated and effective harmony that all of us learn what truly produces the rate, what can reduce it, and who best can do the necessary acts to identify and reduce the rates. Then governmental industrial hygiene will have the recognition and rewards it deserves. Then scientific knowledge and prestige will come to us.

Our real objective is the good health of the working, adult person. He deserves recognition now as an important person in his community. His personal and community dignity deserve full attention and protection. He deserves every bit as much public health as all other groups long ago served. All other served groups depend upon him.

This is your challenge. It is not only our opportunity but that of others, too. But the leadership and primary responsibility belongs to governmental industrial hygiene. It will not come successfully from any other source.

I would not close without expressing my deep appreciation for the loyal and consistent assistance given at every turn by the individual members of our Executive Committee and by many Conference members. No vacuum which remains is their fault, they have earned the Chairman's high regards and sincere thanks. Working with our next year's Chairman has been a delight. Most of all I need to cite the very burdensome and all too frequently thankless volume of work done by our Secretary-Treasurer. He and "Genny" shall remain warm memories.

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THE MODERN FOUNDRY ENVIRONMENT

George E. Tubich
Michigan Department of Health

I. Introduction

The physical basis of the modern foundry industry is something new under the sun. The industry suddenly woke up to the realization that many of its traditional markets were being lost to more imaginative market-minded industries. In order to be competitive it was necessary to develop new methods, materials, and equipment. The foundrymen of 10-15 years ago would not recognize the present day vocabulary of shell mold and cores, CO_2 molding, hot-core box, cellular metal, siliconizing, air-set cores, vacuum degassing, nodular iron, and many others.

In the past when foundry problems were discussed we thought in terms of dust and silicosis, lead and lead poisoning and zinc and metal fume fever. However certain features of the modern foundry environment appear to have graver significance in their capacity for present and future harm. Never before has the foundryman been surrounded by so many obvious as well as insidious dangers to health, limb and life itself.

In disucssing the new processes and materials you will note that in some instances the hazards are obvious, in others limited useful data are available, and finally there are a host of new materials and combinations that require a great deal of study.

II. New Processes and Developments

A. Pattern Making

The newest development in this area is the Nickel Carbonyl Process. The master pattern of wood, plastic or metal is placed in a depositing chamber. The chamber is purged with CO_2 and pattern temperature is raised to 325°F. The liquid carbonyl is vaporized and the gas deposits pure nickel on the surface of the pattern. The system is again purged with CO_2 to remove any remaining CO and nickel carbonyl. The result is a highly polished, tough surface on the pattern, improving surface finish and increasing pattern life.

A coating of metal can also be deposited on wood patterns and core boxes by the use of a metallizing spray gun. The low melting alloy sprayed contains 40 - 58% bismuth, 26 - 44% lead, 11 - 60% tin, and 8 - 10% cadmium.

Considerable use is made of urethane, polyester, and epoxy resins for fabrication of a wide variety and sizes of patterns.

Pneumoconiosis is not generally considered to be a problem in pattern making operations. Several references cite such cases and attribute the involvement to wood and emery dust.

B. Molding and Core Making

1. CO_2 Molding

Sand is mixed with 3-6% sodium silicate, molded and gassed with CO_2 for 10-20 seconds. While CO_2 is the preferred agent the reaction is also accomplished by ammonia, hydrochloric acid, methyl and ethyl alcohols, sulfur dioxide and nitrous oxides. This reaction forms silica gel, 0.5-1.0% Na_2CO_3, and possibly cristobalite. A wide variety of additives are used to produce certain desirable characteristics: dry slaked lime, cresol phenolics, pitch, sea coal, fly ash, ammonium chloride, sulfides.

Improper gassing pressures and failure of gas applicator valves have resulted in the workers' hands being frozen to the applicators.

There is contradictory data in the literature on the effect of small amounts of Na_2CO_3 in increasing the rate of silicosis development.

Dr. Holt, Reading University, England, is in the process of studying the comparative effects of conventional and CO_2 sand molding.

2. Shell Molding

Studies have already revealed the significant hazards of dust, solvent vapor, gases, and dermatitis. The long term effect of irritant gases and the dust exposure or phenolic resin coating on the silica dust particle is not clearly known.

3. Petro Bond Molding

Water additions to the molding sand are replaced with a petroleum based oil as used for industrial cooling and lubricating. The bonding agent is a modified bentonite, referred to as bentone, that requires the use of methyl alcohol or propylene carbonate as a catalyst.

Dust concentrations and airborne free silica content at the various operations are surprisingly low. Oil mist and/or vapor vary from 1-20 mgs/M^3 and alcohol vapor at the muller 5-100% of LEL. When the casting temperature at shakeout is over 700°F. the sand will ignite. The ductwork for exhaust systems virtually become oil pipe lines and are the source of many fires. One foundry has adapted a steam jenny for frequent cleaning of the ductwork.

4. Investment

A serious silica hazard exists in the investment casting process. Fortunately the development of the ceramic shell method utilizing Al_2O_3 has all but eliminated this problem. The binder requires sodium fluoride as a catalyst.

Additions of piperdine, morpholene or triethylamine are being made to the ethyl silicate-alcohol binder to control setting time. Under suitable conditions the phosphate binders can liberate phosphine and when pouring temperatures are in the range of 2500°F., P_2O_5 is released. Dehydration of "plaster of paris" molds is being carried out in CO atmospheres and during pouring small amounts of SO_3 are liberated.

After wax burnout mercury was used to wash out the ash residue from the mold cavity. It was found that compressed air achieved the same result.

5. Cores

The most recent core binder receiving a great deal of interest in the industry is the furfural alcohol resin or more commonly called

"Hot Core Box". It consists of a urea-formaldehyde resin modified with furfural alcohol and a catalyst of phosphoric acid, ferric or ammonium chloride, or ammonium phosphate.

The resin-sand mixture is blown into a corebox whose temperature is about 400°F. and the core is cured in about 15 seconds. The cores can also be cured at room temperature by increasing the amount of catalyst added. During these curing cycles, significant amounts of formaldehyde are released.

Other core binders in use are acrylic and epoxy resins.

6. Mold Materials

The problems of diagnosis of silicosis will be complicated by the introduction of a wide variety of molding materials to produce a desired characteristic in castings. In many instances one or two molding lines of these materials are incorporated into conventional operations. Some of these are: olivine, zircon, perlite, vermiculite, feldspar, mullite, kayonite, ilmenite, serpentine, graphite, carbon sand and chrome-magnesia. These materials are used singly or in a wide variety of combinations with sand or other materials along with a number of different binding agents. For example a hollow shell core is filled up with CO_2 sand and placed in a petro-bond mold or a mold consisting of 83% SiO_2, 13% olivine and 3% air-set cement.

C. Metals

Improving the metallurgical characteristic of metals has received a considerable portion of time in this industry. It is impossible to list all the developments for the common and newer metals. There is no doubt that some of these developments will have significance on the health of the foundry worker.

There have been many instances of explosions from residues, coatings, or activated surfaces on a variety of metals such as zircaloy-2, uranium, uranium alloyed with a variety of metals, i.e., niobium, tin, lead, bismuth, copper, antimony, gold or zirconium; titanium, titanium-manganese alloy; highly alloyed magnesium and thorium. These explosions emphasize the need for careful preliminary testing and for the use of adequate personal protective equipment whenever new processes involving the more pyrophoric metals are being developed.

An interesting development is that of cellular metal. For Al alloys, gas forming components such as zirconium or titanium hydride are added to the molten aluminum and poured in conventional molds. The void volume is 75% of original casting. In special applications the voids are filled with lead or epoxy resins.

Some metallurgical improvements are brought about by additions to the furnace or ladle. Some of these are: ferro-cyanide and selenium, thallium, silicon and columbium, cerium fluoride, depleted uranium, beryllium, chromium, cadmium, lead and magnesium.

The addition of lead shot to the ladle of steel improves machining properties. Lead fume concentrations are many times the safe limit. Grinding and welding on these leaded steel castings present similar problems.

Nodular or ductile iron is formed by additions of Mg and other metallic compounds. During machining an odor very similar to that of commercial acetylene is produced. This is attributed to a reaction between magnesium carbide and water (as vapor or in cutting oil). Recent studies have shown that phosphine is also liberated during machining.

Degassing and grain refining find additions of hexachlorethane, phosphorous pentachloride, metallic sodium, lithium and bismuth, zirconium and boron, teflon, and carbon tetrachloride in a nitrogen carrier.

The fluidity of non-ferrous metals during pouring is greatly improved by spraying the mold surfaces with a solution of hexachlorethane in ether.

In desulfurization operations considerable quantities of CO are released.

There has been an increase in vacuum and high pressure (100 M psi) melting. In vacuum arc melting there is always the possibility that the skittering arc will erode the copper crucible and cause an explosion.

Electron bombardment is used in high vacuum to melt chemically active metals. Heat for melting is supplied by an electron gun which serves as a cathode and bombards the melt stock with electrons.

Melting, pouring, and subsequent operations involving the exotic metals are being carried out in rooms of inert atmospheres and the operators are required to wear personal life support systems.

In a process referred to as siliconizing, a silicon tetrachloride atmosphere is maintained in heat-treat furnace to improve the wear resistance of certain castings.

There appears to be increasing evidence that ferrous and non-ferrous metal fume and dust may be a significant factor in carcinomas of the upper respiratory system. A number of studies in this country and in Europe provide data that point in this direction. While a number of materials have been implicated there are no straight-forward conclusions as to a single etiological agent. Much additional work will be required before an unequivocal answer is possible.

D. Radioisotopes

The most common use of these materials is in non-destructive testing of castings. A limited use is involved in research projects.

Several devices are available to measure sand moisture and density. One involves the use of a plutonium beryllium fast neutron source. The fast neutrons collide with the H_2 nuclei in the water atoms in the sand producing slow neutrons that can be counted electronically. The number of slow neutrons is proportional to the sand's moisture content. For use with conveyed sand the same fast neutron source determines moisture and Cs 137 is the gamma source for density measurement.

E. Solvents

Many of the new processes involve the application of solvents. Basically foundrymen are not familiar with the toxicity and explosion characteristics of these materials. These two features have already resulted in a number of injuries, deaths, and damage.

F. Noise

Only minor attempts are being made in this area. Noteworthy are the rubber lined tumbling mills and where casting temperature at shakeout permits the cross bars on the shakeout deck can be rubber coated.

G. Casting Grinding

In steel foundries arc-air wash is rapidly replacing swing grinders. Large amounts of metal fume are liberated and up to 50 ppm of CO. Snag grinding and abrasive cut-off wheels that contain cryolite will decompose at the grinding line temperatures to release fluorides.

H. Ventilation

The principle of low-volume high-velocity (LVHV) has merit on operations such as portable grinding, chipping, and decoring; however, its use in this country has been extremely limited.

In addition to the ACGIH Ventilation Manual those interested in industrial ventilation will find the several publications of the British Steel Casting Research Association (BSCRA) on dust control and collector efficiency very worthwhile.

III. Conclusion

The foundryman, through his technology, has created a wealth of new methods and materials. This has taken up so much of his total time, effort, thought, and ingenuity as to leave him little time on learning what might be its ultimate effects upon himself. The foundryman, as well as many others, derives an undue comfort from the crude statistics that the people in no previous society have been known to die young in such small numbers and to live old in such large numbers. The easy conclusion is that we are healthier now than ever before and that modern life holds no serious threat to health. However, if we examine these statistics carefully, we find that we have merely extended the unproductive extremes of infancy and senility.

In law, the suspect is innocent until his guilt has been proved beyond reasonable doubt. In the protection of the health of the foundryman, such absolute proof often comes late. To wait for it is to invite disaster, or at least to suffer unnecessarily through long periods of time.

THE NURSE ON THE OCCUPATIONAL HEALTH TEAM, STRANGER OR CO-WORKER?

Mary Louise Brown
Division of Occupational Health
U.S.P.H.S.

Occupational health is essentially a team effort. Success depends upon the ability of the members to join forces to work for a common result. Implicit in this concept of occupational health is a stern challenge. Teamwork is one of the most demanding of all professional activities.

The occupational health team is a multi-disciplinary one, bringing together physicians, engineers, nurses, industrial hygienists, and chemists. The focal point of the team's efforts is the health and effectiveness of workers at and through their place of employment. The very character of the occupational health team, as well as certain intrinsic factors, presents obstacles to the attainment of a high degree of cooperation. Some of these can be more readily resolved than others.

