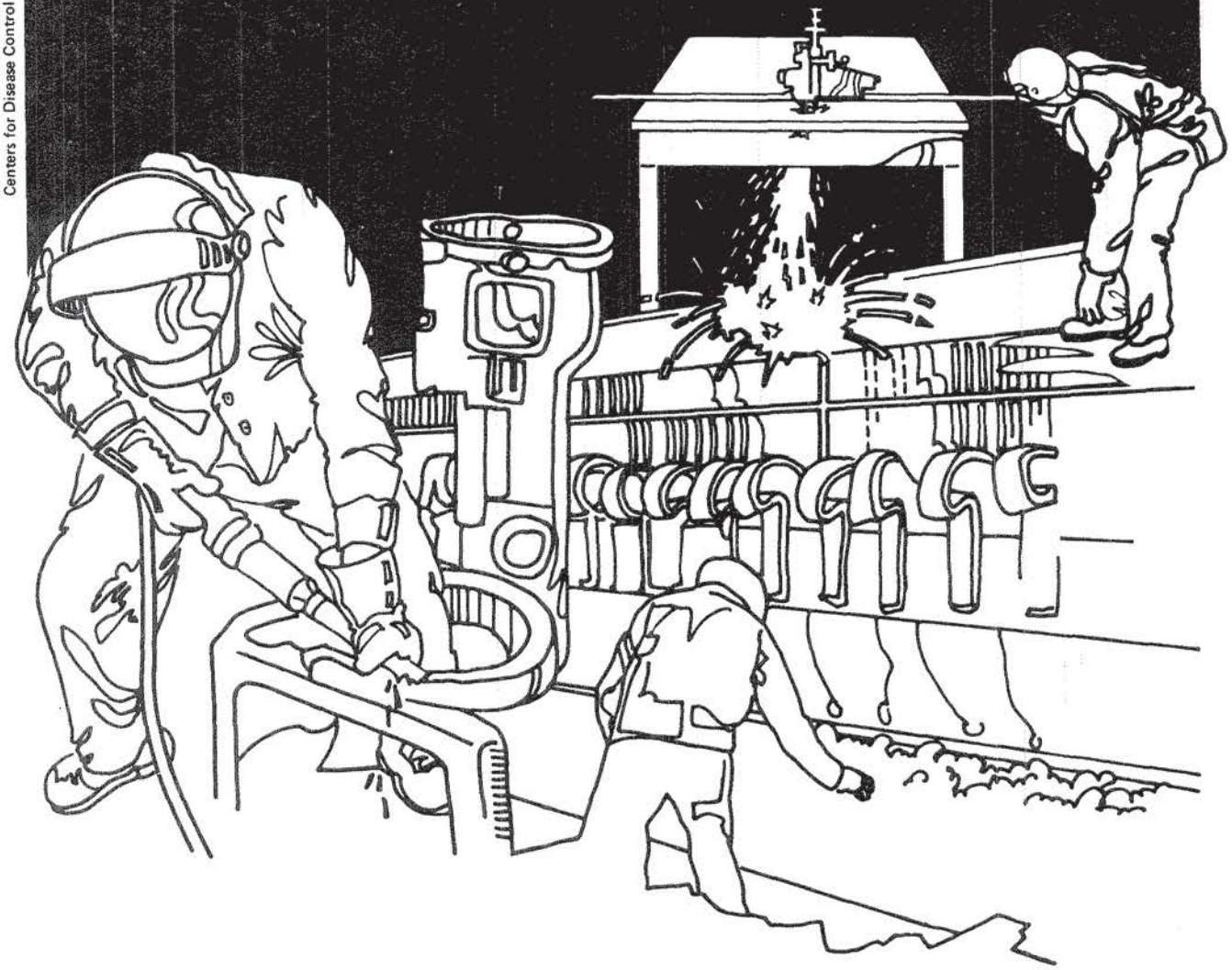
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health

NIOSH



Health Hazard Evaluation Report

HETA 83-385-1469
AGRICULTURAL COMMISSIONER,
SAN LUIS OBISPO COUNTY
PASO ROBLES, CALIFORNIA

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 83-385-1469
May 1984
AGRICULTURAL COMMISSIONER,
SAN LUIS OBISPO COUNTY
PASO ROBLES, CALIFORNIA

NIOSH INVESTIGATORS:
Molly Joel Coye, M.D., M.P.H.
Anne Burdick, M.D., M.P.H.
James Cone, M.D., M.P.H.
Dick Lewis, M.D.

