

L. de Tollenaere - Brussels

F. Kennedy - Ponca City

April 1, 1975

Thanks for the information re VCM in air and residual VCM in polymers. Vinatex provided Saddle Brook with a copy recently which was forwarded to me. We have since ordered copies for the VCM and PVC plants.

Flynt Kennedy

lm

CHEMICALS
RESEARCH

APR 1 1975

Interoffice Communication

To Mr. F. Kennedy - Ponca City

From L. de Tollenaere

Date March 24, 1975

Subject

FK
WSD
CK
APM
WDS
LM

As is shown on the attached correspondence, the British Federation has published a guide about analysis methods regarding VCM in the air and residual VCM in polymers. We have ordered a guide like this for our information in Brussels and we wonder whether this is of interest to you. Please let us know if you want to order one on your behalf.

LDT/cvw

L. de Tollenaere

Thanks for the information re VCM in air and
residual VCM in polymers. The material provided
Siddhant with a copy recently which was
forwarded to me. We have ordered copies for the
VCM and PVC plants

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VRD 0002013231

FEDERATION OF CHEMICAL
INDUSTRIES OF BELGIUM

Mr. Calhoun
CONOCO

February 24, 1975

PS./143

Dear Sir,

The British Federation has recently published a very interesting practical guide about analysis measurements of vinyl chloride in the air as well as residual vinyl chloride in the polymers.

This work can be obtained at a price of 20 Pounds Sterling a piece at the following address:

Publications Department
Chemical Industries Association Ltd.
Alembic House
93, Albert Embankment
London SE1 7TU

I thought that in view of the interest of this work, it was worthwhile to have you informed personally.

Yours faithfully,

Paul F. Smets
General Manager

Translation: dd



FEDERATION
DES INDUSTRIES
CHIMIQUES
DE BELGIQUE asbl

Monsieur CALHOUN
CONOCO

WNO 0002013232

SQUARE MARIE-LOUISE 49
1040 BRUXELLES

le 24 février 1975 N./réf. PS./143

Cher Monsieur,

La Fédération britannique vient de publier un très intéressant guide pratique des mesures d'analyse du chlorure de vinyle dans l'air et du chlorure de vinyle résiduel dans les polymères.

Cet ouvrage peut être obtenu au prix de 20 livres sterling, pièce, au

Publications Department
Chemical Industries Association Ltd
Alembic House
93, Albert Embankment
London SE1 7TU

J'ai cru que l'intérêt de l'ouvrage méritait que je vous en informe personnellement.

Je vous prie de croire, cher Monsieur, en mes sentiments les meilleurs.

Paul-F. Smets
Directeur général



CHEMICALS
RECORDS
FEB 24 1975

VRD 4402013233

Interoffice Communication

To Distribution
From K. L. Schurter
Date February 19, 1975
Subject Solvay

CATH-KYS

The purpose of my meeting with Messrs. Klatt and Secousse of Solvay on 2/10/75 was to determine their progress in reducing residual VCM and to determine whether we could find a basis of working together on this problem.

Solvay is working on the problem in two ways. The first is "heat treatment" (steam stripping), and where this approach hits limits, they try to make the resin more porous (especially for bottle resins). Solvay may cooperate with Conoco on steam stripping (see below), but they would not disclose their formulation technology for porous, low molecular weight resins unless we took out a full license.

Among the things I learned are:

1. They can achieve 100 ppm in a 5385 type resin without steam stripping. They do have separate recovery vessels in their plants which may explain this low level. They believe it will be easy to get below 10 ppm in this type of resin using steam stripping.
2. They now have part of their plant set up on a temporary basis with steam stripping (in the recovery vessel). They have been able to get from below 10 ppm residual VCM in very porous resins to about 300 ppm for low molecular weight resins using this system. They do experience quality degradation (including resin color) with extreme steam stripping.
3. The main objective of this work is to get a bottle resin with less than 10 ppm residual VCM with no degradation in quality.
4. They are about to launch production trials to confirm their laboratory work. They have looked at both batch and continuous steam stripping, but will not decide which approach to commercialize until the trials are made. They expect to have the trials complete in about eight weeks.
5. They want to wait until they get the results of the trials before attempting to work out a cooperative program with Conoco. Obviously, if they are very successful, they will probably want to talk about a license with us. If they are not too successful, they would entertain a cooperative development program.
6. Solvay has both rotary and fluid bed dryers. Although the differences are marginal, they find that lower residual VCM comes out of the rotary versus fluid bed dryer for equal slurries.

VRD 0002013234

Distribution
2/19/75
Page Two

7. There is no truth to the ECN report of a major bottler of mineral water in France moving away from PVC bottles. Even if this company wanted to make such a change, it would take three years to get in new equipment.
8. Maltoni's feeding study of rats shows no problems after 50 weeks. Secousse couldn't recall the doses involved.

I plan to follow up with Solvay on my next trip in about three months.


K. L. Schurter

mj

Distribution: F. Kennedy, L.N. Vernon, J.F. Gabbett, W.R. Sorenson,
R.D. Gamblin, R.T. Ferrell, W.R. Beaty, D.H. Sanders,
Claude De Rie

cc: JDB, JJJ



DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL

FEB 19 1975

NATIONAL INSTITUTE FOR OCCUPATIONAL
SAFETY AND HEALTH
5600 FISHERS LANE
ROCKVILLE, MARYLAND

CHEMICALS
RESEARCH

FEB 24 1975

Dr. Flynt Kennedy
Manager Chemical Research Division
Research and Development Department
Conoco
Box 1267
Ponca City, Oklahoma 74601

Dear Dr. Kennedy:

On January 22, 1974, the National Institute for Occupational Safety and Health was advised of three deaths from angiosarcoma of the liver at a single vinyl chloride polymerization plant. Since that time, we have received reports of twenty-nine additional cases among polymerization workers in the United States and nine other nations. Details on these cases are given in attached Table I.

Review of these cases according to date of diagnosis shows that all but three were diagnosed within the last seven years. Although the cases have clustered since that time, it is probable that the high risk of this disease for polymerization workers might have gone unnoticed except for the observation of a case in 1973 by a plant physician who reviewed earlier records and identified four cases during the prior ten-year period. The difficulty of making an early determination of an association of such a rare disease with an occupational exposure, even when the exposed worker is at very high risk, is also pointed up by the distribution of cases over time. Of the first eight cases diagnosed between 1961 and the end of 1968, six were from four plants in the United States, one was from France and one was from West Germany.