The first obstacle, and certainly one that brooks no tolerance, is the lack of mutual understanding of the potential contribution of the various members of the team. Second is the necessarily uneven number of personnel in the various disciplines represented in occupational health. This is related to the third, namely the problems encountered because many establishments cannot support a full complement of professional occupational health personnel. Fourth, all too often personnel in this field lack adequate training to perform effectively. Still a fifth problem, and probably the key one, is the shortage of personnel. This results in additional work burdens and pressures to get the immediate job at hand done, with no time to think of cooperative efforts. Here is how the personnel situation, present and projected is viewed by an expert advisory committee recently convened by the Surgeon General of the Public Health Service. According to estimates of the Gross Committee, there are now 2,300 industrial physicians, 16,000 occupational health nurses and 1,300 industrial scientists. The committee estimates that in 1970-1972 there will be 2,900 physicians, 19,000 occupational health nurses, and 1,600 scientists. These figures fall far short of the anticipated needs. Leaders in the field are sure that these future needs as presently reviewed cannot be met.

Various interested groups, including official agencies, professional organizations, and universities are working to solve some of the obstacles. As a first step, we as individuals can best direct our efforts to understanding and strengthening our respective roles. While all disciplines should do some serious soul searching in this area, I should like to confine my observations to the nurse and what may properly be expected of her.

In many employee health programs, especially in the smaller and medium-sized industries, the nurse is the only professional member of the occupational health team who works full time. She must at all times be a top-notch occupational health nurse, never a pseudo physician, health educator, or engineer. The others on the team must be available to play their role, whether they are drawn from an official agency, insurance company, university, or other sources. The success of the program depends on her understanding of their role and on her ability to involve them in the total occupational health program.

The level of the occupational health nurse's performance is related to the creative use that she makes of her skills and understandings. The nurse's effectiveness is based upon the depth and variety of her knowledge of nursing, public health, and occupational health. Important too, is her own personality and how well she works with others. Equally important is the expectation that the physician and the engineer on the occupational health team have of her contribution. The members of the occupational health team should expect the nurse to bring to her work in industry a broad understanding of the physical, and social sciences, as well as a comprehensive understanding of the art and science of nursing, public health, and occupational health.

Nurse leaders, employers of occupational health nurses, physicians, and industrial hygiene engineers must begin to demand an expert occupational health nurse who is able to function independently as a professional nurse and cooperatively with them in planning and in carrying on occupational health activities. This expert occupational health nurse would understand the emphasis placed on health maintenance and rehabilitation activities in occupational health. She would be able to plan and to give nursing care to workers who are injured or ill.

An expert occupational health nurse would also be able to identify environmental factors and to understand their effect on health. Her co-workers should expect her to use this knowledge and her frequent contact with employees to watch for early signs of intoxication and for problem areas in the work environment. Her activities will be somewhat like those of a detective's "girl-Friday," as she calls problems to the attention of the physician, management, and the engineer who will handle them. Unless they heed her observations and use her reports as a basis for studies and program planning, they are not functioning as members of the team.

The occupational health nurse's contribution is further strengthened by an understanding of social legislation, including workmen's compensation, disability legislation, labor laws, and health and safety codes. Such knowledge provides a basis for a program that permits the utilization of community health and welfare services.

Her understanding and appreciation of the importance of production and the interrelationships of departments within a business enterprise will help her to be realistic about what health personnel can do. She will adapt nursing activities to the work environment. Her health counselling and health education will focus on helping workers know how to protect their own health and to use health resources.

Because she knows proper, legal, ethical nursing practice, she will not accept responsibilities that go beyond her ability as a nurse. The other members of the occupational health team have a right to expect the nurse to:

1. identify her role and her relationship with them and to work effectively

2. develop relationships with workers that encourage them to use the occupational health service and to assume responsibility for conserving and promoting their own and their family's health

3. develop and carry on expert nursing care that meets the individual demands of the workers and the industry

4. communicate with workers, allied professional personnel, industrial management, and labor representatives to develop an integrated, coordinated occupational health program

Some of the nurses now active in the field do function as excellent occupational health nurses. Many do not. Many never will unless members of the occupa- health team expect and permit the nurse in an occupational health unit to function as knowledgeable occupational health nurse.

Similar high expectations of performance should prevail in official agency programs in occupational health. Thirty-five occupational health nurse consultants, fifty-two physicians, 144 engineers, and 138 industrial hygienists are employed in such programs. The nurse consultant in the official agency has more opportunity to know the engineers and industrial hygienists than do the nurses who work in industry. Here the ratio of nurse to engineer and physician is reversed from that found in industry. There are only 35 occupational health nurse consultants to give consultation to the 16,000 occupational health nurses.

The provision of consultation for occupational health nurses and others who are primarily concerned with employee health services is the major responsibility of the nurse consultant in the official agency. Her job satisfactions and those of the others in the occupational health unit depend upon her ability to use her comprehensive knowledge of occupational health, public health, and her skills and understandings of nursing consultation to:

1. help develop, implement and evaluate the program for the unit in which she works

2. participate in unit activities, including promotion of new and improved employee health services, field studies and epidemiological research

3. identify, develop and carry on studies related to occupational health nursing service

4. evaluate occupational health programs and recommend modifications when indicated

5. assist in the development of standards for occupational health nursing practice

6. motivate occupational health nurses to meet accepted standards of practice

7. develop and carry on or help others to carry on educationsl programs for occupational health nurses

8. consult with the Director of Public Health Nursing and other members of her staff on problems relating to occupational health and occupational health nursing

9. consult with public health personnel concerning their activities in the development and implementation of adult health programs at the community level and at places of industrial employment

10. consult with nursing educators on problems related to occupational health nursing education

Many of the occupational health nurse consultants are prepared to be expert nurses on the occupational health team. Some are not. Most do not have the opportunity to function as outlined. Many more positions must be created and prepared occupational health nurses recruited to fill them.

In closing, I should like to urge that we in official agencies take the leadership in putting more action rather than talk into teamwork. Working together for a common purpose is dependent upon each individual member of the team knowing the others, recognizing their contribution, and doing his own job so that the others may also contribute. All must believe that the end result is greater than that accomplished by independent activity.

We are now living and working in an era of specialization. The needs of society for occupational health services will be met only if we move headlong into an effective collaborative effort.

SUMMARY OF THE 1961 NATIONAL HEALTH COUNCIL OCCUPATIONAL HEALTH PROMOTION PLAN

Jan Lieben, M.D.
Pennsylvania Department of Health

The National Health Council is a coordinating agency of some 50 or 60 national health organizations, about half voluntary and the other half professional ones.

For the past few years the National Health Council has annually conducted a Forum on various problems of interest to workers in the health field.

The forums are invitational meetings. This year's Forum dealt with safety with communications, last year and the 1959 Forum dealt with the "Health of the People Who Work". The Chairman for this Forum, who also became the president of the National Health Council in 1961, was Dr. James Sterner, Medical Director of the Eastman Kodak Corporation.

All the speeches of the Forum in Chicago were compiled in an attractive and extremely well written book entitled "The Health of the People Who Work". Besides that a Follow-up Committee was set up under the chairmanship of Marion Folsom, former Secretary of Health and Welfare under Eisenhower. Its purpose was to look into the matter of why occupational health services had not gained wider acceptance and to develop a plan to promote occupational health. Through the work of the Follow-up Committee the National Health Council obtained a contract from the U.S.P.H.S. to undertake a study and to develop a concerted and consistent effort to promote occupational health.

You might ask, like I did, why should the National Health Council, a collection of voluntary and professional agencies, be so interested in occupational health.

Well, the answer to me is a simple one. For years voluntary agencies have courted large employers. Since there are so many organizations interested in them, industries have often found it physically impossible to give them the attention they would like. If a foothold can be gained in industry, large groups of employees can be reached in a relatively easy manner with educational materials and fund-raising necessary to accomplish goals becomes easier.

A sincere desire to be helpful in problem areas and the above reasons are in my opinion the reasons for the interest of the National Health Council in occupational health.

Somebody was needed to undertake this study and prepare the plan. I was asked to be the project director and Dr. Wilbar, our Secretary of Health, kindly consented to give me a three-month leave of absence to undertake the study.

The plan was to learn through discussions with prominent persons from professional, voluntary, labor, and management organizations what the obstacles to the effective promotion and reasons for the slow progress of occupational health programs have been: Then to report to the advisory committee and with their aid prepare a plan to remedy this situation. (A simple little task to be accomplished in three months.)

In view of our chairman's pre-occupation with the clock I shall limit myself here to the enumeration of the most pertinent obstacles found hindering the rapid spread of occupational health programs and to a short discussion of the plan which was developed.

Reasons for the Slow Progress and Expansion of Occupational Health Services - Based on Interviews with Persons of Knowledge in the Field and on Committee Discussions

1. Failure to convince management that expenditures for occupational health are a good investment.

2. The term occupational health is practically unknown. When we are asked - what are you working in and we say "in occupational health" we are almost invariably met with a blank expression: People don't know what we are talking about. There is a need to make this term known to people just like the name of commercial products - Alka-seltzer, Pabst Blue Ribbon, or Pepsi Cola for those who think young.

3. When promoting occupational health services, we have frequently only suggested one type of service - namely a part-time physician and a full-time nurse. We should try to be flexible and offer the consumer a variety of services. We must tailor the work towards the needs of the community.

4. There are not enough good studies available for different plants which show the actual dollar and cent savings a good occupational health service can accomplish.

5. There are not enough trained physicians and nurses familiar with the employees' environment available. Too frequently physicians are hired on the basis of the proficiency at the golf course and the cocktail lounge and the nurses effectiveness is often determined by a study of personal attractiveness and her evident personality.

6. Medical ethics do not permit physicians to advertise their services. Medical societies should undertake the task to get together physicians interested in occupational health and plants wanting their services.

7. Salaries are often inadequate.

8. Job tenure is shaky. Occupational health too often is a leak area; money is allowed to dribble away for occupational health, when the company's finances are in good shape, when business conditions get tough the leaks through which money has dribbled away are plugged and occupational health services fall by the way side.

9. Many physicians in private practice regard occupational health services as a threat which might cut into their income. They do not realize that case-finding programs, health education, and health counselling should increase rather than decrease their practice.

10. The requirements for physician and nursing time in many plants are rather small and neither physician nor nurse can be expected to devote large amounts of time and money toward a training for a job which involves only one or a few hours per week.

11. Orientation of occupational health programs either toward management or union.

12. Limited scope of occupational health services - it may be First-Aid only.

13. Resistance of industry towards government, and any promotional efforts the latter may undertake.

14. Difficulties in inter-relationships of various groups, namely, physicians and engineers or physicians and nurses.

These problems which have been enumerated have been recognized by many persons in the field throughout the United States and partial solutions have been accomplished in many areas.

For instance the placement efforts of the Contra Costa County, or North Carolina State Medical Societies - help to make available physicians interested in industrial employment to prospective employers.

Or the Hartford and New Haven small plant health services which provide full-time physicians services to plants of 100 - 1,000 employees.

Or the study of Cipolla and Brown in the Journal of Occupational Medicine, October 1960 depicting the lost time experience of 2 hotels, one with an organized employee health service and the other without it.

None of the problems which have been enumerated are beyond solution. Good answers are available, but have only been implemented sporadically here and there.

I feel that this part of the study may have accomplished one thing, namely, it has listed under one cover a large number of the problems which face us and has listed a number of answers available for their solution.

The second part of the study is a blue-print for a new way of attacking our problems. It is based on the successful experience of the Health Association of Rochester, New York, in which Dr. Sterner has taken a leading part. It also borrows the methods successfully used by voluntary organizations throughout the country, namely the principle of local affiliated community organizations for occupational health directed by a national organization.

The Plan

The objectives of the proposed plan are to extend and improve occupational health services throughout the United States and to improve through preventive medicine the health of the people who work.

The organizations suggested at both the national and local level proposes the following prime members:

1. Management
2. Labor
3. Voluntary and official agencies
4. Professional occupational health organizations.

Two alternate structures are suggested to spearhead the plan at the national level:

1. A new organization which might be termed Occupational Health Foundation composed of organizations of the above four groups.

2. The National Health Council which has among its members many representative organizations from labor, management, official, and professional groups.

Local Organization

This should include, again, organizations of the four groups mentioned above.

The goals of this local organization would include:

1. The promotion of occupational health services for business and industry.

2. Education with respect to occupational health activity.

3. Emphasis on the benefits to be derived from definite policies and procedures regarding occupational health in individual companies.

4. Advice to voluntary agencies regarding the kind of program desired by and acceptable to companies and employees.

Activities of the local community organization might include:

1. Local inventory of industry and business.

2. An inventory of services available in the community.

3. An inquiry about the wishes and needs of employers and employees.

Typical programs which can be made available in most areas without any difficulty are:

1. A diabetes detection program
2. A mobile chest x-ray unit visit
3. Health education movies
4. Promotion of a new, or cooperation with an existing, cardiac evaluation clinic
5. An alcoholism program
6. Glaucoma detection
7. Multiphasic screening
8. Courses in occupational health for physicians and nurses
9. Cooperation with County Medical Society to bring prospective employers and physicians seeking employment together
10. Promotion of individual or cooperative in-plant health services
11. Discussion of early case-findings and its impact on health insurance premiums
12. Discussions of workman's compensation laws.