I. SUMMARY

On August 10, 1983, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation from a representative of employees at the Paso Robles office of the San Luis Obispo County Agricultural Commissioner, in Paso Robles, Califoria. The request was prompted by the discovery that thallium and other pesticides stored in the office building had contaminated the office.

In 1977, the Paso Robles office was moved into a converted pesticide mixing and storage facility; pesticides were stored, repackaged and distributed from this building continuously until 1983. In spring of 1983 it was found that thallium sulfate, strychnine and other pesticides had accumulated in the wood floors and furniture of the office area, presumably because a ventilation outlet from the storage area exhausted directly over the office workers. The office was vacated in May 1983. Samples of the wood from the office floor, analyzed by the Department of Food and Agriculture, were found to contain thallium sulfate, stychnine, zinc phosphide, 2,4-D, dinitrophenol, dinitrocresol, DDT, and dieldrin. Cal-OSHA samples of floor sweepings and dust from the attic storage area which vented into the office confirmed contamination with thallium and zinc.

On October 19, 1983, NIOSH investigators conducted a site visit during which 24 workers were interviewed and examined. NIOSH also reviewed California-OSHA industrial hygiene data for the building, medical records for employees who had previously been medically evaluated, and a self-administered questionnaire which had been distributed to some of the exposed employees.

The questionnaire, physical examination and review of medical records identified one case of neurologic and dermatologic findings consistent with thallium poisoning; on evaluation by a neurologist, electromyography and nerve conduction studies showed evidence of axonal polyneuropathy, also consistent with thallium poisoning. In addition, three more workers reported symptoms suggestive of excessive thallium exposure which had resolved during the four months after leaving the contaminated building. Several workers reported neurologic symptoms consistent with histories of substantial exposure to a variety of pesticides as applicators or to paints and solvents.

Based on the environmental sampling performed by Cal-OSHA, and on medical record review, interview and examinations by NIOSH medical staff, it is concluded that a health hazard had existed in the Agricultural Commissioner's office in Paso Robles due to pesticides. Thallium poisoning with neurologic and dermatologic effects was diagnosed in the case of one worker, and three more workers reportd symptoms consistent with excessive thallium exposure. These complaints and findings have been resolving since removal of the employees from thallium exposure. Further medical evaluation is recommended in Section VII of this report for several other workers found to have neurologic deficits consistent with exposures to other pesticides or to paints and solvents.

KEYWORDS: SIC 0721 (Crop Planting, Cultivation, and Protection), pesticides, thallium sulfate, strychnine, organophosphates, dermatitis, hair loss, structural pesticides, applicators.

II. INTRODUCTION

The Agricultural Commissioners' offices in California sell and distribute pesticides for rodent control and institutional and urban structural applications. One or more members of the small staff in each office may mix and/or package the pesticides, and all staff members may handle the packaged pesticides in sales and distribution to the public. Some of these pesticides, such as thallium sulfate, have been restricted from public sale and use, and are applied directly by employees of the Department of Food and Agriculture. The concerns which prompted the request for this evaluation arose when methods of storage for the pesticides resulted in contamination of the office area, and when subsequent medical examination of five workers found evidence of potentially thallium-related health effects.

III. BACKGROUND

In 1977, the Paso Robles office was moved into a converted pesticide mixing and storage facility; pesticides were stored, repackaged and distributed from this building continuously until 1983. Approximately 6-8 workers were in the office on a permanent or frequent basis. In spring of 1983 it was found that thallium sulfate, strychnine and other pesticides had accumulated in the wood floors and furniture of the office area, presumably because a ventilation outlet from the storage area exhausted directly over the office workers. On May 18, the office was vacated.

Samples of the office floor wood were obtained and analyzed by the Worker Health and Safety Division of the Department of Food and Agriculture, with findings as follows:

thallium sulfate	615	ppm
strychnine	27	ppm
zinc phosphide	1.6	ppm
2,4-D	43	ppm
(dinitro); 2-sec-butyl-4,6 dinitrophenol; dinitrocresol	800	ppm
dieldrin	25	ppm

Results of Cal-OSHA sampling reported on June 23 confirmed the contamination of office floor sweepings and attic dust with thallium (range 26 - 131 ppm) and zinc (range 205 - 2380 ppm). Air samples in the office and adjacent areas showed no detectable thallium or zinc compounds in the air; sampling for organic-based pesticides revealed no airborne materials in the part per billion range.