While an exact estimate of the incidence of liver angiosarcoma among polymerization workers cannot be determined until exposed-to-risk figures become available, it is already apparent that these workers are at very high risk of this disease. Approximately 5,600 men are currently employed at 36 facilities in the United States. To date, 15 cases of angiosarcoma of the liver have been reported from four of these facilities, all of which have been in operation for more than 25 years. Nine cases have been reported from a single facility which employs less than 300 workers. A further indication that the earliest cases are coming from the older plants is seen in the distribution by date of initial exposure. All but one case was initially employed prior to 1958 and more than 70 percent of the cases were initially employed 20 or more years ago.

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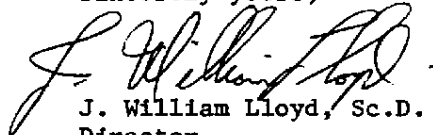
Page 2 - Dr. Flynt Kennedy

Since the average latent period from first exposure to diagnosis is about 19 years, we would not expect to see many cases at this time from the newer plants.

Preliminary findings from continuing epidemiological investigations of U.S. polymerization workers indicate that these men also may be at high risk for other malignant neoplasms, particularly of the brain where a significant excess has been noted.

Details of reported cases of angiosarcoma of the liver among other workers with exposure to vinyl chloride are shown in attached Table II. It should be noted that in two of these cases primary angiosarcoma of the liver cannot be definitely confirmed. While too few cases have been reported to draw any definitive conclusion regarding a cause and effect relationship, the age at diagnosis for these cases, which like that for the polymerization workers is considerably lower than that observed for cancer of the liver in the general population, suggests the possibility of a common etiology. It also should be pointed out that with such a rare disease it may be some time before we can determine whether workers exposed to lower levels of vinyl chloride are at excess risk for angiosarcoma of the liver or other malignancies. It is, therefore, imperative that the non-polymerization workers be kept under continued surveillance.

Sincerely yours,



J. William Lloyd, Sc.D.

Director

Office of Occupational Health
Surveillance and Biometrics

Enclosures

NIOSH
January 22, 1975

TABLE I

REPORTED CASES OF ANGIOSARCOMA OF THE LIVER AMONG
VINYL CHLORIDE POLYMERIZATION WORKERS

COUNTRY	CASE #	BIRTH DATE	1st VC or PVC EXPOSURE	DX ANGIO-SARCOMA	AGE AT DX	YRS 1st EXP TO DX	TOT YRS EXP	DATE OF DEATH
Canada	01	AWAITING DETAILS						
Canada	02	AWAITING DETAILS						
Canada	03	AWAITING DETAILS						
Canada	04	AWAITING DETAILS						
Czechoslovakia	01	AWAITING DETAILS						
Czechoslovakia	02	AWAITING DETAILS						
France	01*	00-00-00	00-00-00	00-00-00	43	19	19	00-00-67
Great Britain	01*	00-00-01	00-00-46	12-00-72	71	26	20	12-00-72
Great Britain	03	06-00-37	02-00-66	00-00-74	38	8	4	12-24-74
Italy	02*	11-13-29	00-00-57	12-13-72	43	15	6	12-00-72
Norway	01*	12-23-15	03-00-50	12-20-71	56	22	21	01-04-72
Rumania	01	AWAITING DETAILS						
Sweden	01*	06-23-27	08-14-51	02-00-70	43	19	18	10-20-70
United States	01*	10-17-23	12-09-48	03-03-73	49	22	16	03-03-73
United States	02*	08-19-33	11-15-55	05-00-70	36	14	13	09-28-71
United States	03*	05-25-15	11-28-45	12-19-73	58	28	28	12-19-73
United States	04*	01-15-24	07-06-52	08-19-67	43	15	15	01-07-68
United States	05*	01-25-12	06-19-44	04-09-64	52	20	18	04-09-64
United States	06*	00-00-29	01-17-62	02-00-74	45	12	12	ALIVE
United States	07*	05-03-22	08-00-44	00-00-68	45	24	18	03-23-68
United States	08*	05-06-20	10-07-46	08-00-61	41	15	15	08-29-61
United States	09*	11-08-31	09-09-54	03-01-74	43	17	17	ALIVE
United States	10*	08-16-13	06-12-51	05-00-68	55	17	17	05-10-68
United States	11*	05-27-09	10-14-46	03-00-70	61	23	23	03-16-70
United States	12*	11-17-18	09-13-49	05-02-69	50	20	15	05-02-69
United States	13*	12-01-21	08-19-44	05-00-74	53	30	30	07-04-74

TABLE I (continued)

REPORTED CASES OF ANGIOSARCOMA OF THE LIVER AMONG
VINYL CHLORIDE POLYMERIZATION WORKERS

COUNTRY	CASE #	BIRTH DATE	1st VC or PVC EXPOSURE	DX ANGIO- SARCOMA	AGE AT DX	YRS 1st EXP TO DX	TOT YRS EXP	DATE OF DEATH
United States	16*	11-04-27	05-08-50	00-00-69	41	17	4	03-27-69
United States	17	05-06-31	06-23-55	10-11-74	43	19	19	ALIVE
W. Germany	01*	07-26-31	10-14-57	09-25-70	40	11	11	12-14-71
W. Germany	02*	06-24-30	10-01-57	09-19-68	38	13	13	01-25-69
W. Germany	04*	00-00-00	00-00-00	00-00-00	44	17	11	00-00-00
W. Germany	05*	00-00-00	00-00-00	00-00-00	49	11	11	ALIVE

Total Reported Cases = 32

Median Values:

15 U.S. Cases

45.0

19.0

17.0

10 Non-U.S. Cases

43.0

16.0

12.0

25 Total Cases

44.0

17.0

16.0

* Indicates microscopically confirmed angiosarcoma of the liver.

"00" Indicates unknown data.

NIOSH
January 22, 1975

TABLE II

REPORTED CASES OF ANGIOSARCOMA OF THE LIVER AMONG
NON-POLYMERIZATION WORKERS EXPOSED TO VINYL CHLORIDE

COUNTRY	CASE #	BIRTH DATE	1st VC or PVC EXPOSURE	DX ANGIO-SARCOMA	AGE AT DX	YRS 1st EXP TO DX	TOT YRS EXP	DATE OF DEATH	
Great Britain	02*	09-08-14	00-00-46	02-00-70	55	24	11	12-00-70	Note 1
Italy	01	06-15-34	00-00-65	04-19-71	36	6	3	04-16-71	Note 2 & 7
Sweden	02*	11-27-11	00-00-45	05-15-72	61	27	23	08-16-72	Note 3
United States	14	00-00-13	08-18-38	06-00-73	60	36	00	07-03-73	Note 4 & 8
United States	15*	00-00-25	00-00-00	07-00-72	47	00	00	02-15-73	Note 5
W. Germany	03*	07-16-30	00-00-00	02-00-68	43	14	14	10-10-73	Note 6

Note 1 Pouring PVC oil mixture onto fabric bases

Note 2 Production of PVC sacks

Note 3 Production of Vinyl Chloride

Note 4 Machine operator covering electrical wire with PVC plastic insulation

Note 5 Accountant at plant making PVC fabric

Note 6 Loading pesticide cans with VC propellant

Note 7 Angiosarcoma involving liver, lung, and pericardium. Although difficult to determine, primary site seems to be pericardium.