National organization would have the following goals:

1. To encourage and stimulate the development of strong community organizations dedicated to the promotion of occupational health.

2. To provide guidance, advice, and consultation for local organizations; to serve as a central source of technical information and assistance.

3. To assist the community organization, on request, in the investigation and solution of specific problems.

4. To stimulate publicity in national business magazines on the values and need for occupational health programs.

5. To work with national voluntary and professional organizations to assist in the preparation of occupational health material such as pamphlets and visual aids.

This is more or less the general idea of the plan as prepared and approved by the advisory committee under the leadership of Jim Sterner and submitted to the Public Health Service. I understand copies of the report will be available on request from Dr. Magnuson.

As matters stand now, the big problem, as usual, is the securing of funds to put the plan into operation on a large scale. I understand the committee will be working on this. In the meantime I cannot see any reason why all or parts of the plan cannot be put into operation at the local or state level.

GENERAL SESSION

May 14, 1962 - 2:00 P.M.

Dr. William L. Wilson, Chairman, Presiding

TEAMWORK AND CHALLENGE

R. Lomax Wells, M.D.
The Chesapeake and Potomac Telephone Companies

The health of the American worker is the concern of many people. Occupational health services are well established and functioning effectively in most large industries in our country. However, the largest percentage of workers (approximately 90%) are employed in small plants and though an increasing number of small plants are establishing health services, the challenge in this area remains great.

I have chosen to talk with you for a few minutes today about teamwork in our chosen field of occupational health. The understanding and support of top management is essential to the success of any occupational health service. To measure benefits accruing to the business in terms of dollars is difficult. For example, how can one measure morale and individual worker efficiency in terms of dollars? Reduced absenteeism can be measured in dollar savings, but in all honesty can we say that an improved attendance record is purely the end result of the activities of the physician, the industrial hygienist and the nurse? I think not, -- we are simply a part of the management team, the sum total of whose efforts may result in reduced absenteeism and dollar savings. Can we claim full credit for defining areas resulting in greater safety for the workers? I think not, -- the immediate supervisor and the individual worker are essential members of the team if our recommendations are to be carried out and be effective. It takes everybody in the plant to make a successful team.

In talking with you today I represent the American Academy of Occupational Medicine. The By-Laws of the Academy include the following objectives:

1. "The primary objective of the Academy is the maintenance and improvement of the health of industrial workers with improvement in occupational efficiency as a corollary. This shall be broadly construed to include cooperation with acceptable agencies that may promote either directly or indirectly the physiological well being of the employed population.

2. "To this end, the prevention, diagnosis, treatment and care of occupational illnesses and injuries will be fostered. Research directed toward a better understanding of the pathogenesis of occupational diseases and improvement in methods of prevention and care will be instituted and encouraged.

3. "The results of these scientific investigations, as well as instruction in the causes and effects of occupational illnesses and injuries will be made available to all interested agencies, groups, and individuals in forms suited to their needs and capacities, so that the knowledge may be used in the best interest of the workers."

In part, the Constitution of your Conference states, -- "the objectives of the Conference shall be to promote industrial hygiene in all its aspects and phases; to coordinate industrial hygiene activities in all their aspects and phases by official federal, state, local and territorial industrial hygiene agencies; to encourage interchange of experience among industrial hygiene personnel in such official organizations; ...."

By "promoting industrial hygiene in all its aspects and phases" you demonstrate your dedication to the same fundamental principles of prevention of occupational disease and injury and to research in these areas as do we in the American Academy of Occupational Medicine.

Our respective By-Laws and Constitution commit us to a common goal, -- improvement in the health of the American worker. This is why I have included "teamwork" in the title of my paper. Only as a team where the industrial physician and industrial hygienist are associated in the same work place or involved in research together can the two groups be most effective. I would hope that our common goal would strengthen this concept of teamwork. We need to exchange ideas and to let one another know what we are doing to the end that we meet our stated objectives. We have worked together as an effective team in the past; I anticipate we shall continue to work together in the future.

The physician in occupational medicine and the industrial hygienist should be well oriented in the field of epidemiology, for both are involved with the agent, the host, and the environment. More often than not your primary areas of activity are with the agent and environment and ours with the host. These three cannot be separated if we are to develop effective programs to protect the worker. Each of us must have an understanding and appreciation of the importance of our primary areas of endeavor if we are to correlate our work efficiently, -- this calls for teamwork of the highest order. There can be no room for "pride of discovery" or "pride of authorship" or for unilateral action; there simply must be a coordinated and synchronized attack on our common problems as they affect the worker's health and welfare.

So much for teamwork. What lies ahead? Where and what are the challenges facing us? For a few moments indulge me, if you will, while I have the temerity to suggest some problem areas.

New concepts of industrial hygiene are in demand as the result of new industrial processes. Technical problems are constantly arising as the result of the development and use of new physical and chemical agents:

1. Physical Agents - The various types of physical energy which have become increasingly significant in the industrial environment constitute a major challenge to our ingenuity in protecting the health of exposed workers.

   a. The greatest emphasis must be placed on radioactivity and in the various aspects of microwaves. Radioactivity problems are not new, but the problem is greater due to higher levels of radiation and an increasingly large number of exposed workers. In my own field of medicine the potential exposure has increased and the effect of fallout from nuclear testing presents a constant challenge. A whole new vista of possible carcinogenic and genetic effects has been opened up as the result of these changes. Exposure, shielding, time, personal monitoring, medical and bio-assay monitoring command our attention. The effects of heating from microwaves as a biological problem demand further investigation and studies.

b. Sound has been with us from the beginning of time and yet we have not solved the problem of noise in industry. The problem is under constant study by capable investigators, but there are many industrial operations that have not recognized that they have a problem. While the eyes are closed to the problem, the ears remain open and susceptible to damage.

c. One final challenge in this area - as the use of ultrasonic sound waves increases in the industrial environment, will we be prepared to say what are the safe tolerance levels for exposed workers?

2. Chemical Agents - The rapid rate of production of new materials of unknown toxicity by the chemical and metallurgical industries is no new problem to you; it is a safe assumption to state that it will continue to become one of increasing magnitude. The newer metals and alloys, missile fluids, plastics, and resins are familiar to you. One very real problem is the occurrence of toxic symptoms before the hazard is recognized. Another is the development of new toxic qualities among substances of known toxicity when used in different combinations with newer substances. Examples of the latter situation are vaccum plating of various metals such as beryllium, cadmium and selenium and the use of carbon dioxide in welding.

There always remains with us the problem of aggravation of a pre-existing condition in cases of compensation claims. Qualitative and quantitative data are not always easy to produce in a proven fashion and the problem then resolves itself into a matter of medical opinion - about which there may be conflicting medical opinions to cloud the issue.

It would appear to me that uniformity and jurisdictional problems arise from a series of Federal Laws enacted since 1927. This is in no sense a criticism of the laws or the need for them. They simply present a challenge to the manufacturer and his medical and hygienist advisers to see that the manufacturers' products are labelled properly under the several laws. This is essential to the protection of the manufacturer, employees handling the products, and the ultimate user or consumer. Among these laws are the Federal Poison Caustic Act of 1927 now superseded by The Federal Food, Drug and Cosmetic Act of 1938; the Federal Insecticide, Fungicide, and Rodenticide Act of 1947; the Federal Hazardous Substances Labeling Act of 1960, as well as the Amendment to the Food, Drug and Cosmetic Act dealing with color additives.

Another major challenge facing the occupational physician is the high incidence of emotional disorders as the primary or aggravating factor in industrial absenteeism. Job frustration and job dissatisfaction may result from automation where the employee fails to or cannot identify his job with the end product. Compartmentalization of factory work areas contributes to the development of emotional disorders. Present facilities for adequate and effective mental health counseling are inadequate and challenging.

Doyle[1] has pointed out that "The present occupational health approach in the nation is a two-pronged one involving (1) the identification and study of occupational disease and (2) occupational disease control and worker health maintenance through optimal utilization of industrial hygiene and preventive medical services." He goes on to point out that "forces shaping the future practice of occupational health include such diverse influences as workmen's compensation humanitarian factors, scientific and technical advance, automation, patterns of medical care, absenteeism and medical care costs to labor and management and availability of trained manpower."

A comment on "availability of trained manpower," -- the American Academy of Occupational Medicine states in its By-Laws: "The Academy will take an active part in the education of medical, nursing, and technical personnel in the field of occupational medicine. A constant effort will be made to raise and maintain at a high level the professional standards of occupational medicine." Our membership is dedicated to the fostering of education in occupational medicine at the undergraduate and graduate levels, but a major problem is manpower. We must find better ways to stimulate interest in our specialized areas among intelligent young men and women with enquiring minds. This is no small task. It is, perhaps, the major challenge facing us today, for without capable men and women in adequate numbers, we cannot begin to cope with the problems and challenges facing us. The Education Committee of our Academy has been directed to take a fresh look at this problem and to find ways and means whereby the Academy can stimulate existing programs in our Medical and Graduate Schools and to propose new approaches to this problem. I am sure that you must share with us the same anxieties in this area in your own specialty. I hope your group will continue to be among leaders in this all-important activity.

I would urge that we support intelligent legislation designed to improve and make more uniform existing Industrial Hygiene and Workmen's Compensation Laws. We live in an economic climate where the tugs and pulls on the public coffers grow stronger each day. These are reflected in an increasingly heavy tax burden on individuals and the corporations. This demands of us that we accept the challenge of being alert to and reviewing proposed legislation in these and other areas related to our endeavors.

The United States Public Health Service has recently released the Report of the Committee on Environmental Health Problems(2) under the chairmanship of Dr. Paul M. Gross. This report covers the whole wide range of environmental health problems and should be on your desk for review and study. Whether or not a National Institute of Environmental Health ever materializes, this report takes a look into the future wherein lie many more challenges than I have proposed this afternoon. I commend it to you.

The future can bring fascinating advances in many areas. Much exploration is needed in the areas of ergonomics and stress evaluation, immunology, biochemistry, as well as in epidemiology, toxicology, and the effect of psychological, social, and economic factors upon the health and efficiency of workers. The challenges are crystal clear. Let us, as individuals and as a team, get on with the job!

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ARE OCCUPATIONAL HEALTH PROGRAMS VIABLE?

Mitchell R. Zavon, M.D.
Cincinnati Health Department

The question asked by the title of this talk is meant in all seriousness. Formally organized programs of industrial hygiene or occupational health have been established in the United States for about a half century. Next year the State Industrial Hygiene programs of New York and Ohio will celebrate their golden anniversaries. In the following year the Occupational Health Section of the American Public Health Association will celebrate its mid centenary. There were earlier activities in this field of endeavour[1] but this is not intended as a historical resume but only to illustrate that this subject, occupational health, has been on the scene for an appreciable period of time.

During the half century that occupational health programs have been in existence in official agencies their growth has been spotty and irregular. Most growth has been confined to a few States and a couple of the larger cities but many parts of the country have not been covered by any program until the very recent past. Even now, in 1962, all States do not have an official agency for occupational health programs and where programs do exist they are often weak and woefully understaffed.

The need for health protection for the adult population has been recognized by the health professions and by official and voluntary health agencies. Yet, attention to the health of the population while at their place of work has lagged in the midst of a general growth of activity in the field of adult health. Haven Emerson, as long ago as 1934, urged Health Departments to be concerned with occupational diseases and to make occupational health an integral part of their programs[1]. His urgings had little effect. With few exceptions growth of interest occurred only in response to the priming of Federal Government funds.

There have been some very recent indications that the trend has been reversed and occupational health programs are growing once again[2]. This apparent reversal should be examined in more detail to determine whether it is real.

What Does Viability Imply?

To me viability in the sense used here means an awareness of life and an existence keyed to needs and an anticipation of unmet needs and demands yet to arise. An occupational health program which is aware of unmet needs and at the same time is unwilling to commit itself to meeting these needs is not viable. A program of occupational health which exists only to fulfill routine committments is not truely viable.

The non-viable program, as I have defined it, will exist as long as Federal funds are available. It may not survive the loss of Federal funds. Only when the unmet needs are probed and an attempt made to fulfill those needs is made will occupational health survive. Only in this way can this concept of preventive health maintenance gain acceptance. A Director of one program has written, "....if we ask for a certain amount of additional money we explain that this is going to be for the hiring of a man, pay his travel, and provide him with equipment to conduct plant surveys in industrial plants in a certain district. He will visit all the industries in this district on a routine basis, make evaluations, provide consultation and laboratory service, and engineering services when necessary.