Because of concern over possible health efffects of this exposure, five employees were referred to the Northern California Occupational Health Center in San Francisco for clinical evaluation.

In July, a brief questionnaire was distributed by the Center and completed by 19 employees, and hair samples were collected for analysis as described in Section VI.

IV. METHODS AND MATERIALS

A. Environmental

No environmental sampling was performed by NIOSH. Cal-OSHA sampling results are summarized in Section III.

B. Medical

The medical charts for the five workers referred to the Northern California Occupational Health Center were reviewed, together with the self-administered questionnaire completed by 19 workers at the Paso Robles office by the Center. On October 19, NIOSH conducted a site visit in Paso Robles. During the site visit, a questionnaire and physical examination was offered to all workers who had been employees of the Agricultural Commissioner's office and had physically been in the office building on a regular or intermittent basis.

A neurological examination was performed, including examination of cranial nerves, gait and station, coordination, deep tendon reflexes, muscle tone, strength and atrophy, and sensory discrimination. In addition, a dermatologist examined the exposed skin, nails and hair. The pattern and distribution of scalp hair loss was noted, including the normal variants of male pattern and traction alopecia. A hair pull test was performed to observe the number and proportion of telogen (resting) and anagen (growing) hairs obtained when approximately 20 hairs were tugged in the parietal, occipital and bitemporal areas of the scalp; a normal ratio is considered to be 9:1.

V. EVALUATION CRITERIA

A. Environmental

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet only those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

B. Toxicological

Because of the great variety of pesticides handled in Agricultural Commissioners' offices in California, only the potential health effects of chronic low level exposure to those pesticides identified as contaminants of the office area are discussed. A more detailed discussion of the health effects of these and other pesticides may be found in references (1) and (2).

1. Thallium Sulfate

Thallium is used as a rodenticide, but has been restricted from public use since 1965 in the U.S; it is also used in industrial manufacture of optical lenses, fireworks, jewelry, and in chemical processing. (3,4) Thallium sulfate is a soluble thallium compound, and can be absorbed by inhalation (breathing), ingestion (swallowing), or by contact with the eyes or skin. Soluble thallium compounds are very toxic, and with frequent exposure can can accumulate in the body over time. The half-life (time required for half of an absorbed dose to be excreted from the body) of thallium is variable, with a maximum of 30 days.

Symptoms of excessive exposure are nausea, vomiting, diarrhea, abdominal pain, and bleeding from the gut after an acute exposure, or hair loss, soreness of the mouth, fatigue, trembling, pain in the legs, severe weight loss, and emotional disturbance after chronic (long-term) exposure. More severe symptoms are drooping eyelids, crossed eyes, weakness, numbness and tingling of the arms and legs, trembling, and pain and tightness of the chest. Hair may fall out 2-3 weeks after a sudden exposure, or slowly over time with a chronic low-level exposure. In most cases, hairs in the axilla and public area are spared.(5) Recovery may be complete, but permanent neurologic effects have been reported, with liver and kidney damage and cardiovascular effects including tachycardia, hypertension and EKG changes. Thallium can be measured in the hair or urine; hair measurements may reflect exposures weeks to months prior to the test.

The current OSHA standard is 0.1 milligram of soluble thallium compounds per cubic meter of air (mg/m3) averaged over an eight-hour work shift.

2. Zinc Phosphide

Zinc phosphide is used as a rodenticide in baits containing 1% or less of the compound, and pastes containing 5-10%. The high toxicity of this compound is primarily due to hydrolysis to phosphine gas. The compound may be absorbed by inhalation or ingestion, and the symptoms produced are essentially the same by either route of entry. Early symptoms are vomiting, diarrhea, cyanosis, rales, tachycardia and hypotension, and fever. Zinc phosphide rarely causes occupational poisoning, although inhalation of dust from grain coated with the compound produced

severe poisoning in one report. Symptoms are apparently reversible in surviving victims. (2)
There is no OSHA standard, NIOSH or ACGIH recommendation for zinc phosphide.