Note 8 Diagnosis: Sarcoma (possibly "angiosarcoma"), liver. Possibility of generalized neoplasm of the reticuloendothelial cell system cannot be ruled out.

* Indicates microscopically confirmed angiosarcoma of the liver.

"00" Indicates unknown data.

VRD 0002013239

A

BACKGROUND INFORMATION ON CHLOROPRENE

Office of Occupational Health Surveillance and Biometrics

National Institute for Occupational Safety and Health

January 20, 1975

CHLOROPRENE

Introduction

In a letter to Mr. Edward J. Baier, Acting Director, NIOSH, dated December 16, 1974, Dr. John A. Zapp, Director, Haskell Laboratory, E.I. du Pont de Nemours and Company (Du Pont), Louisville, Kentucky, expressed concern over the potential carcinogenicity of chloroprene (2-chlorobutadiene). Du Pont had begun looking closely at this substance recently because of the similarity in chemical structure with vinyl chloride. Du Pont has utilized chloroprene in the production of neoprene (polychloroprene) since 1931.

In the course of a literature search on chloroprene toxicity, Du Pont uncovered two recent Russian articles that suggest an increased incidence of skin and lung cancer in workers exposed to chloroprene. Also, two other articles in the Russian literature were located that described animal experiments in which chloroprene adversely affected embryo development in rats and mice.

Du Pont has informed its employees of the Russian reports and has alerted its customers to the possibility of "escaping chloroprene" during the processing of neoprene. The Company is conducting epidemiological studies in humans and animals to ascertain the carcinogenic potential of chloroprene.

Background Information

Chloroprene is a colorless liquid that is slightly soluble in water. It is soluble in alcohol and diethyl ether, and has a vapor density of 3.0, three times that of air, with a boiling point of 59.4°C. Chloroprene is used as a chemical intermediate largely as a monomer for the manufacture of a synthetic rubber.¹ It is a chlorine-substituted derivative of 1,3-butadiene. Chloroprene can polymerize spontaneously at room temperature, the process being catalyzed by

light, peroxides, and other free radical initiators. It can also react with oxygen to form polymeric peroxides. Because of its instability, flammability, and toxicity, chloroprene has no end product uses. It is produced in large quantities mainly for polymerization and marketing under the trade name of Neoprene.²

Neoprene was developed in the U.S. by Carothers³ and was originally introduced by Du Pont in 1931 under the brand name Duprene.⁴ Although during recent years other suppliers have come on the market with their own brand name, neoprene is generally used as a generic name for polychloroprene rubbers.

Neoprene is obtained by emulsion polymerization of chloroprene (2-chlorobutadiene) and consists mainly of 1,4-transpolychloroprene. There are two main classes, the sulfur modified type and the non-sulfur modified type, indicating the differences in polymerization techniques. Several subtypes of both are available, differing in viscosity and crystallization rate.⁴

Neoprene's most valuable properties are its resistance to weathering and oil. It is also resistant to abrasion, heat, flame, oxygen, ozone, and solvents. The main applications of neoprene are in high performance articles such as cable sheaths, hoses, fabrics, adhesives, and a large number of technical rubber articles. The automotive industry is the largest consumer of neoprene.⁵

Toxicity

Human: The primary responses to chloroprene appear to be central nervous system depression and significant injury to lungs, liver, and kidneys.¹ Humans exposed to chloroprene have been reported to develop dermatitis, conjunctivitis, corneal necrosis, anemia, temporary loss of hair, nervousness, and irritability.⁶

Two Russian reports suggest that chloroprene exposure is associated with an increased incidence of skin and lung cancer.^{7,8}

These studies concern a large-scale epidemiological investigation of industrial workers in the Yerevan region of Russia. During the period 1956-1970, 137 cases of skin cancer were discovered through examination of 24,989 persons over age 25. The population was subdivided into five subgroups according to the character of their employment:

Group I: Persons who never worked in industrial plants

Group II: Persons working in non-chemical industries

Group III: Persons with extended work experience in chloroprene production

Group IV: Persons working in industries using chloroprene derivatives

Group V: Persons working with chemicals unrelated to chloroprene

The following table depicts the results of the study:

	Exposure Group				
	I	II	III	IV	V
Number examined	8520	8755	684	2250	4780
Number of cases	11	35	21	38	32
Percent	0.12	0.40	3.00	1.60	0.66
Average age of cases	72.1	68.9	59.6	59.1	64.4
Average duration of employment					
for cases (in years)	16.3	15.4	9.5	8.7	13.8

As can be seen from the table, the incidence of skin cancer was greatest in the chloroprene exposed group, and was substantially greater than that for the three unexposed groups. Persons exposed only to chloroprene derivatives also showed an increased incidence of skin cancer. A gradient in the skin cancer incidence is seen among the five groups reflecting the potential for exposure to toxic chemicals in the work environment. The average age of the cases in both the chloroprene and chloroprene derivative groups was signifi-

cantly less than that for the other groups. The average duration of employment was much shorter for the chloroprene and chloroprene derivative groups than for the other non-exposed groups. The investigators concluded that development of chloroprene-induced skin cancer is preceded by chronic dystrophic and inflammatory skin ailments which are caused by the binding of chloroprene to the free SH groups in the cells, with the formation of RS-CH compound types.

The incidence of lung cancer among 19,979 workers in the same region was also studied. During the period 1956-1970, 87 cases of lung cancer were identified from the records of the local oncology department. The population was subdivided into four subgroups according to type of employment:

Group I: Workers who had extended contact with chloroprene and/or its derivatives

Group II: The first "control group" consisting of truck drivers, polishers, cabinet makers, stokers, gasoline station attendants, typesetters, painters, and others

Group III: The second "control group" consisting mainly of electricians, carpenters, joiners, arc welders, tinsmiths, furnace workers, etc.

Group IV: The third "control group" consisting of persons who worked in professional occupations

The following table summarizes the results of the analysis:

	Exposure Group			
	I	II	III	IV
Number at risk	2934	4780	6045	6220
Number of cases	34	22	11	4
Percent	1.16	0.46	0.18	.064
Average age of cases	44.5	54.9	59.3	60.2
Average duration of employment for cases (in years)	8.7	10.3	19.9	18.5

As can be seen from the table, the group with exposure to chloroprene or its derivatives experienced the highest incidence of lung cancer. A gradient in the lung cancer incidence is seen according to exposure group which reflects (roughly) the potential for exposure to toxic chemicals in the work environment. As with the results for skin cancer, the average age and duration of employment for the cases in the chloroprene exposure group is substantially less than for the non-chloroprene control groups. It is interesting to note that the average age of the lung cancer cases in the chloroprene group (44.5) is significantly less than the average age of the skin cancer cases in the same group (about 59).