"The reasons this is necessary are because the population in this district has increased 20%, the number of industrial plants has increased 50%, and they are typed in categories of those presenting significant potential health hazards...."(3

The present political emphasis is stated to be on health care. It is actually directed toward hospital care and preventive health maintenance is de-emphasized while lip service is paid to the concept.

Emphasis on disease entities, heart disease, cancer, multiple sclerosis and a host of other diseases, leaves little room for any generalized approach such as occupational health requires.

Occupational Health and the Newer Responsibilities

Emphasis on specific disease entities and their control has resulted in a stereotyped method of fund solicitation. "Disease X is a killer. Stop the killer. Your money can stop Disease X." This technique works equally well in door to door solicitations and solicitations at the doors of State and Federal Legislatures.

Health Departments and other official agencies have resorted to the same approach in some instances. Disease X in this case may be translated air pollution or radiation or some other entity with which we are concerned. The objective is always that of developing competency in an area presently unsought and unattended. Very frequently this procedure works remarkably well. A program of occupational health which totaled 11 persons in 1953 has split and split again. During this process an air pollution and a radiation program were created with a total of 45 persons employed, 16 of whom are in occupational health(4).

The splitting process is not always as successful. In more than one instance additional responsibilities have been included in the occupational health program but inadequate funds have been advanced for these new responsibilities. The result has been a dilution of the program and a diminution in the service offered by the program in occupational health.

Where additional funds and additional personnel have accompanied additional responsibilities, the actual amount of funds and personnel may not have kept pace with the added responsibilities. Only a careful analysis of each situation would reveal whether or not added responsibilities have received commensurate additional support and such an analysis is not available. My impression, and I would emphasize that this is only an impression, is that as occupational health programs have taken on responsibilities in civil defense and broadened their responsibilities in radiation protection and air pollution, their original function has tended to wither on the vine to some extent.

I do not for a moment wish to imply that these newer responsibilities are unimportant or frivolous. There can be no doubt of the need for the attention given such vital functions. We are, however, discussing occupational health programs and in this context there is some doubt that additional responsibilities in related areas have actually done much to strengthen the occupational health activity in most instances. These additional functions have the negative function of focusing attention on activities which are the glamour babies of the moment and by contrast decreasing the attention given to occupational health.

Occupational Health Programs

The scarcity of available medical personnel has in some instances resulted in the development of occupational health programs which have little or no medical representation. In such programs the emphasis, of necessity, is on inspection and engineering control with little or no attention to problems of a non-environmental nature. This type of problem is of great importance but do not underestimate the importance of the non-environmental problems and the need to use biological measurements to detect early evidence of unsafe environmental conditions. The program oriented completely toward environmental control is as unbalanced as the program directed exclusively toward medical interests.

The physician working in industry is usually much more oriented toward medical problems than toward environmental problems. The failure of the official agency program to be greatly concerned about the industrial physician's principal problems results in part in a lack of sympathetic understanding for the problems of the official agency. The official agency in turn looses the vigorous support which it might expect from someone in the same area of interest.

The occupational health problems of paramount interest in most industry today are subjects such as the prevention, care, and treatment of back complaints, dermatological problems, alcoholism, and the vagaries of awards under workmen's compensation insurance which hinder the placement of workers who have developed degenerative disease. Should the physician recommend preplacement back radiography? What is the experience of employing persons who are overweight, have a history of diabetes, or have had tuberculosis? What State or local Occupational Health Program is prepared to furnish advice and assistance to the part time or full time industrial physician who poses questions such as these? Are there answers available?

By and large Occupational Health Programs have not been eager to tackle this type of problem. Yet this is the type of problem that most needs investigation and answers. The environmental problems are important but they are not nearly as frequent as the type of problem I have mentioned.

I can come to no conclusion regarding the viability of Occupational Health Programs. I leave that to the future to determine. I would suggest that those responsible for such programs in official agencies might do well to re-examine the means and the ends. The needs of yesterday are not necessarily those of today and if they are, they may not be the only needs. Occupational health problems abound in industry. Industry today is far more than manufacturing. It includes the service trades and such institutions as hospitals, one of our larger industries. Unless Occupational Health Programs are responsive to the needs of our changing industrial pattern and continue to focus attention on their primary objective, the health protection and health maintenance of the working population, the future may perform an autopsy instead of applauding the exploits of a worthy adult.

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Better Ventilation for Close-Quarter Work Spaces

RICHARD S. BRIEF
LAWRENCE W. RAYMOND
WILLIAM H. MEYER

Medical Research Division
Esso Research and Engineering Co.
Linden, N. J.

and

JOHN D. YODER

Humble Oil and Refining Co.
Bayway, N. J.

As the result of a long range study of fume and heat outputs in closely confined spaces, the authors have developed a nomogram for determining the ventilation rate for welding processes; reached basic conclusions regarding ventilation pattern, direction, and velocity; and developed rules for ventilation where heat, rather than fume, is the controlling variable.

CONTROL OF ATMOSPHERIC CONTAMINANTS in the worker's environment, when work is performed in confined spaces, represents a most critical area of ventilation. When an operation is surrounded by walls or obstructions, or is completely enclosed within a tank or tower, air movement is restricted and potential exposures to dust, fume, gases and heat are greatly enhanced. Most exposures are not acute in the sense that there is a demanding need for control to prevent outright collapse. But even at the lower levels of exposure, environmental factors may be directly responsible for uncomfortable or undesirable conditions leading to undue fatigue and a reduction in the quality and quantity of work output.

In the petroleum and chemical industries considerable enclosed vessel work is required in equipment such as fractionation towers, drums and tanks. Exposures may exist during construction but are potentially more severe during maintenance, after the unit has handled toxic materials. Industrial hygiene surveys have shown that improved control of environmental conditions in such confined spaces would be beneficial.

In the affiliated companies of Standard Oil Co. (N. J.) a high degree of interest in improved confined space working conditions was expressed by the various medical, operating and mechanical departments. For this reason, a research project was formulated to develop optimum methods for ventilating distillation towers in which welding and cutting operations were being performed. This type of vessel work represents a large man-hour expenditure in a refinery and therefore was chosen as a logical starting point. Results derived from such a study would be strictly applicable to welding and cutting in towers. However, the basic findings should be extendible to other types of work in enclosed spaces, such as spraying, cleaning and abrasive blasting. In scope, the research was divided into several phases—literature survey, evaluation of existing ventilation techniques, determination of optimum ventilation schemes, and development of ventilation criteria.

Summary of Available Data

The purpose of this phase of the study was to determine what had been done regarding control techniques and criteria for work in enclosed spaces. Information regarding gases and fumes, composition and quantity, during welding and cutting were also relevant in relation to ventilation criteria.

Tebbens and Drinker[1] reported information pertaining to various type electrodes. The major components of mild steel welding fumes were Fe_2O_3, TiO_2 and MnO_2. Stainless steel fumes contained relatively high quantities of fluorides derived from the electrode coating in addition to the oxides of chromium, nickel, calcium and silicon. J. W. Roe[2] discusses gases and fumes from fusion welding and his data are in broad agreement with those

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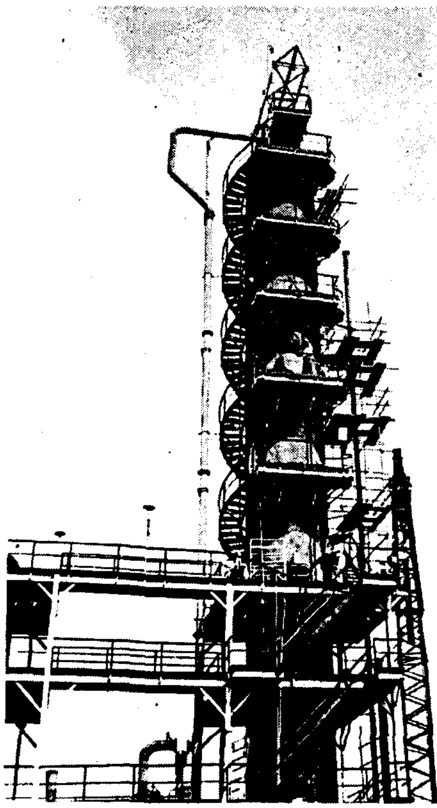


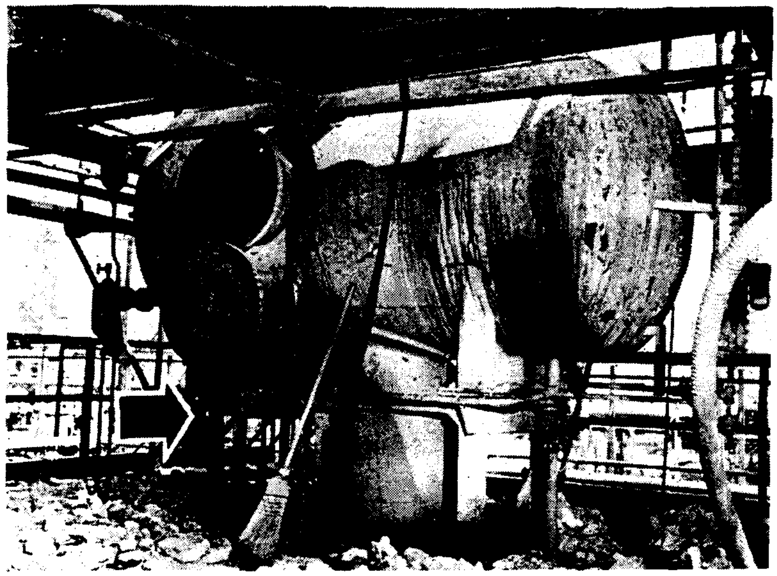


Fig. 1 (left). Tray removal and replacement were done in the top half of this 150-ft tower; both torch cutting and welding were studied at different levels. Fig. 2 (above). A high degree of confinement was encountered during welding of a nozzle in this 190 cu ft reflux drum.

previously cited. Nitrogen oxides and ozone are the major gases of toxicological importance evolved and both investigators mentioned that the hazard is very low for manual arc-coated rod welding. Little information is available, however, concerning cutting. Tebbens and Drinker conclude that ventilation specifications can be written with the concentration of visible particulate matter as a criterion. Where welding is done in an almost totally enclosed space of 2000 cu. ft. or less, they suggest the following minimum ventilation rates per welder for general air dilution to 30 mg per cu. meter:

Steel electrodes	CFM
5/32 in.	250
3/16 in.	400
1/4 *in.*	700
Alloy (fluoride coated), 5/32 in.	250
Galvanized plate, 5/32 in.	1000-1500

The American Standards Association[3] and the U. S. Department of Labor[4] define a confined space as one having less than 10,000 cu. ft. per welder or having an overhead height of less than 16 feet. Any work space may also be considered confined if structural barriers obstruct cross ventilation. Recommended ventilation for such spaces is 2,000 cfm per welder, minimum. The Bureau of Ships[5] specifies forced ventilation air requirements in enclosed spaces (5,000 cu. ft. or less) when welding on uncoated ferrous metals as follows:

Space volume, cu. ft.	Minutes per air change
4000-5000	4
3000-4000	3
2000-3000	2
Less than 2000	1

This Navy manual also summarizes the many variables which must be evaluated in addition to the above requirements.

1. Dimensions and geometry of work space
2. Number of operators (gas or electric)
3. Composition of coatings of metals
4. Type and size of electrode and amperage used
5. *Rate of welding*
6. Effects of air currents in work space; are fumes concentrated in breathing zone
7. Tendency of fumes to stratify or flocculate
8. Effects of visibility on accident rate
9. Excessive heat

Use of local exhaust ventilation is well documented in the references cited suggesting flow rates of 100 fpm at the point of welding for control. Local exhaust or respiratory protection are mandatory when fumes of cadmium, mercury, lead, or other highly toxic fumes are evolved. This type of control has certain drawbacks most important of which is that close cooperation of the workmen is required in placing and moving the hoods for good control. Also, hoses are cumbersome in small areas, especially in that they may hinder the movement in and out of small openings.

As mentioned, little or no data are available concerning hazards and control of cutting operations. Only brief mention is made of the magnitude and control of excessive heat in practical situations. Based on energy input, the order of magnitude of heat release per electrode is 400-500 Btu, a significant quantity, especially during warm weather work.

Results of this literature survey appear to be in line with unpublished industrial hygiene survey data and support the conclusion that improved means for ventilating confined spaces is desirable. For vessel ventilation of this type, general ventilation has merit over local exhaust. While the data reported may serve as base lines, insufficient information is available to permit practical application of equipment and techniques for control of day-to-day work in enclosed spaces.