VI. RESULTS AND DISCUSSION

Five employees were questioned and examined at the Northern California Occupational Health Center, and 19 employees were examined and completed questionnaires during the NIOSH visit to the Agricultural Commissioner's Office at Paso Robles. Eleven were female, and 13 were male. Ages ranged from 23 to 71, with a mean age of 40.5 years.

1. Exposures

In analyzing the symptoms reported during interviews on October 19, the employees were divided into three job categories representing relative extent of estimated pesticide exposure:

Group A = (4) office workers, maximum exposure to contaminated area

Group B = (16) non-office workers, minimal/no exposure to pesticides

Group C = (4) pesticide applicators, continuous potential exposure to wide variety of pesticides, but little handling of thallium sulfate and no work in the contaminated office area

Duration of exposure ranged from 1-18 years. Five employees reported that a previous pesticide-related doctor's first report of work illness had been filed, one from strychnine, one from a hand burned by pesticides, one from Todon, one from a 1080 exposure with a puncture wound, and one from thallium exposure. Multiple known pesticide exposures were reported, particularly by Group C, including Roundup, 1080, Dibrom, 2,4-D, 2,4,5-T, paraquat, ethylene dibromide, atrazine, and others. Repirator use was reported by 9 employees, and glove use by 14, largely when moving or mixing rodent bait.

Past exposures which could result in peripheral neuropathy were reported for thallium (15 employees), lead (3), and mercury (3). Other than birth control pills, no medications with reported effects on the peripheral nervous system were reported.

2. Symptoms

A total of 11 workers reported symptoms of parasthesias, 6 reported hair loss, and 5 reported changes of mood or personality changes noted since working at the Paso Robles office. One employee gave a two year history of diffuse hair loss including

pubic, axillary and eyelash hair which had improved since June, 1983. Other symptom frequencies are listed in Table 1. There was no apparent trend associating estimated thallium exposure with symptoms.

One of these employees, who had a two year history of hair loss, irritability, headache, intermittent abdominal pain, paresthesias, mild weakness of the upper extremities, was referred to a neurologist. Electromyography and nerve conduction studies demonstrated evidence of axonal polyneuropathy, consistent with excessive thallium exposure.

3. Case Report

Review of medical records, medical interviews and physical examination of the workers identified one employee who had had a two year history of hair loss, fatigue, increased sweating, thirst and urinary frequency, irritability, headache, decreased appetite with a 10 pound weight loss, intermittent abdominal pain, paresthesias and mild weakness of the upper extremities. The workers had also noted small bumps on both lower eyelids over the preceding year, tingling in the hands and feet accompained by numbness extending as far as the wrist and ankles over the past eight months, and intermittent diarrhea and increasingly severe hair loss over the past six months.

This employee performed primarily clerical tasks, and had been seated directly beneath the air supply vent carrying air from the attic area used for pesticide storage. In the first two months after the workers had been removed from that building, the symptoms had markedly decreased. The patient was then referred to a neurologist for evaluation. Electromyoghraphy and nerve conduction studies showed evidence of axonal polyneuropathy consistent with thallium poisoning. In the ensuing several months, the worker's symptoms have continued to resolve; a repeat of the nerve conduction velocity study on this worker in October was within normal limits.

On examination by the dermatologist, this employee had alopecia of the legs, the lateral third of the eyebrows and a small area of the parietal scalp, and gave a history of diffuse hair loss including pubic, axillary and eyelash hair, resolving since leaving the contaminated building. At the time of this examination, almost four months after removal from exposure, an alternative diagnosis of diffuse alopecia arreata could not be ruled out.

4. Physical Examination

Neurologic Findings: Decreased peripheral nerve sensation was detected in three employees, and four employees had symmetrically decreased or absent reflexes in one muscle group only. The remainder were normal, with the exception described in the case report above.

Dermatologic Findings: Twelve employees demonstrated male pattern baldness. Two employees had mild traction alopecia. The remainder of the hair examinations were normal, with the exception described in the case report above. Nail and hair pull examinations were normal.