The authors note that the magnitude of the lung cancer risk in chloroprene-exposed workers is about the same as for chromate workers in the same district.

Of the 34 cases of lung cancer in workers exposed to chloroprene or its derivatives, 18 were among persons having direct and prolonged exposure to chloroprene monomer. The remaining 16 cases were persons whose exposure was to chloroprene latexes. If this breakdown is applied

to the two chloroprene subgroups shown in the skin cancer table (Groups III & IV), the lung cancer rates would be 2.6 ($18 \div 684$) for the group with exposure to chloroprene monomer and 0.7 ($16 \div 2,250$) for the group exposed to chloroprene latexes. This difference presumably reflects the gradient in total amount of exposure to chloroprene.

Animal: Animal experiments have shown that a concentration of 250ppm in air is toxic and a concentration of 75ppm may be toxic with continued exposure. Exposure to vapor first causes irritation of the respiratory tract, followed by depression of respiration and, if exposure is continued, asphyxia. The vapor is a central nervous system depressant. It causes severe degenerative changes in the vital organs, particularly the liver and kidneys. In addition, blood pressure is lowered and lung changes accompany exposure, especially at the higher concentrations.⁶

Chloroprene has caused hyperplasia of lymph nodes and a decrease in the number of lymphocytes in rats.⁹ During acute and chronic chloroprene exposure, changes in adrenal gland function have also been noted.¹⁰

Even in low concentrations, chloroprene affects male reproductive organs causing degenerative changes resulting in reproduction interferences. Male reproductive organs appear to be more susceptible to the effect of chloroprene than female.¹¹

Chloroprene has an effect on embryogenesis. In rats and mice, it causes an increase in the total embryonal mortality and reduction in the fetal weight of offspring of females exposed during pregnancy.^{12,13}

Permissible Occupational Exposures:

The American Conference of Governmental Industrial Hygienists established the threshold limit of chloroprene at 25ppm ($90\text{mg}/\text{m}^3$).¹⁴ This level was based

on the work of Cook¹⁵ and Von Oettingen,¹¹ and is the current Occupational Safety and Health Administration, Department of Labor standard.

Priority List Status

Chloroprene is listed as number 412 on the NIOSH Priority List for Criteria Development for Toxic Substances and Physical Agents. An estimated 2,500 workers are exposed to chloroprene in the United States. The severity rating for chloroprene is 325 on a scale of 0 to 6,000.

Producers and Suppliers

The following is a list of the major producers and suppliers of chloroprene and neoprene in the U.S.:

Chloroprene

Location

Dupont	Victoria, Texas Laplace, Louisiana
Petro-tex Chemical Corp. Petro-tex Chemical Subsid.	Houston, Texas

Neoprene

Location

Dupont	Laplace, Louisiana Louisville, Kentucky Montague, Michigan*
Petro-tex Chemical Corp. Petro-tex Chemical Subsid.	Houston, Texas

*Shut Down in 1972

Source: Adapted from 1974 Directory of Chemical Producers, USA, Stanford Research Institute, Menlo Park, California, 1974.

Annual production figures for chloroprene are not available. Following are the annual figures for neoprene:

<u>Year</u>	<u>Neoprene Production (millions of pounds)</u>
1968	340
1969	350
1970	325
1971	340
1972	370
1973	385

Source: Chemical Economics Handbook, Stanford Research Institute, Menlo Park, California, 1974.

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F. Kennedy

CHEMICALS
RESEARCH

JAN 20 1975

Interoffice Communication

To Dr. Charles Whetstone

From G. G. Greenfield

Date January 16, 1975

Subject DISCUSSIONS WITH DR. DI LUZIO ON APPLICATIONS OF HIS
WORK TO THE VCM PROBLEM

EC	2
WBS	1
AILU	1
WBS	1
LM	

While in the vicinity, I stopped at Tulane Medical School to talk to Dr. DiLuzio primarily about the potential applications of his work on mechanisms and prevention of chemically induced liver injury to the VCM problem. We also discussed his cancer research and the possibilities for reversing existing cases of angiosarcoma and spotting potential cases early.

Several branches of his work may be of interest:

- (1) Vitamin E supplementation has been shown to essentially eliminate the effects of ethyl alcohol, carbon tetrachloride and several other chemicals on the liver at encountered exposure levels. This effect is quite likely to apply to VCM and is probably the most promising area for work which could have an immediate impact on the problem.
- (2) His work with ethyl alcohol showed that certain metabolites, rather than the alcohol itself, are linked to liver damage. Selective blocking of those metabolic paths eliminates liver damage. (This may be the answer to safe and economic alcoholism. One glass of wine would maintain a long term state of intoxication with no danger of liver damage. Sell your stock in Seagrams!) While correlaries may exist with VCM which would help in understanding the mechanism of the problem, direct practical significance is not as likely as with the Vitamin E work.
- (3) It may be that VCM exposure is only one correlate of the problem. Work by DiLuzio and others has shown that interactive effects can be much more significant than direct effects. For instance, simultaneous lead or calcium and endotoxin levels can cause precipitous death with each at levels orders of magnitude below that which would cause problems with independent exposure. It could be that some other co-factor is involved in cases where angiosarcoma has been linked to VCM exposure. A co-factor could also be a deficient state such as an inadequate antioxidant state which could be corrected with Vitamin E supplementation.
- (4) DiLuzio's model of natural bodily defenses against cancer (probably simplified for my sake) is that macrophages in the blood cannot recognize and destroy malignant cells unless those cells are labeled with a chemical referred to as "recognition factor" (RF) which apparently complexes with malignant cell walls. Cancer is accompanied by a depression

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Gaylord G. Greenfield

Gaylord G. Greenfield

Gaylord G. Greenfield

CONOCO

VRD 0042013252

Interoffice Communication

To J. D. Burns
From D. A. Kuhn
Date January 10, 1975
Subject Supporting Cancer Research on Vinyl Chloride

RECEIVED

JAN 15 1975

MEDICAL DIV.

I received a package of information from Bob Gerwig from Dr. Charles Shaw at M.D. Anderson Hospital in Houston concerning a proposed program as well as a discussion of what he is currently doing, a reprinting and some information about his cancer prevention center. These are attached.