Existing Techniques

The basis for appraisal of ventilation effectiveness was the extent of fume and heat reduction attained through the use of various equipment and methods commonly employed. Studies made during turnaround operations (periodic scheduled or unscheduled maintenance) in a variety of refinery vessels formed the basis for these field studies, namely 20 cases. Welding and/or cutting was done in:

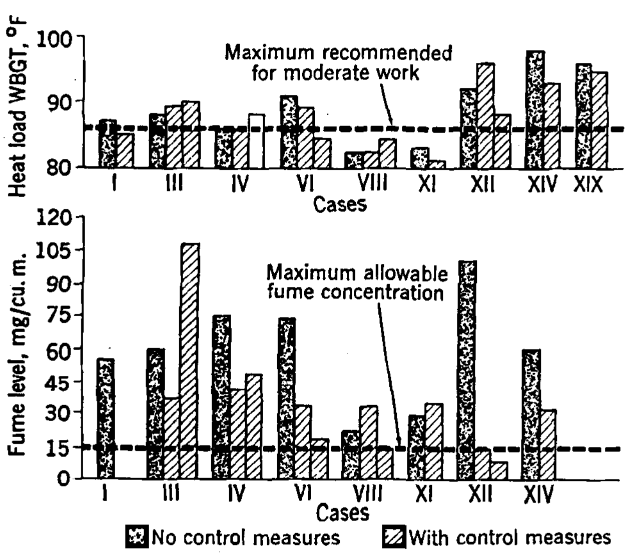


Fig. 3. Comparative results for fume and heat as obtained in a variety of actual situations. Even when control measures were employed, excessive levels can be seen to exist. Results formed the basis for a detailed study of confined-space ventilation.

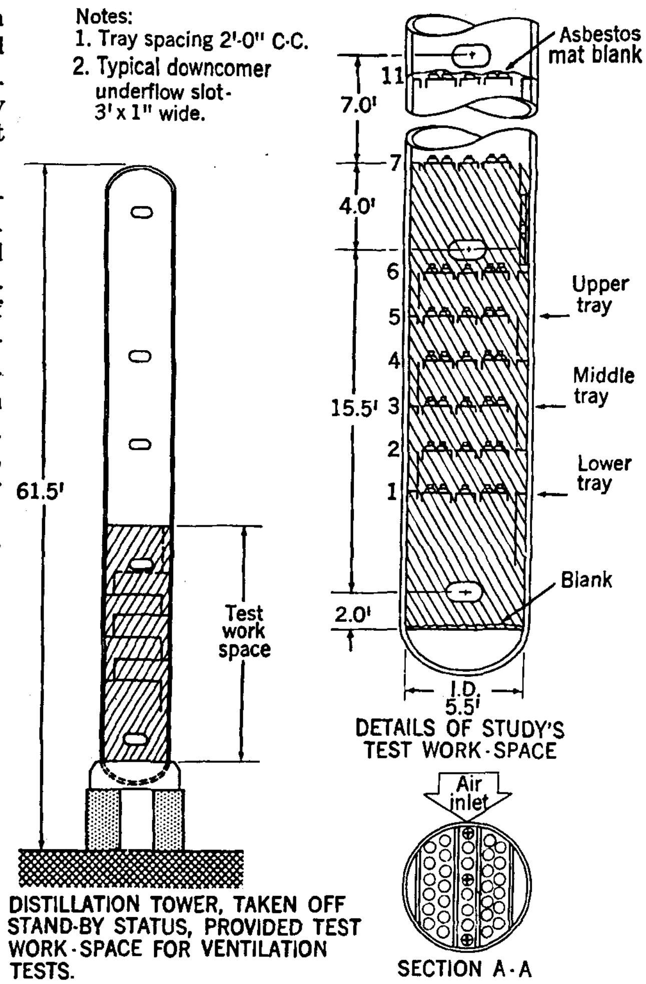


Fig. 4. Baton Rouge refinery test work space. Work was done on trays 5, 3 and 1, and progressed down the tower from the manhole near tray 6. On each tray data were taken at the three cross-marked locations in section A-A.

1. A 10-ft. diameter isobutane tower (Fig. 1)
2. A 7-ft. diameter butane tower
3. A 10-ft. diameter circular drum (front cover)
4. A 7-ft. diameter re-run tower
5. A 5-ft. diameter cylindrical drum (Fig. 2)
6. A 20-ft. by 10-ft. acid sludge settler
7. Railroad tank cars

It had been hoped that direct comparison of fume and heat levels—measured with and without ventilation—could be made to show whether or not the ventilation was doing an effective job. While this practice was followed in much of the field work, the urgent nature of turnaround completion made it impossible to obtain "matched" sets of data in all cases.

Fig. 3 shows the results obtained where comparative measurements could be made. As can be seen from this chart excessive conditions often occur

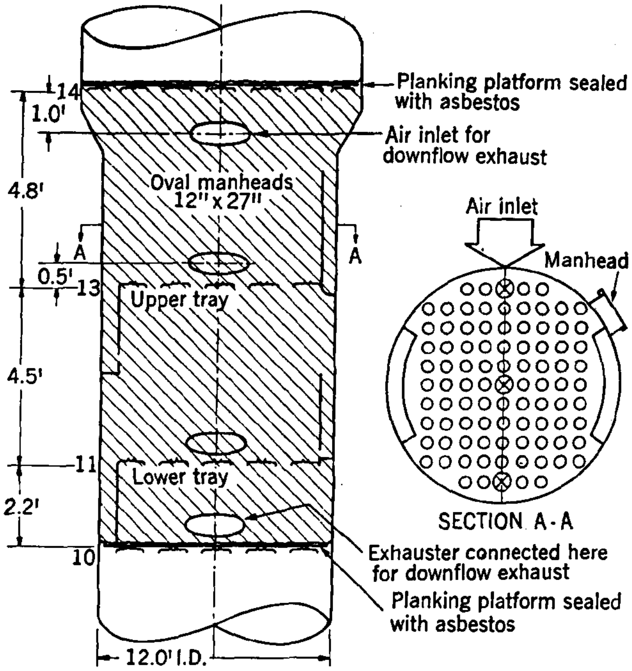


Fig. 5. Bayway refinery test work space. Work was performed on and between trays 13 and 11. For each situation data were obtained at the cross-marked points in section A-A.

when present ventilation measures are used. Fume and heat were cut an average of one-third where ventilation was used; but actual ventilating practice sometimes increased fume levels. Often, levels of fume and heat were well in excess of maximum recommended limits. It was found from these studies that on turnaround jobs, the decision of whether or not to ventilate is usually left to the individual. Even though equipment is provided, in only about 50% of the jobs is it used. Frequently the ventilation method utilized is not the best.

In the review of existing methods and techniques it was soon recognized that the basic concepts of air flow in relation to contaminant removal were not being considered. Assuming a work place between two manheads, air can be directed up or down, and these conditions can be achieved by either blowing or exhausting. It is also possible to blow and exhaust simultaneously in opposite manheads creating a push-pull ventilation scheme; this is often done. Welding position, up or downhand, was another variable noted.

Optimum Ventilation Schemes

The basic data having been reviewed, a research project was designed to evaluate the most effective ventilation method for reducing fume and heat levels.

This phase of the program consisted of evaluating the optimum ventilation in a 5.5-ft. diameter vessel. After making this determination, extension of the data to a 12-ft. diameter vessel would be attempted to assess the effect of diameter or work space area on the ventilation scheme(s) selected. In conjunction, ventilation criteria which could be practically employed were to be developed. The work was done in two refineries of Humble Oil and Refining Company—the Baton Rouge, La., refinery in the summer of 1959, and the Bayway, N. J., refinery in the winter of 1961. These towers are detailed in Fig. 4 and 5.

Fume Generation. Since this variable was to be standardized, an effort was made to utilize similar welding rate, cutting rate, amperage, voltage and the like during test runs by study personnel. The fume was restricted to four different processes and materials: welding on mild and stainless steels, gas cutting of mild steel, and arc-cutting of stainless steel.

Welding of mild steel plate was performed at a constant rate of about 3 to 4 coated rods (5/32-inch dia. x 14 inches long) each 5 minutes. During the studies constant output of the welding machine was maintained.

The energy consumed in torch cutting was maintained at a normal and fairly constant rate during the testing. A No. 6 cutting tip was used to cut successive strips of 4-inch dia steel pipe, (3/8-inch wall thickness). Actual gas rates during the cutting were 8.5 SCFH (standard cubic feet per hour) propane and 150 SCFH compressed air.

Type 304 stainless steel pipe (4-inch dia—3/8-inch wall) was cut into successive strips by the arc-cutting process. This technique utilized 1/4-inch copperclad carbon-graphite electrodes operated at up to 400 amps and 30 volts with a constant setting on the welding machine.

Sampling and Instrumentation. Reduction of fume in the work space at the worker's breathing zone was the criterion used to compare the effectiveness of the ventilation rate and the technique used. As a base-line condition fume levels were measured without ventilation. The effectiveness of the schemes used was then compared with the no ventilation level. Figures 6 and 7 show a typical before-and-after situation encountered. The welding or cutting operation was conducted at three points on a tray—at the tray center, and nearest to, and farthest from the air inlet. Breathing zone samples of fume concentrations were obtained at each position. The sampler head was held in such a way to collect air as it would be inspired by the welder. This work was repeated on different tray levels in the two towers studied under controlled conditions.

The time required for the work space to reach steady state conditions was evaluated by both a heat balance on and fume loading in the work space. This period is best described as a build up from "no work" conditions to steady state. After build up, a dynamic

Fig. 6 (left). Welding without ventilation is shown being studied. A sample of fumes taken in the welder's breathing zone was measured at 80 mg per cu. m. Fig. 7 (right) shows same situation but with a downflow general exhaust of 53 fpm average velocity being employed. The fume concentration was reduced to 5 mg per cu. m.

equilibrium is established between the generation of heat and fume by the work and their removal from the work space by ventilation. It was found that the concentration of fume tended to maximize because of rapid flocculation, particularly at high concentrations. The steady state period represented conditions of maximum fume concentration developed during the test. After the build up period, the air in the welder's breathing zone was sampled for 5 to 10 minutes. Also during this period measurements were made in the Baton Rouge tower to determine the heat load to which the worker was being exposed, at steady-state. In this vessel, because heat was a parameter, a 10 minute "clean out period" followed the sampling to bring heat back to "no work" levels prior to the next cycle. In the Bayway study—done in the winter—this was not necessary and the next cycle was conducted without a "clean out" step. The two approaches were evaluated and found to be identical as far as generated *fume* levels were concerned.

The environmental factors affecting heat stress were measured by means of dry bulb, wet bulb, natural wet bulb, and black globe temperatures and air velocity. Work was estimated to be moderate or at a metabolic expenditure of about 700 Btu per hr.

Control Measures. It was found that the Lamb air ejector was the most commonly employed air mover in the refineries studied. In the initial study of existing practice it was found that often these units were not used correctly. Unless the opening through which the Lamb units exhaust air is fully covered, much of the air handled will "short circuit." That is, air around the outside of the opening —instead of air from the work space—will be drawn into the ventilator. Fig. 8 shows such an ineffective installation while Fig. 9 shows how this was corrected with a gusset plate. The gusseted Lamb units are hung on the manway lip by angle straps which give a good air seal. These units were used during the study to provide general exhaust ventilation. The vaneaxial fan shown in Fig. 9 was outfitted with a sheet metal adapter to fit the oval manheads in the Bayway study. Other control measures employed were the use of a local exhauster and air circulation provided by a household-type fan in conjunction with low rates of general ventilation.

Results and Observations

Fume Control. Fig. 10 summarizes the average performance obtained in the Baton Rouge study for various ventilating schemes applied to downhand welding. The results are for a ventilation rate of 1600 cfm or 67.5 fpm average velocity. For a higher flow rate of 2500 cfm the average fume reduction was about 8% better while at a rate of 1000 cfm the results were poorer by a similar amount. These flow rates were chosen because they were within the capacity of the Lamb air movers used.

Although all methods showed a large reduction in fume levels—even the poorest having an 80% reduction—schemes V-3 and V-4, where the air was mechanically exhausted out the bottom below the work space, were the best. The values in Fig. 10 represent average fume levels within the tower. As would be expected these levels varied on different trays within the tower and at different positions on the tray. One or more of these locations might show poorer performance than the average. However, it was felt that for evaluation purposes, the average fume concentration was most descriptive.

From the above information, exhausting only, out of the lower opening, can be considered best for downhand welding. There are five other advantages to this scheme:

(1) With the top manway open easy entrance and exit is provided.

(2) Hoses, cables and materials may be easily pulled into the work space.

(3) Communication with the outside man is facilitated.

(4) Ventilators used to supply air to the work space may create noise levels of such magnitude as to represent a potential source of noise-induced hearing loss, (e.g., when used to supply air, the 10-inch Lamb ventilator—operated with 22 psig air at the unit—gave an overall sound pressure level of 108 db in the Baton Rouge tower. From octave band analysis information, it was found that exposure to this noise for more than three hours per week might involve the risk of long-range hearing loss[6]).