5. Laboratory Examination

Hair was reportedly obtained from the occiput scalp of most of the potentially thallium exposed workers by a laboratory technician at a local hospital. The hair was cut at the midpoint of the hair shaft and the distal half was sent to National Medical Services, Inc. for determination of thallium levels by atomic absorption spectrophotometry. Fingernail samples were also sent to this laboratory from one employee. Although all samples were negative for thallium, the hair analyses cannot be regarded as conclusive, as the sampling was done several months after exposure ceased. Analysis of the proximal half of the hair might have revealed thallium levels even several months after exposure. Serology for syphilis and screening for thyroid disease in the employee with diffuse alopecia were both negative.

6. Discussion

Due to the difficulty of controlling thallium exposures in a building with contaminated dust, and the fact that thallium is well absorbed by skin as well as inhalation, Cal-OHSA recommended on June 23 that this building not be used as a regular office; use as an office had been discontinued as of May 18.

Based on the medical findings presented above, it is concluded that the employee who had had the greatest direct exposure to contaminated exhaust from the storage area had neurologic and dermatologic findings consistent with thallium poisoning, now resolving after removal from exposure. Three employees reported symptoms consistent with excessive thallium exposure, and eight others reported symptoms consistent with excessive exposure to other pesticides; due to the relatively low level and chronic nature of these exposures, it was difficult to identify the effects of single substances. The symptoms and the dermatologic complaints have either resolved or are continuing to resolve in all cases. The nerve conduction velocity for the most heavily affected employee, when repeated in October, was within normal limits.

Symptoms or physical findings suggesting neurologic effects were reported by several of the pest control applicators (Group C) and one of the workers not exposed to pesticides who had a history of exposure to paint and solvents for more than 15 years (Group B). It was recommended that these employees receive further medical evaluation.

VII. RECOMMENDATIONS

1. Employees with abnormal findings in the interview and/or physical examination should receive further medical evaluation.

VII. REFERENCES

1. NIOSH. Occupational Diseases: A Guide to Their Recognition. US DHEW/PHS/CDC, 1977. Publication No. 77-181.

2. Hayes, Wayland J. Pesticides Studied in Man. Baltimore: Williams & Wilkins, 1982.

3. Saddique A and Peterson C. Thallium poisoning: a review. Vet and Hum Toxicol 25:1, 1983.

4. NIOSH/OSHA. Occupational Health Guidelines for Chemical Hazards. US DHHS/PHS/CDC, January 1981.

5. Horton RJM. Thallium, in: Toxicology of Metals, Volume II, U.S. Environmental Protection Agency, Contract No. 68-02-1287, 1977.

IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared By:

Molly Joel Coye, M.D., M.P.H.
Medical Officer
NIOSH, Region IX
San Francisco, California

Anne Burdick, MD, MPH
Fellow, Occupational Dermatology
University of California, San Francisco

James Cone, MD, MPH
Assistant Clinical Professor
Department of Medicine
University of California, San Francisco

Dick Lewis, MD
Resident, Occupational Medicine
Northern California Center for Occupational Safety and Health

ACKNOWLEDGEMENTS:

NIOSH would like to thank Drs. Charles Becker and Michael Aminoff of the Northern California Occupational Health Center for their assistance in this evaluation.

X. DISTRIBUTION AND AVAILABILITY

Copies of this Determination Report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Information Resources and Dissemination Section, 4676 Colombia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the national Technical Information Service (NTIS) 5285 Port Royal Road, Springfield, Virginia. Information regarding its availability through NTIS can be obtained from the NIOSH Publications Office at the Cincinnati address.

Copies of this report have been sent to:

1. Requestor
2. Agricultural Commissioner, San Luis Obispo County
3. NIOSH -- Region IX
4. Cal-OSHA
5. Federal-OSHA

For the purpose of informing the affected employees, a copy of this report shall be posted in a prominent place accessible to the employees for a period of 30 calendar days.

HE # 83-835

TABLE I: SYMPTOMS BY JOB CATEGORY

JOB CATEGORY*	N=	NAUSEA	PARES-THESIAS	SLEEPINESS	MOOD CHANGES
GROUP A	4	2	2	2	1
GROUP B	16	10	7	7	4
GROUP C	4	1	3	2	0

* job categories defined in Section IV

DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTERS FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
ROBERT A. TAFT LABORATORIES
4676 COLUMBIA PARKWAY, CINCINNATI, OHIO 45226

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE. $300

Third Class Mail

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF HHS
HHS 396