I believe our objective in supporting any research should be directed towards determining the chemicals causing cancer and what kind of cancer they produce as well as determining which of the population are susceptible to cancer, primarily those caused by chemicals. There has been a long standing program to accomplish the first objective and no doubt it will continue into the future. Many studies are in progress now especially on vinyl chloride. A novel approach is just beginning to accomplish the second objective, determining who is susceptible. This is the thrust of the research of Dr. Shaw at M.D. Anderson Hospital. Here is where Conoco can make a special contribution for the prevention of cancer and protection of our workers.

The basic idea behind Dr. Shaw's work is that there is an enzyme in the body of some people that will prevent cancer. This has been found in work he has done on cigarette smoking. Based on one's heredity, he either has it or doesn't. If we could test for this enzyme we would know whether anyone was susceptible or not. In addition, the work suggests that any test animal should also be screened for this enzyme. If the test animal has it, then he will be resistant to cancer and would be analogous to a human who has this enzyme. If not, he would be analogous to a human without the enzyme and presumably susceptible. Thus, we could make better judgements of extrapolating animal data to the human condition.

During my conversation with Dr. Whetstone he indicated he was very much in favor of Conoco supporting this program because he perceived the work to be high quality. This was based in part on the mutual assistance Dr. Shaw and Dr. Whetstone have given each other within the recent past. He was lead to Dr. Shaw through his readings of all the literature he could find on cancer caused by chemicals. As he progressed, he found himself directed to Dr. Shaw by the quality and subject of his papers.

J. D. Burns
January 10, 1975
Page Two

VRD 0002013253

There are likely other places of equal quality that we could place our support. However, M.D. Anderson Hospital is in Houston near one of our major offices. Many of our Houston executives are involved in public service in the Houston area, and here we have a chance to support an exciting new area if we choose this route. Dr. Shaw's budget indicates \$41 M for the first year, but I understand this has been inflated now to \$50 M. Apparently there is no commitment beyond the first year, so we could review it the end of the first year to see if we should support him further. As Dr. Shaw's work progressed, we would be able to obtain the benefits early. Through our Medical Department we could keep in touch with what he is doing.

I recommend we defer discussing this with our top management until the February meeting. However, this should provide enough background to initiate the subject with them at the Innisbrook meeting in January. I recommend we consider supporting this program.



D. A. Kuhn

ee

Attachments

cc: Dr. Whetstone/Ponca City ✓
Dr. Lembke/Ponca City



V80 0002813254

Interoffice Communication

To R.W. Gerwig
From C.H. McGlothlin
Date January 8, 1975

CC: JDBu, WBC, HRF, RWG, ACK,
GJK, WCK, JJL, RWM, JWS,
KLS, MT, LNV, RDW
F. Kennedy

Subject Special Work Projects Undertaken by MCA, SPI, etc.

As you know, there have been several recent instances where such organizations as the SPI or the MCA have undertaken specific work or research projects on behalf of the represented companies. They bill these companies for their agreed shares of the specific project cost. Where this is clearly the case, I have obtained agreement of Tom Pickrell, Controller's Department, that these items can be charged to operating expenses rather than contributions.

Since this is a sensitive area from a policy standpoint, this procedure of charging these to operating expense should be followed only when advance assessment for the individual project has been specifically agreed to by Conoco. It would not apply to special assessments that cover generally increased associated expenses.

I recommend that any such agreements for special projects or work be limited to your approval in advance.

C.H. McGlothlin
C.H. McGlothlin

jb
CC:
T.R. Pickrell

CHEMICALS
RESEARCH

JAN 10 1975

ER
WDB
CC
AD
LM

Approved
Robert W. Gerwig
January 8, 1975

CHEMICALS
RESEARCH

JAN 8 1975

FK
VAD 0002013255

January 3, 1975

N. R. Di Luzio, Ph.D.
Chairman, Dept. of Physiology
1430 Tulane Avenue
Tulane University
New Orleans, La. 70112

Dear Doctor Di Luzio:

December 16, 1974, you sent a communication to Gaylord Greenfield, Saddle Brook, New Jersey, relevant to antioxidants, polyvinyl chloride and angiosarcoma of the liver. Mr. Greenfield and I are quite enthusiastic about your work in this area. For some time I have attempted to get more background material on antioxidants but to date the information made available to me is quite scanty.

I am requesting from your extensive publication list the following reprints, initially, until I get some background information on your work. Perhaps then at some future date it would be possible for Mr. Greenfield and I to meet personally with you and explore various areas for future experimentation relevant to our areas of interest.

PUBLICATION

NUMBER

Protective influence of DPPD on hydrazine induced lipid peroxidation & hepatic injury.	#320
Recognition factors & cancer	#330
Peroxidation of lipids in alveolar macrophages & pulmonary protective factor by aqueous extracts of cigarette smoke	#331
Pyrazole inhibition of ethanol, allyl alcohol & allyl formatted induced hepatic injury	#334
Alcohol & the liver	#344
Prevention of hydrazine induced lipid peroxidation & hepatic injury by DPPD	#385
Comparative uptake of BSP by isolated Kupffer & parenchymal cells.	#354
Factors modifying susceptibility to bacterial endotoxin: the effect of lead & cadmium	#359
Glucan mediated macrophage-induced necrosis of human malignant cells	#360

Sincerely,

ORIGINAL SIGNED BY

CHARLES L. WHETSTONE MD
ASSISTANT MEDICAL DIRECTOR

Charles L. Whetstone, M.D.
Assistant Medical Director

cc: Mr. Gaylord Greenfield - Saddle Brook
bjc



CHEMICALS
RESEARCH

AKRD 0002013256

Interoffice Communication

To K. L. Schürter
From J. F. Gabbett
Date December 23, 1974
Subject NIOSH Listing of Liver Angiosarcoma - 14 November 1974

Copy to RWG

Attached, for your information, is an up to date world listing of angiosarcoma cases published by NIOSH on 11/14/74. It does not, however, include the four Canadian cases released on 11/13/74.