(5) Ejectors used as supply ventilators may supply air of poor quality, since compressed air used to drive the unit might contain rust particles, oil droplets and carbon monoxide.

Overhead welding was similarly studied with various ventilation schemes. Fig. 11 gives a summary of these results which show that upflow ventilation—exhausting only—is preferred. Obviously it would be undesirable and perhaps impractical to alternately change the direction of air flow to accommodate the type of welding performed; that is, relocating the air exhauster as the welding operation changes from uphand to downhand and vice versa would not be acceptable.

Since upflow exhaust is the most effective way of controlling fume from overhand welding and downflow exhaust is the most effective way of reducing fume from downhand welding, the ventilation scheme selected should depend upon the predominance of the welding operation conducted. When there is no clear case, downflow exhaust, for the practical reasons suggested previously, would be preferred.

Fume Levels and Standard Ventilation Tests. The fume loading data for downhand mild steel welding were averaged for each velocity studied in both the Baton Rouge and Bayway towers. The concentration of fume in the breathing zone of the welder at the near edge, center and far edge was averaged for the trays studied at each downflow velocity employed. The Baton Rouge work space was much deeper (see Fig. 4 and 5), hence three tray levels were studied there compared to two trays in the Bayway test.

Analysis of fume concentration versus average tower velocity yielded a regression equation (with probability exceeding 99.9%) as follows:

$$\log C = 1.85894 - 0.02154 \frac{Q}{A}$$

where C = concentration of mild steel welding fume, mg per cu. meter,
Q = total air volume exhaust rate, cfm,
A = cross-sectional area of the tower, sq. ft.

It is obvious from the correlation obtained that tower diameter—in the 5.5 to 12-ft. range—does not affect the manner in which fume is controlled by general exhaust ventilation.

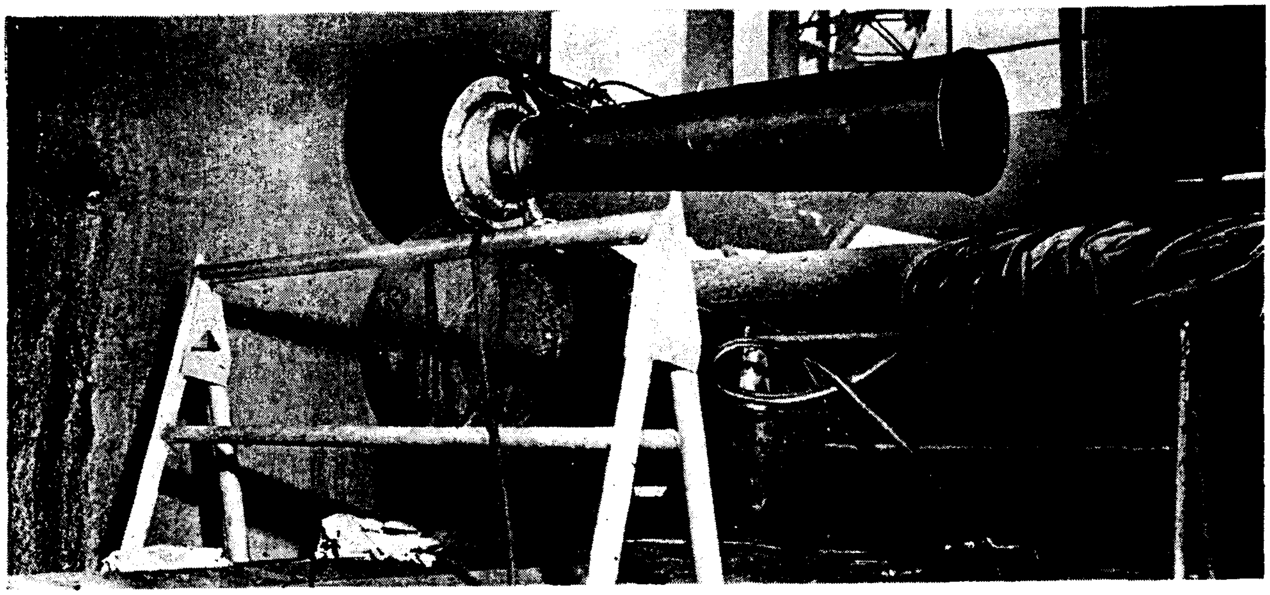
The regression curve developed for mild steel welding shows that the decrease in fume content follows a logarithmic decay pattern. The regression coefficient, –0.02154, gives the decay rate which would be expected for any fume controlled by general exhaust ventilation in the confined spaces studied. This extension of the data to other fumes (or their components) is logical and to be expected based on the character of fumes and the mechanism of air dilution control.

By re-arranging the regression equation into a generalized expression it becomes more useful. Thus:

$$Q/A = 46.43 \log (C_1/C)$$

where C_1 = initial concentration (without ventilation), mg/cu.m.
C = desired concentration (with ventilation), mg/cu.m.
Q/A = average tower velocity, fpm

The solution to the generalized expression and conversion to suggested ventilation rate has been developed in an alignment chart, Fig. 12. Estimates of fume or component concentration without ventilation have been summarized from both the Baton Rouge and Bayway studies and are tabulated in Table 1 in Fig. 12. These values should be considered as estimates only. They may be revised or amended as more data are accumulated from various operations in enclosed spaces.



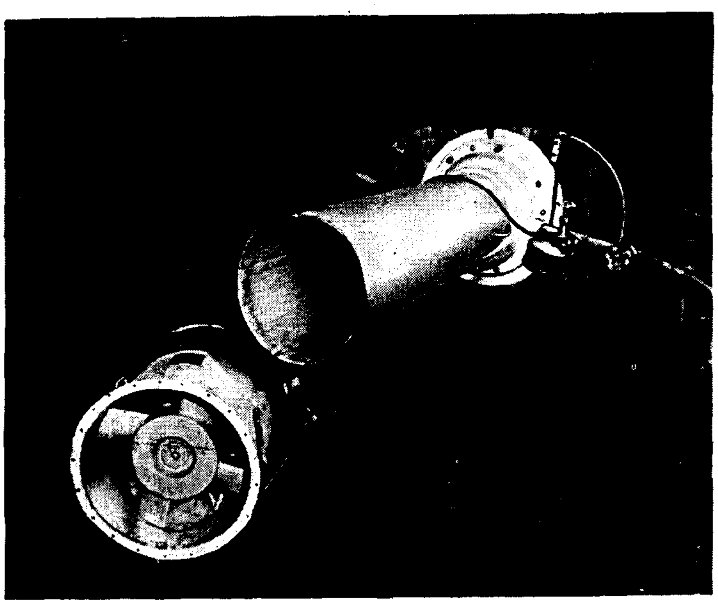


Fig. 8 (above). As installed on the oval manhead, this air ejector is handling more outside air than work-space air. Fig. 9 (left). Installing a plywood adapter to prevent short-circuiting of air improves the ejector's efficiency in exhausting the work space. Two air lines feeding ejector also improve its performance. Vane-axial blower on deck was used in study to obtain high flow rates.

Use of Chart. In using the alignment chart (Fig. 12) the total fume or component of the fume *without ventilation* is estimated or taken from Table 1. Values here represent fume concentration and analysis data obtained during the course of the ventilation study. The concentration value on the right scale is connected to the diluted concentration desired on the scale immediately to the left. The line thus established is continued to intersect the center scale (velocity and fume reduction scales) which serves as a pivot line. The tower diameter on the slanted scale is now connected with the intersection on the pivot line and the line continued to intersect the left scale, the suggested ventilation rate. It should be noted here that at the center scale the average tower velocity and/or the percent fume reduction obtained may be read. However, neither item is necessary to estimate the exhaust ventilation rate. The following examples show how this method is used to solve actual problems.

Example 1: Stainless steel welding using 5/32-inch electrodes will be performed in a 10-ft. dia vessel. How much exhaust ventilation would be needed to maintain chromium content in the fume to 0.1 mg per cu.m.?

Solution: The solution is shown on the alignment chart. From Table 1, assume the average CrO_3 concentration without ventilation is 0.93 mg per cu.m. Connect 0.93 mg per cu.m. on the right scale (component without ventilation) to 0.1 mg per cu.m. on the next scale to the left (component with ventilation). Extend this line to intercept the center scale.

Join this point with 10 feet on the tower diameter scale (slanted) and read 3530 cfm on the far left scale as the suggested ventilation rate. This flow will take care of average conditions. If further assurance of control is needed, higher air flow rates can, of course, be used. The alignment chart can again be employed in the same manner, but instead of starting with 0.93 mg per cu.m., use perhaps 1.6 mg per cu.m. of CrO_3. The suggested flow obtained by this recalculation is 4390 cfm.

Example 2: Mild steel welding will be done with 5/32-inch electrodes in a 7-ft. dia tank. What rate of exhaust ventilation would be needed to control fumes to 15 mg/cu.m.?

Solution: For the welding conditions specified, an average fume concentration of 72.3 mg per cu.m. is expected as noted in Table 1. Connect 72.3 mg per cu.m. on the right scale (fume without ventilation) to 15 mg per cu.m. on the next scale to the left (fume with ventilation) and continue the connecting line to intercept the center scale (average tower velocity). Now join this intersection point with 7 ft. on the tower diameter scale (slanted) and read 1230 cfm as the suggested exhaust ventilation rate on the far left scale.

An extension of the fume emission data from the 5/32-inch x 14-inch electrodes to other size electrodes has been studied by Tebbens and Drinker. The characteristics of different size coated rods evaluated in their study are tabulated in Table 2 along with a ratio of fumes released related to 5/32-inch electrodes.

They concluded that ⅓ to ½ of the fume from steel electrodes can be attributed to the coating. However, it was noted that even with almost identical electrodes, relative to core and coating weight, the fumes generated could vary as much as three-fold. The wide variation was explained by differences in coating materials. The fume ratios, viz., 1:1.8:3.9, can be applied to the fume concentration data shown in Table 1 for use with the alignment chart. In this manner estimates can be made of initial fume concentration when using other than 5/32 in. electrodes. For example, if in Example 1 the electrodes had been ¼ x 14 inches instead of 5/32 inch, the average concentration, last column in Table 1, would be $0.93 \times 1.8 = 1.67$ mg per cu. m.

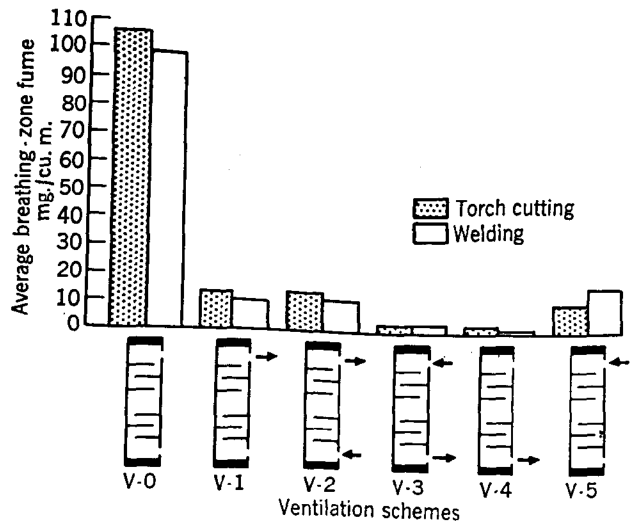
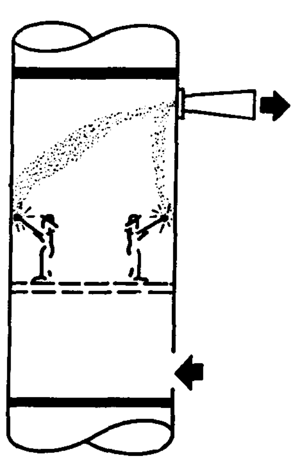


Fig. 10. Comparative performance of the five ventilation schemes studied for downhand welding and cutting. Although all schemes gave good results compared to no ventilation (V-O), schemes V-3 and V-4 showed that downflow exhaust was the preferred method.

One other aspect should be considered—that of more than one welder in the work space. The study considered only one welder working at a time. Clearly, many welders working simultaneously will produce more fume than one welder. Therefore, the fume estimates shown in Table 1 should be multiplied by the number of welders working together to get a better assessment of fume released in the work space.

However, there is a limitation to using both of these multiplication factors. That is, there appears to exist an upper level of fume concentration that can be sustained before flocculation and agglomeration occur. The resultant large particles settle out of the air quite rapidly; particularly at high con-



WORK	AVERAGE VELOCITY, fpm	FUME IN BREATHING ZONE, mg/cu.m.	
		UPFLOW SCHEME	DOWNFLOW SCHEME
OVERHEAD WELDING	0	50.7	50.7
	22	7.8	17.6
	37	4.4	10.2

Fig. 11. Results obtained in a study of overhead welding showed that upflow exhaust ventilation is preferred for overhead work.