J. F. Gabbett

J. F. Gabbett

mj

cc: GJK, JSC, LNV, DAK, JJL, JDBu, RWG, FK

NIOSH
November 14, 1974

RESEARCH & DEVELOPMENT

DEC 16 1974

W. M. SANTANA

TABLE 1

REPORTED CASES OF LIVER ANGIOSARCOMA IN WORKERS EXPOSED TO
VINYL CHLORIDE OR POLYVINYL CHLORIDE

COUNTRY	CASE #	BIRTH DATE	1st VC or PVC EXPOSURE	DX ANGIO- SARCOMA	AGE AT DX	YRS 1st EXP TO DX	TOT YRS EXP	DATE OF DEATH
POLYMERIZATION WORKERS								
Czechoslovakia	01	AWAITING DETAILS						
Czechoslovakia	02	AWAITING DETAILS						
Great Britain	01*	00-00-01	00-00-46	12-00-72	71	26	20	12-00-72
Italy	01	AWAITING DETAILS						
Italy	02	AWAITING DETAILS						
Norway	01*	12-23-15	03-00-50	12-20-71	56	22	21	01-04-72
Sweden	01*	06-23-27	08-14-51	02-00-70	43	19	18	10-20-70
United States	01*	10-17-23	12-09-48	03-03-73	49	22	16	03-03-73
United States	02*	08-19-33	11-15-55	05-00-70	36	14	13	09-28-71
United States	03*	05-25-15	11-28-45	12-19-73	58	28	28	12-19-73
United States	04*	01-15-24	07-06-52	08-19-67	43	15	15	01-07-68
United States	05*	01-25-12	06-19-44	04-09-64	52	20	18	04-09-64
United States	06*	00-00-29	01-17-62	02-00-74	45	12	12	ALIVE
United States	07*	05-03-22	08-00-44	00-00-68	45	24	18	03-23-68
United States	08*	05-06-20	10-07-46	08-00-61	41	15	15	08-29-61
United States	09*	00-00-31	05-28-45	03-01-74	43	29	17	ALIVE
United States	10*	08-16-13	06-12-51	05-00-68	55	17	17	05-10-68
United States	11*	05-27-09	10-14-46	03-00-70	61	23	23	03-16-70
United States	12*	11-17-18	09-13-49	05-02-69	50	20	15	05-02-69
United States	13*	12-01-21	08-19-44	05-00-74	53	30	30	07-04-74
United States	16*	11-04-27	05-08-50	00-00-69	41	17	4	03-27-69
United States	17	05-06-31	06-23-55	10-11-74	43	19	19	ALIVE
W. Germany	01*	07-26-31	10-14-57	09-25-70	40	11	11	12-14-71
W. Germany	02*	06-24-30	10-01-57	09-19-68	38	13	13	01-25-69

1575102000 QRD 0002013257

VC MONOMER PRODUCTION WORKERS

Sweden	02*	11-27-11	00-00-45	05-15-72	61	27	23	08-16-72
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COMPOUNDERS, FABRICATORS, ETC.

Great Britain	02*	09-08-14	00-00-46	02-00-70	55	24	11	12-00-70	Note 1
United States	14	00-00-13	08-18-38	06-00-73	60	36	00	07-03-73	Note 2 & 5
United States	15*	00-00-25	00-00-00	07-00-72	47	00	00	02-15-73	Note 3

OTHER VC EXPOSURE

W. Germany	03*	07-16-30	00-00-00	02-00-68	43	14	14	10-10-73	Note 4
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Note 1 Pouring PVC oil mixture onto fabric bases

Note 2 Machine operator covering electrical wire with PVC plastic insulation

Note 3 Accountant at several fabrication plants (work history under review)

Note 4 Loading pesticide cans with VC propellant

Note 5 Diagnosis: Sarcoma (possibly "angiosarcoma"), liver. Possibility of generalized neoplasm of the reticuloendothelial cell system cannot be ruled out.

* Indicates microscopically confirmed angiosarcoma of the liver.

"00" Indicates unknown data.



(A)

VRD 0002013259

8:05 am

To FK

Date 1/8/75

From lm

Dr. Kirk stopped by with the following message:

Dr. Sharrah is interested in the work of the fellow at Baylor on antioxidants to aid in metabolizing chlorinated hydrocarbons. However, MLS does not have it budgeted. If RWG and FK want to proceed, they will have to arrange for necessary funding.

Tulane??

*Attach to
mailing to MLS*

VRD 0002013260

MEMORANDUM

Ponca City, Oklahoma
December 16, 1974

To:	J. C. Kirk	G. Perkins
	D. B. Burrows	C. L. Whetstone, M.D.
	W. R. Beaty	D. V. Porchey
	O. C. Kerfoot	(E.A. Setzkorn-R.E. Laramy)
	A. J. Lundeen	R. G. Weiss
	W. R. Sorenson	

Subject: VCM/PVC OSHA Regulation

The 2nd Distrist Federal Appeal Court held Friday, December 13, 1974 that the VCM/PVC OSHA Regulation effective date by STAYED, pending litigation.

I do not know when the three-man appeal bench will have completed its review of the facts and be prepared to rule on the petition.

Flynt Kennedy
lm

TULANE UNIVERSITY

School of Medicine

NEW ORLEANS, LA. 70112

Department of Physiology
1430 Tulane Avenue

December 16, 1974

NRD 0002013262

Gaylord Greenfield
Conco Chemical Division
Continental Oil Company
Park 80, Plaza East
Saddle Brook, New Jersey 07662

Dear Mr. Greenfield:

It was indeed a pleasure to chat with you recently relative to the problems of polyvinyl chloride. I have read with significant interest the recent article in Barron's relative to the impact of polyvinyl chloride exposure on industrial economics.

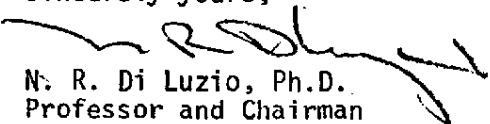
As indicated to you, we have previously considered the possibility that antioxidants could be employed in the modifications of polyvinyl chloride induced hepatic angiosarcoma. There appears to be little question that the most effective resolution of the PVC problem would not only be reduction in exposure which is already well under way in industry, but also to consider the possibility of providing a chemical protective agent. An agent such as vitamin E, if it were found to function as a prophylactic agent possessing the ability to inhibit the development of hepatic lesions in PVC exposed animals, could be readily utilized. The unique advantage of vitamin E is that it is essentially non-toxic and the fact that it has been available for clinical use for a considerable period of time. The time and cost of new drug development could well be avoided.

We would be interested in the possibility of assisting Conco in their endeavors not only in the resolution of the PVC problem, but also in view of our interest in determining whether or not polyvinyl chloride acts perhaps like other hepatotoxic agents in free radical mechanisms of hepatic injury.

I have enclosed for your information a copy of my curriculum vitae which you will note, relates to mechanisms of chemical induced liver injury with emphasis on alcohol, carbon tetrachloride, and hydrazine. It also defines our more recent studies in mechanisms of tumor growth and development as influenced by alterations in host defense systems. As indicated to you during our conversation, it may be possible to tie some of these aspects together in the investigation of polyvinyl chloride induced hepatic injury and development of angiosarcoma.

Please let me know if I can be of further assistance.

Sincerely yours,


N. R. Di Luzio, Ph.D.
Professor and Chairman

NRD/mgl
Enclosure

KRD 0002013263

CURRICULUM VITAE

Nicholas Robert Di Luzio: Born May 4, 1926, Hazelton, Pennsylvania

DEGREES:

B.S., with honors, University of Scranton, 1950
Ph.D., University of Tennessee Medical Units, 1954

MILITARY SERVICE:

U.S. Army Air Force, 1944-1946

SCHOLARSHIPS AND FELLOWSHIPS:

1. Laboratory assistant, Department of Biology, University of Scranton, 1948-1950.
2. Predoctoral Research Fellow of the Public Health Service National Institutes of Health (University of Tennessee) 1952-1954.