Fig. 12. Alignment Chart for Fume Control Ventilation

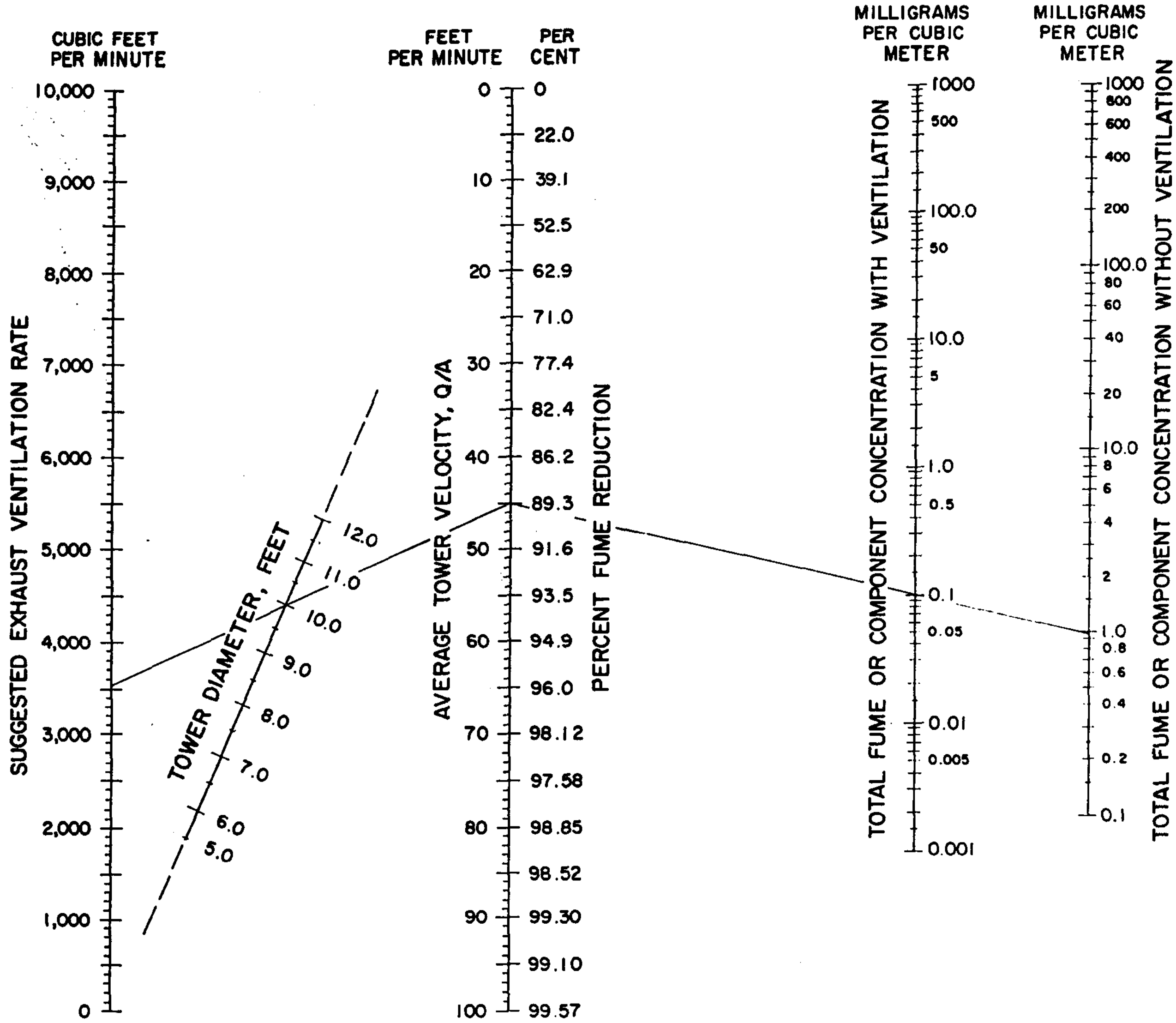


Table 1

FACTORS FOR USE IN DETERMINING CONFINED SPACE VENTILATION

OPERATION	MATERIAL	LIMITING COMPONENT IN FUME	TARGET CONCENTRATION WITH VENTILATION mg/cu.m.	ESTIMATED CONCENTRATION WITHOUT VENTILATION, mg/cu.m.	
				RANGE	AVERAGE
WELDING	MILD STEEL	TOTAL WEIGHT	15	33-206	72.3
TORCH-CUTTING	MILD STEEL	TOTAL WEIGHT	15	38-224	105.
WELDING	STAINLESS STEEL	CrO_3	0.1	0.6-1.6	0.93
ARC-CUTTING	STAINLESS STEEL	CrO_3	0.1	9.4-16.0	12.5

This alignment chart for determining ventilation requirements in close-quarter work spaces is a generalization of the regression equation developed in the text. Table I serves as a guide in estimating fume concentration without ventilation for various operations. The authors feel that the chart is applicable to any close-quarter work involving contaminants.

Table 2. Relationship of Fume to Electrode Size

Electrode size, inches	5/32 x 14	¼ x 14	5/16 x 18
Weight core metal, gms	34	89	178
Weight coating, gms	10	24	51
Power, watts	4500	9900	18,000
Fumes per electrode, gms	1.3	2.3	5.0
Fume ratio related to 5/32-in electrodes	1.0	1.8	3.9

centrations the decrease in fume content may be as much as 50% in one-half hour.(1) Thus, even though the factors described above may predict rather high initial fume concentrations, the actual level may be significantly lower. *Tests in the vessels studied gave maximum levels of about 250 mg per cu.m.* Values much beyond this would not be expected to occur.

Between-Tray Work. It was found during the course of these studies that air entering a work space is most effective when it can be directed from the inlet to the man and then out through the exhauster. If the air must first pass through some restriction such as a bubble tray, its effectiveness is diminished and its fume controlling properties are accordingly reduced. Such a situation occurs when a man must weld between trays where no manway exists for entering the space from the outside. This requires the welder to cut a small opening in either the top or bottom tray and work his way into the space to perform the tasks required. Obviously work under such conditions poses additional ventilation problems because the presence of trays both above and below tends to restrict motion. This situation was simulated in the Bayway tower. The results, averaged across the tray, are shown in Fig. 13. It can be seen that as the average velocity was increased, the levels of fume from both mild steel and stainless steel welding were reduced. Although the levels were lowered by similar percentages, they were not reduced by the same order of magnitude as would have occurred at the same air flow if the tray above the worker were not there.

Use of Air Circulation. The Baton Rouge study explored the directional aspects of air movement in confined spaces. It became evident that the key to best control lies in moving the contaminant away from the breathing zone. The direction of the generated heat, fume or other contaminants in relation to the breathing zone must be counteracted by direction and velocity of cleaner air. Apparently this concept is so basic it is often overlooked in setting up ventilation for confined space work. As shown in Fig 14, by simply sketching in trained arrows, a good picture of the effective airflow direction can be obtained. The situation on the left is not uncommon; air is blown into both openings creating turbulence and poor removal of fume. A little thought, and perhaps a sketch, would have given good air direction and control away from the breathing zone as shown on the right. *It can be concluded from this figure that ventilation rate in itself may be less important a factor than the ventilation scheme used for controlling the confined space contaminants.* A scheme which gives undesirable air patterns in a work space may give equally poor control at high or low flow rates.

Fig. 15 presents the results obtained from an experiment to ascertain the effect of circulating the welding fume throughout the work space in an effort to dilute the breathing zone concentration. An average tower velocity through the confined space of only 22 fpm was employed for this test. A household-type propeller fan with a rheostat to control fan revolution rate was used to direct work space air between the worker's breathing zone and the welding task. It can be seen that a velocity of 100 fpm through the working zone gave excellent control of the fume level. Control was improved slightly by increasing the circulation rate to 300 fpm, but because the fume level was already quite low at the 100 fpm condition, only minor improvement would be expected.

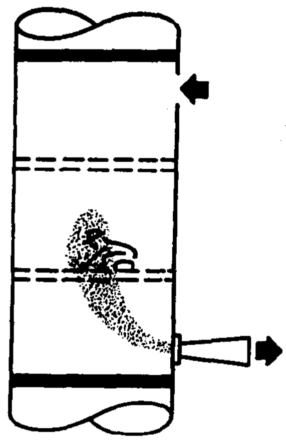
The volume delivered by the household-type fan was estimated to be 130 cfm at the low rate of 100 fpm in the welding zone and 420 cfm at the 300 fpm rate.

At 300 fpm sparks actually turned in their flight and were redirected away from the fan. Fume clearly moved away from the worker. As the velocity of the fan was decreased the sparks hit the fan blades although fume was still being controlled. At about 30 to 50 fpm the fume was not controlled but drifted into the breathing zone. The test was interesting because it showed that there are two factors in controlling fume within confined spaces:

1. The effect of air change rate through the work space;
2. The effect of distributing contaminants from a local generation point throughout the work space to obtain maximum dilution.

Table 3. ASA Local Exhaust Specifications

Distance from arc or torch, inches	Minimum air flow, cfm	Duct diameter, inches
4-6	150	3
6-8	275	3½
8-10	425	4½
10-12	600	5½



WORK	AVERAGE VELOCITY, fpm	FUME IN BREATHING ZONE mg/cu.m.	
		MILD STEEL	STAINLESS STEEL
DOWNHAND WELDING	0	75.9	52.8
	22	34.7	20.0
	37	26.8	15.8

Fig. 13. When a restriction such as another tray is situated in the path of incoming air, the fume controlling properties are diminished. The results shown here substantiate this conclusion.

A combination of the two, as shown in this test, seems to be the most satisfactory way of controlling fume when general ventilation alone will not suffice. Use of a circulating fan plus low general ventilation would have advantage in winter work. During the cold weather, workers might be reluctant to use high ventilation rates because of the chilling effect. However, lower rates with the circulating fan might have greater appeal.

This combined approach would also have application in the control of fume generated during between-tray work described previously.

Local Exhaust. If properly applied, local exhaust can be quite useful in all types of welding situations including confined space work. The American Standard[3] on this subject contends that freely moving exhaust hoods should be provided with a rate of air flow sufficient to maintain a velocity of 100 feet per minute in the zone of welding. Shown in Table 3 below are ASA recommendations for rates of ventilation required to obtain this control velocity using a 3 in. wide flange on the exhaust hood. If a flange is not employed the minimum air flow should be increased by 20%.

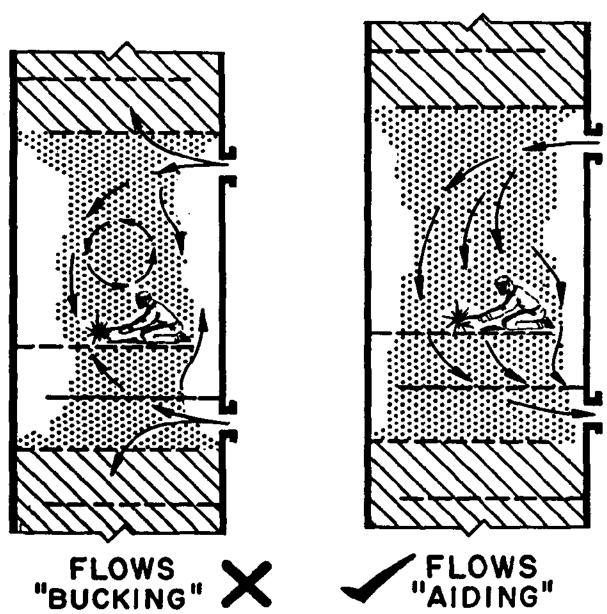


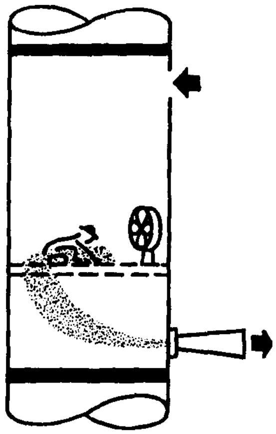
Fig. 14. A ventilation technique, regardless of its flow rate, must give desirable air flow patterns in the work space to be effective.

Tests in the Bayway tower with a 4 in. unflanged round duct found that as little as 80 cfm applied at 8 inches from the welding zone captured about 85% of the fume generated (see Fig. 16).

Although local exhaust provides removal of fumes with comparatively low flows, the area of influence of the exhaust opening is limited. At about one diameter from the plane of the exhaust opening, the air velocity has decreased about 90%. Therefore, to obtain maximum effectiveness the welder must re-position the exhaust hood as he changes welding locations to keep the hood in close proximity to the fume source.