AWARDS:

1. Lederle Medical Faculty Award, 1958-1961.
2. Research Award, International Society for Research on Reticuloendothelial System (Gold Medal and Scroll for Outstanding Achievement and Research), 1964.

SOCIETIES:

1. American Association for the Advancement of Science (Fellow)
2. Reticuloendothelial Society
3. American Physiological Society
4. Council on Arteriosclerosis of the American Heart Association (Fellow)
5. Society for Experimental Biology and Medicine
6. American Association for the Study of Liver Diseases
7. International Conference on the Biochemistry of Lipids
8. International Society of Parenteral Nutrition
9. Transplantation Society
10. American Heart Association
11. Experimental Hematology

ARD 0002013264

ACADEMIC APPOINTMENTS:

1. Instructor, Dept. Physiology, University of Tennessee Medical Units 1955-1956.
2. Assistant Professor, Department Physiology, University of Tennessee Medical Units, 1957-1959.
3. Associate Professor, Dept. Physiology, University of Tennessee Medical Units, 1959-1962.
4. Professor, Department of Physiology, University of Tennessee Medical Units, 1962-1964.
5. Professor and Chairman, Department of Physiology and Biophysics, University of Tennessee Medical Units, 1964-1968.
6. Professor and Chairman, Department of Physiology, Tulane University School of Medicine, 1968-present.

VISITING INVESTIGATOR:

1. Dorn Laboratory for Medical Research, Bradford Hospital, Bradford, Pa. Summer, 1954.
2. Research Participant, Pathology and Physiology Section, Oak Ridge National Laboratory, Summer, 1956.
3. Research Participant, Biochemistry Branch, Biology and Medical Division U.S. Naval Radiological Defense Laboratory, San Francisco, Summer, 1958.
4. Visiting Professor, The Graduate School, New England Institute, Ridgefield, Connecticut (1966-1970).

CONSULTANT:

Member-Tennessee Advisory Committee on Atomic Energy (1958-1968).

Scientific Advisory Committee of National Council on Alcoholism (1963-1968).

Riker Laboratories (1961-1970).

Naugatuck Chemical (1965-1968).

Immunology and Microbiology Study Committee - American Heart Association (1966-1971).

Alcoholism and Alcohol Problems Review Committee - National Institute of Mental Health (1971-1974) (Chairman, 1974).

General Electric (1974).

PATENTS:

(#3,081,226) on a reticuloendothelial stimulant
(#3,658,070) on a tobacco smoke filter

SOCIETY OFFICES:

President - Reticuloendothelial Society (1965-1967).

Vice President - International Society for Research on the Reticuloendothelial System (1965-1969).

EDITORIAL BOARD

Advances in Experimental Medicine and Biology (Plenum Press).

VRD 0002013265

VRD 0002013266

ADDITIONAL ACTIVITIES - N. R. Di Luzio, Ph.D.

1. Medical Student Admission Committee (1968 -)
2. Founder and Director, Tulane University School of Medicine
Negro Summer Research Fellowship Program (1968-1972).
3. Executive Faculty Committee (1968 -)
4. Basic Medical Science Council (1968 -), Chairman (1970-1972)
5. Louisiana Heart Association (1968 -)
Chairman, Research Committee (1972-1974)
Trustee (1971 -)
6. Leukemia Society of American (New Orleans Chapter) (1970-)
Member, Board of Trustees
Chairman, Research Committee (1970-1973).
7. Tulane Medical Center Development Fund Executive Committee
(1971 -)
8. Tulane Medical Center Planning Committee (1970-1972)
9. Personnel and Honors Committee (1968-1974)
10. Scientific Review Committee of Clinical Cancer Research Centers
11. Committee to evaluate establishment of Lung Center
12. Consultant-New Orleans Alcohol Safety Program (1969-1972).

PUBLICATIONS OF DR. N. R. DI LUZIO

1. Action of choline on in vivo and in vitro synthesis of phospholipids. D. B. Zilversmit and N. R. Di Luzio. Fed. Proc. 10:151, 1951 (abstract).
2. Synthesis of phospholipids in diabetic dogs. D. B. Zilversmit and N. R. Di Luzio. J. Biol. Chem. 194:673-683, 1952.
3. Phospholipid metabolism in phlorizinized dogs. N. R. Di Luzio and D. B. Zilversmit. Fed. Proc. 11:34, 1952 (abstract).
- ✓ 4. The turnover of liver and plasma phospholipids of phlorizinized dogs. N. R. Di Luzio and D. B. Zilversmit. Am. J. Physiol. 170:472-476, 1952.
- ✓ 5. Influence of choline on phospholipid metabolism of normal and choline deficient dog liver slices. N. R. Di Luzio and D. B. Zilversmit. Am. J. Physiol. 171:720, 1952 (abstract).
6. Action of cortisone and desoxycorticosterone acetate on the plasma lipids of adrenalectomized dogs. N. R. Di Luzio, M. L. Shore and D. B. Zilversmit. Fed. Proc. 12:197, 1953 (abstract).
7. The effect of cortisone and desoxycorticosterone acetate on the turnover of plasma and tissue phospholipids of adrenalectomized dogs. D. B. Zilversmit, N. R. Di Luzio and M. L. Shore. XIX Internatl. Physiol. Congress, p. 914, 1953 (abstract).
- ✓ 8. The in vitro stimulation of phospholipid synthesis by choline in choline deficient dog liver slices. N. R. Di Luzio and D. B. Zilversmit. J. Biol. Chem. 205:867-871, 1953.
9. The role of tissue phospholipids in the metabolism of fats. N. R. Di Luzio. Doctoral Thesis, 1954.
10. The effect of cortisone and desoxycorticosterone on the plasma lipids of adrenalectomized dogs. N. R. Di Luzio, D. B. Zilversmit and M. L. Shore. Metabolism 3:424-432, 1954.
11. The effect of adrenalcortical hormones on phospholipid turnover of adrenalectomized dogs. D. B. Zilversmit, N. R. Di Luzio and M. L. Shore. Metabolism 3:433-437, 1954.
- ✓ 12. Protein-induced inhibition of colloidal gold uptake by liver. N. R. Di Luzio and D. B. Zilversmit. Am. J. Physiol. 179:630, 1954 (abstract).
13. Influence of exogenous proteins on blood clearance and tissue distribution of colloidal gold. N. R. Di Luzio and D. B. Zilversmit. Am. J. Physiol. 180:563-565, 1955.
14. The effect of x-irradiation and choline on the reticuloendothelial system. N. R. Di Luzio. Am. J. Physiol. 181:595-598, 1955.

YRD 0002013268

- ✓15. Cortisone and epinephrine effect on plasma, liver and aortic lipid partition and phospholipid turnover. A. Dury and N. R. Di Luzio. Fed. Proc. 14:40, 1955 (abstract).
16. Plasma lipid and lipoprotein alterations in adrenalectomized dogs. N. R. Di Luzio. Fed. Proc. 14:38, 1955 (abstract).
- ✓17. The influence of cortisone and epinephrine on liver, plasma and aortic lipid partition and phospholipid turnover. A. Dury and N. R. Di Luzio. Am. J. Physiol. 182:45-50, 1955.
18. Is the cholesterol-fed rabbit choline deficient? N. R. Di Luzio, M. L. Shore and D. B. Zilversmit. Circulation 12:495, 1955 (abstract).
19. The effect of choline on the tissue phospholipid metabolism of the choline deficient rabbit. N. R. Di Luzio, M. L. Shore and D. B. Zilversmit. Am. J. Physiol. 183:609, 1955 (abstract).
20. The effect of choline deficiency on the reticuloendothelial system of the rat. N. R. Di Luzio. Fed. Proc. 15:49, 1956 (abstract).
- ✓21. The effect of choline, heparin and aureomycin on fatty livers of dogs. N. R. Di Luzio and D. B. Zilversmit. Proc. Soc. Exp. Biol. Med. 91:338-341, 1956.
22. The role of the kidney in the etiology of renal hyperlipemia. N. R. Di Luzio and C. Riley Houck. Fed. Proc. 15:50, 1956 (abstract).
23. The effect of choline on phosphatide metabolism of choline deficient and cholesterol-fed rabbits. N. R. Di Luzio and D. B. Zilversmit. Proc. Soc. Exp. Biol. Med. 92:454-456, 1956.
24. Reticuloendothelial function and radiation response. N. R. Di Luzio. Rad. Res. 5:475, 1956 (abstract).
25. The effect of starvation on the phagocytic activity of the RES. N. R. Di Luzio. IV Internatl. Congress Hematol. p. 294, 1956 (abstract).
26. The role of the kidney in the etiology of renal hyperlipemia. N. R. Di Luzio and C. R. Houck. J. Clin. Invest. 35:1381-1384, 1956.
27. The effect of starvation on the phagocytic activity of the RES. N. R. Di Luzio and B. S. Powers. RES Bulletin 11:25-27, 1956.
28. The effect of cholesterol feeding on the plasma lipid fractions of adrenalectomized dogs. B. S. Powers and N. R. Di Luzio. Fed. Proc. 16:234, 1957.
29. RE function during alimentary lipemia. N. R. Di Luzio. Fed. Proc. 16:31, 1957.
30. The effect of x-irradiation on the plasma lipid fractions of the rabbit. N. R. Di Luzio and A. K. Simon. Rad. Res. 7:79-84, 1957.
31. The effect of trypan blue and x-irradiation on the RES of the rat. N. R. Di Luzio, A. K. Simon and A. C. Upton. Arch Pathol. 64:649-656, 1957.

VRD 0002013269

32. Dietary cholesterol and the endocrine regulation of plasma lipids. N. R. Di Luzio and B. S. Powers. Circulation 16:486, 1957 (abstract).
33. The role of choline in the turnover of phospholipids. D. B. Zilversmit, and N. R. Di Luzio. Am. J. Clin. Nutrition 6:235-241, 1958.
- ✓ 34. The effect of acute ethanol intoxication on liver and plasma lipid fractions of the rat. N. R. Di Luzio. Am. J. Physiol. 194:453-456, 1958.
- ✓ 35. Bone marrow, plasma and liver lipids following x-irradiation. E. E. Elko, and N. R. Di Luzio. Fed. Proc. 17:41, 1958 (abstract).
- ✓ 36. Liver and plasma metabolism in acute ethanol intoxication. N. R. Di Luzio. Fed. Proc. 17:35, 1958 (abstract).
37. Dietary cholesterol and adrenal regulation of plasma lipids. B. S. Powers, and N. R. Di Luzio. Am. J. Physiol. 195:166-170, 1958.
38. Effect of single and chronic choline supplements on phospholipid metabolism of the dog. N. R. Di Luzio and D. B. Zilversmit. Am. J. Physiol. 196:887-889, 1959.
- ✓ 39. Effect of x-irradiation on plasma, liver and bone marrow lipids of the rabbit. E. E. Elko and N. R. Di Luzio. Rad. Res. 11:1-6, 1959.
40. Lipid composition of Kupffer cells. N. R. Di Luzio. Am. J. Physiol. 196:884-886, 1959.
- ✓ 41. Isolation and lipid composition of liver parenchymal and Kupffer cells in normal and lipemic dogs. N. R. Di Luzio. Fed. Proc. 18:37, 1959 (abstract).
- ✓ 42. Isolation and lipid composition of liver parenchymal and Kupffer cells following oral and intravenous fat administration. N. R. Di Luzio. XXI Internat'l. Physiol. Congress. p. 76, 1959 (abstract).
- ✓ 43. Lipid composition of liver parenchymal and Kupffer cells and hepatic uptake of administered lipid. N. R. Di Luzio. Am. Oil. Chem. 33rd Fall Meeting, p. 10, 1959 (abstract).
44. The effect of x-irradiation on plasma and adipose tissue lipids of the rabbit. E. E. Elko and N. R. Di Luzio. Rad. Res. 10:440, 1959 (abstract).
- ✓ 45. Hepatic participation in lipid metabolism. N. R. Di Luzio. J. Am. Oil Chem. 37:163-165, 1960.
46. Modification of cholesterosis and lipidosis of rats maintained on an atherogenic diet. N. R. Di Luzio. Nature 185:616-618, 1960.
- ✓ 47. Modification of hypercholesterolemia and hepatic cholesterosis. N. R. Di Luzio. Fed. Proc. 19:15, 1960 (abstract).
48. Reticuloendothelial involvement in lipid metabolism. N. R. Di Luzio. Ann. N.Y. Acad. Sci. Art. 188:244-251, 1960.

- VFO 0002013270
49. Reticuloendothelial involvement in lipid metabolism. N. R. Di Luzio. N.Y. Acad. Sci. Conference on the RES. p. 9, 1959 (abstract).
 50. Influence of zymosan on tissue lipids of normal and cholesterol-fed animals. Symposium, "Drugs Affecting Lipid Metabolism." Milan, Italy, p. 45, 1960.
 51. Plasma lipid metabolism in x-irradiated rabbits. E. E. Elko and N. R. Di Luzio. Rad. Res. 12:432, 1960 (abstract).
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