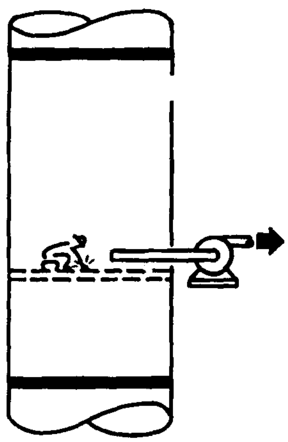
Thus, active cooperation by the welder is inherent in this type of control procedure. Another drawback to this method in enclosed spaces is the fact that the exhaust duct must pass through the manway so that the collected fumes and gases can be discharged to the outdoors. This obstruction of the exit, particularly in the case of an emergency, may be objectionable. Also, if heat is a problem, the small air movement obtained with a local exhauster would not be adequate for heat control.

Tandem Positioning of Workers. Sometimes work is conducted at several levels in a tower, as shown in Fig. 17. If the workers are separated by blanks (made by fitting wooden platforms and asbestos on an intermediate tray), then each section can be treated as a single work space to be individually ventilated. On the other hand, this isolation may



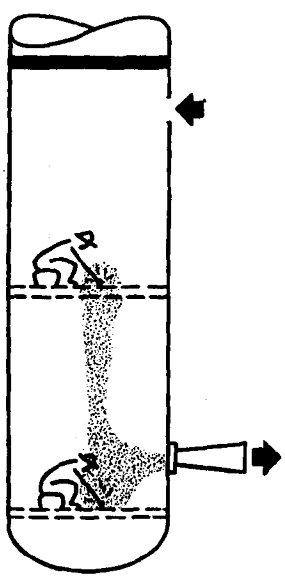
WORK	AVERAGE VELOCITY, fpm	FUME IN BREATHING ZONE, mg/cu.m.
DOWNHAND WELDING - MILD STEEL	22	17.0
	22 + 100 fpm CIRCULATION	3.6
	22 + 300 fpm CIRCULATION	2.6

Fig. 15. Low rate of exhaust ventilation can be employed if the fumes generated are displaced from the welder's breathing zone by a directional velocity of 100 fpm. A small fan or similar device can be used to provide the dispersion required.



WORK	AVERAGE VELOCITY, fpm	FUME IN BREATHING ZONE, mg/cu.m.
DOWNHAND WELDING - MILD STEEL	0	65.3
	0 + 80 cfm LOCAL EXHAUST	9.5

Fig. 16. The local exhaust unit used in these tests was placed 8 inches from the welding and collected about 85% of the fume. Importance of placing unit as near as possible to the work cannot be over-emphasized.



WORK	AVERAGE VELOCITY, fpm	FUME FROM UPSTREAM MAN ENTERING THE DOWNSTREAM BREATHING ZONE, mg/cu.m.
DOWNHAND WELDING - MILD STEEL	42	18.3
	105	5.7

Fig. 17. Tandem work poses a difficult ventilation problem as these data clearly indicate. Breathing air of the downstream man may contain contaminants generated by upstream operations.

TABLE 4. DATA ON HEAT PRODUCTION FROM WELDING AND CUTTING

Operation	Temperature, Deg F Outside	Work Place	Heat Values Radiation, Btu per hr	Convection, Btu per hr	Ventilation, fpm	Yaglou index WBGT
Welding	84	87	0	(150)	67	82.5
Cutting	83	97	375	45	67	88
Welding	88	90	115	(140)	104	82
Cutting	88	94	480	(25)	104	88
Welding	89	100	310	53	0	90
Cutting	89	123	700	340	0	100

Note: ( ) = cooling

not be practical or feasible in some installations. It is then that pollution of breathing air between working levels adds an extra burden to the downstream man.

The downstream man is in a poor position because, first, as was discussed in between-tray work, restrictions which reduce the random motion of air tend to lower the fume controlling properties of the ventilation scheme employed and, second, the fume and heat generated by the upstream welder(s) will contaminate, to some degree, the breathing air of the downstream man.

Tests in the Baton Rouge tower showed that with a welder three trays above, the "fresh air" supplied to the downstream man may contain as much as 18 mg per cu.m. of welding fume. This must be added to the expected fume levels from his own welding or cutting task.

Therefore, tandem positioning of burner-welders at opposite ends of a work space makes the job of ventilation more difficult. A possible solution to such a set-up would be the use of local exhausters, particularly important at the upstream position to capture the fumes before they can enter the downstream breathing air. Another approach would be to use high rates of general ventilation along with a circulating fan (see section on Use of Air Circulation) for the downstream man.

Nitrogen Dioxide. Numerous samples of work space air were analyzed for nitrogen dioxide by the Mine Safety Appliance Co. detector kit. Samples were taken during welding and arc cutting, with and without ventilation. Maximum *fume* concentrations for these operations were 120 and 250 mg per cu.m., respectively. In all cases NO_2 values were below the limit of detection, less than 5 ppm. These data are in agreement with those of Tebbens and Drinker who concluded that the NO_2 produced from coated electrode arc welding, will not exceed the maximum allowable concentration of 5 ppm unless the fume concentration exceeds at least 90 mg per cu.m. and most often 500 mg per cu.m. Arc cutting with copperclad carbon electrodes also appears to require an extremely high fume concentration before NO_2 can be detected.

Effects of High Temperatures. In addition to fumes and gases from welding and cutting operations, heat is a significant problem and often affects both quality and quantity of work output.

Heat data were taken during summer conditions while welding and cutting in the 5½-ft dia tower at Baton Rouge. These data, presented in Table 4 show maximum heat conditions within the tower on the intermediate tray after a standard work period of 15 to 20 minutes.

Radiation and convection were calculated using the method proposed by Haines and Hatch[8] and reflect biophysical heat stress on the worker. The Yaglou Index[9] (WBGT) is an expression of heat level imposed on the body and is calculated from the formula:

$$WBGT = 0.7\ NWBT + 0.3\ BGT$$

where NWBT = Natural wet bulb temperature, deg F (from a stationary wetted thermometer bulb),

BGT = Black globe temperature, deg F

An index of 86 is tentatively suggested as the maximum for a continuous work schedule of 50 minutes on and 10 minutes off. A level of 100 represents very severe physiological strain.

Note in Table 4 that gas torch cutting results in a greater heat load on the worker than does welding under the conditions studied. The heat of combustion of the cutting torch, utilizing 9 cubic feet per hour of propane, was calculated to be about 22,000 Btu per hr. Based on wattage supplied to the 5/32 in. welding electrodes, the heat input is calculated to be about 15,000 Btu per hr. Subjective feelings of warmth also suggest that gas cutting produces a warmer environment.

Under conditions of no mechanical ventilation and at outside conditions as in Table 4, excessive heat from both welding and cutting can occur and may lead to severe physiological strain. With forced ventilation, even at the lowest flow rate of 42 fpm used in the study, all heat levels during welding were below an index of 86 and assumed to be of no health significance. Cutting operations consistently produced heat indices higher than desirable for extended exposures during warm weather work.

Convective cooling is the most practical method for heat control in these situations. Increased velocity and/or supply air cooling may be required. The convective cooling effect on man can be estimated from the equation[8]:

$$C = 2.1\sqrt{V}\,(t_a - 95)$$

where C = Btu per hr
V = air velocity, fpm
t_a = air temperature, deg F
95 = assumed skin temperature, deg F

As work place air temperature approaches skin temperature of 95 deg, cooling effect is decreased; if air temperature exceeds 95 deg, air velocity will add convective heat to the man. As discussed in a previous section, ventilating air required for fume removal can be estimated by means of the alignment chart, Fig. 12. When welding fume is controlled to less than 15 mg per cu.m. (the 8-hr maximum allowable concentration), heat will generally be controlled as well. This assumes of course that ambient conditions are similar to those of the test conditions with a maximum of 90 deg dry bulb temperature. For other conditions and especially for cutting, excess air over and above that required for fume removal may be necessary for satisfactory heat control. Where sufficient cooling cannot be attained under practical limitations, exposures should be controlled by adjusting the work schedule.

Effects of Low Temperatures. The last phase of the program was conducted during an exceptionally long cold period during the winter of 1961. The welding and study personnel wore heavy winter clothing including gloves, long underwear, coveralls, long sleeve jackets, and rubber shoe covers.

Ambient temperatures during the test work were as low as 10 deg F, usually about 20 deg, but occasionally reached 40 to 45 deg. Two radiant heaters each having 2 kw heating capacity were placed in the tower to moderate the chilling temperatures, particularly necessary when the general exhaust ventilation was used.

On the top tray, and to a lesser degree on the lower tray when the outside air temperature was less than 40 to 45 deg, direct flow on an individual created an uncomfortable cooling effect. This was true even with the radiant heaters in close proximity to the worker. It is probable that most workers would prefer the fumes to the cold air and would not turn on ventilation equipment when such conditions prevailed. In this instance the use of a local exhauster or a circulating fan with low general ventilation as described elsewhere would be recommended.

Between trays there was no sensation of air movement even at an average tower velocity of 37 fpm. Nevertheless, the airflow did create a chilling effect on the feet which could be recognized in a short time when the outside temperature was 10 deg. This occurred even when the radiant heaters were used.

In Table 5 the effect of air temperature and velocity on the sensation of cold during cold weather vessel welding and cutting is shown. This is strictly an empirical device to be used as a guide only and represents subjective feelings of the writers and welders. The approach used is somewhat similar to that used by Siple[9] in development of the Wind-Chill index.

For our purposes, the convective cooling equation was evaluated in terms of cold weather work. Here skin temperature of 91.4 deg as used by Siple was substituted for 95 deg. With the same symbol definitions the equation then becomes:

$$C = 2.1\sqrt{V}\,(t_a - 91.4)$$

In Table 5, this equation is solved for various air

TABLE 5 — EMPIRICAL EVALUATION OF EFFECTS OF AIR TEMPERATURE AND VELOCITY ON SENSATION OF COLD

Air temperature, deg F	Q/A = 40	Q/A = 80
	Btu per hour cooling	
68	390	490
59	540	680
50	690	870
41	835	1060
32	985	1250

Rate of cooling, Btu per hr	Sensation
400-500	Hot
500-600	Warm
600-700	Pleasant
700-800	Cool
800-900	Very cool
over 900	Cold

temperatures and average velocities in the vessel. The value of V is not the calculated Q/A but a velocity directly related to the air movement in the work space corresponding to Q/A.

The subjective sensation data are restricted to workers dressed in normal cold weather clothing. It should be noted that with significant air velocity on a man at temperatures below 50 deg complaints of chill will probably occur.

Conclusions

(1) In the vessels studied, control of welding and cutting fumes by general exhaust techniques was found to vary with average air velocity. As general ventilation is increased, fume control on the average is improved. The mathematical relationship between average fume level and general tower ventilation was determined to be $Q/A = 46.43 \log (C_1/C)$

where C_1 = Initial concentration of fume (without ventilation), mg per cu.m.
C = Desired concentration of fume (with ventilation), mg per cu.m.
Q/A = average tower velocity, fpm.

This equation can be applied to total fumes or their components.

(2) Air circulation directed through the work zone to dilute the fumes throughout the work space is an effective way of controlling fume levels if used in conjunction with general ventilation. A velocity of about 100 fpm past the work is sufficient. This combination control method will reduce air requirements below those estimated for general ventilation only.

(3) Fume control by local exhaust method is useful in confined spaces particularly when tandem work is involved. There are, however, some practical limitations to this method. Frequent positioning may be necessary for effective utilization, the ducting may block the manway accessibility, and excessive heat exposures will probably not be controlled.

(4) Upflow exhaust is the most effective way of controlling fume from overhead welding. On the other hand, downflow is the most effective manner of reducing fumes from downhand welding. The ventilation scheme selected, upflow or downflow, should depend upon the predominance of the welding operation performed. When no clear cut case is presented, downflow exhaust is suggested.

(5) If the air first has to pass through a restriction, such as bubble trays, before impinging on a man, its fume dissipating properties are seriously diminished. Thus, the general ventilation scheme by itself may not be an economical way of reducing fume in between-tray work. Instead, local exhaust or use of air circulation in conjunction with exhaust ventilation is suggested.

(6) Suggested ventilation rates for fume control may not be valid during periods of low ambient temperatures. Under these conditions lower rates may be employed (20 to 30 fpm average tower velocity), if small fans are used to disperse fumes from the breathing zone of the welder into the work-space. An alternative approach might be the use of a local exhauster.

(7) Excessive environmental heat can develop during welding and cutting operations in confined spaces. With ambient temperatures to 90 deg, ventilation required to control fumes also controlled heat developed during welding. Additional air or supply air cooling would be necessary to maintain desirable work place temperatures for torch cutting over extended periods.

(8) Although in theory nitrogen dioxide can be formed during welding and cutting operations, no detectable quantities were found during the test program.

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