



MECHANISMS OF ENTRY OF LEAD-BEARING DUSTS INTO HOUSES IN PORT PIRIE.

Alex Kutlaca
BSc, MEnvSt

A dissertation submitted in fulfilment of the requirements
for the degree of Doctor of Philosophy in The Mawson
Graduate Centre for Environmental Studies
The University of Adelaide
April 1998

TABLE OF CONTENTS

	Page Number
TITLE PAGE	i
FRONTISPIECE	ii
TABLE OF CONTENTS	iv
LIST OF TABLES	xv
LIST OF FIGURES	xix
LIST OF PLATES	xx
ABSTRACT	xi
DECLARATION	xii
ACKNOWLEDGMENTS	xiii
CHAPTER ONE INTRODUCTION	1
1.1 PREAMBLE	1
1.2 THE CONTEXT OF RESEARCH	3
1.3 GENERAL RESEARCH DIRECTION.....	6
1.4 THESIS STRUCTURE.....	7
1.5 THE STUDY SITE	11
1.6 PORT PIRIE SMELTER DETAILS	16
1.7 LEAD AND HEALTH IN PORT PIRIE EARLIER THIS CENTURY	17
1.8 AIMS AND OBJECTIVES.....	17
1.9 GENERAL METHODOLOGY	19
1.9.1 VACANT HOUSE SUITE - SITE SELECTION AND HOUSE DETAILS	19
1.9.1.1 SITE SELECTION.....	19
1.9.1.2 GENERAL HOUSE DESCRIPTION	19
1.9.1.3 SOURCE OF HOUSES	22
1.9.1.4 POTENTIAL HOUSE DIFFERENCES	22
1.9.2 RESEARCH WORK TIMING IN VACANT HOUSE SUITE.....	22
1.9.3 SAMPLING MATERIALS AND METHODS.....	22

1.9.3.1	SOIL SAMPLING	23
1.9.3.2	SURFACE DUST SAMPLING	23
a)	Vacuum pump	23
b)	Dust-collecting device	23
1.9.3.3	DEPOSITING DUST SAMPLING.....	24
1.9.3.4	AIR SAMPLING.....	24
1.9.4	ANALYTICAL METHODOLOGY	24
1.9.4.1	DEPOSITING DUST	25
1.9.4.2	STATIC DUST	25
1.9.4.3	AIR-DERIVED SAMPLES	25
1.9.5	ADDITIONAL ELEMENT DATA	25
1.9.6	DATA INTERPRETATION.....	26
1.9.6.1	RAW DATA APPEARANCE	26
1.9.6.2	STATISTICAL COMPARISON OF DATA	27
1.9.7	CONTEMPORANEOUS SAMPLING - POST CLEAN-UP STUDY	27

CHAPTER TWO LEAD THROUGH HISTORY: INTEREST AND INTOXICATION -

- AN HISTORICAL REVIEW 30

2.1	THE EMERGENCE OF LEAD.....	30
2.2	ORIGINS OF LEAD USAGE	31
2.3	LEAD'S INITIAL PRODUCTION INCREASE	33
2.4	HEALTH EFFECTS ASSOCIATED WITH LEAD INTOXICATION	34
2.4.1	GREEK AND ROMAN CULTURES	34
2.4.2	MORE RECENT CULTURES AND HISTORICAL LINKAGES.....	37
2.5	SKELETAL LEAD LEVELS	41
2.5.1	ANCIENT CIVILISATION SKELETAL LEVELS OF LEAD	41
2.5.2	EARLY TO PRESENT CIVILISATION SKELETAL LEAD LEVELS	42
2.5.2.1	EUROPEAN CIVILISATION.....	42
2.5.2.2	JAPANESE CIVILISATION.....	43
2.6	LEAD INTOXICATION IN MODERN TIMES: A BRIEF HISTORY	44
2.7	IN SUMMARY - LEAD TODAY AND IN THE FUTURE	48

CHAPTER THREE LEAD; THE ENVIRONMENT AND EXPOSURE PATHWAYS 50

3.1	LEAD: PHYSICO/CHEMICAL PROPERTIES	50
3.1.1	ELEMENTAL LEAD DETAILS	50
3.1.2	LEAD SALTS	51
3.1.2.1	SOLUBILITY UNDER LABORATORY CONDITIONS	51
3.1.2.2	LEAD'S SOLUBILITY IN VARIOUS WATER BODIES	52

3.1.2.3	HARVESTING FROM ORE	52
3.2	CURRENT PRODUCTION AND ENVIRONMENTAL EMISSIONS	53
3.2.1	PRODUCTION	53
3.2.1.1	END USE PATTERNS	54
3.2.1.2	LEAD IN GASOLENE	57
3.2.2	ENVIRONMENTAL DISCHARGE	57
3.2.2.1	NATURAL SOURCE LEAD EMISSIONS	57
a)	Total	57
b)	Atmospheric	58
3.2.2.2	ANTHROPOGENIC-SOURCED LEAD EMISSIONS	58
a)	All sources	58
b)	Gasolene lead	60
3.3	LEAD IN THE ENVIRONMENT	62
3.3.1	SOIL	62
3.3.1.1	CONTRIBUTORS TO SOIL LEAD	62
a)	Natural sources	62
b)	Anthropogenic influences	63
- i)	Mineralised soil areas	63
- ii)	Urban areas	64
- iii)	Roadway-adjacent soil	65
- iv)	Rural areas	66
- v)	Smelter locations	66
3.3.1.2	SOIL LEAD, PATHWAYS TO HUMANS - ASSOCIATED HEALTH RISKS	66
3.3.2	WATER	68
3.3.2.1	PATHWAYS TO CONTAMINATION	69
3.3.2.2	GROUND WATER	69
3.3.2.3	SURFACE WATER	69
3.3.2.4	HUMAN CONTACT WITH LEAD VIA WATER	70
a)	Reticulated water	70
b)	Rain water storage tanks	71
3.3.3	AIR	71
3.3.3.1	AIR-SUSPENDED PARTICLE DYNAMICS	71
3.3.3.2	AIR LEAD LEVELS	72
a)	Remote areas	72
b)	Rural areas	73
c)	Urban areas	73
3.3.3.3	LONG-TERM AIR MONITORING	75
a)	All locations	75
b)	Smelter-proximate locations	78
3.3.4	FOOD	79
3.3.4.1	DIETARY LEAD	79

3.3.4.2	SOURCES OF LEAD INTO FOOD	80
3.3.5	DUST	83
3.3.5.1	AN OVERVIEW OF THE ROLE OF DUST	83
3.3.5.2	LEADED DUST AS A PATHWAY TO HUMANS	84
3.3.5.3	SOIL AND HOUSE DUST	85
3.3.5.4	SOIL, STREET DUST AND HOUSE DUST	85
3.3.5.5	OTHER LEAD CONTRIBUTORS TO DUST	85
3.3.5.6	LEAD LEVELS - EXTERNAL AND INTERNAL DUST	87
a)	External dust	87
- i)	Remote and rural	88
- ii)	Urban	88
- iii)	Surrounding the home	88
- iv)	Industrial regions	89
b)	Indoor dust	89
3.3.5.7	URBAN VERSUS RURAL DUST LEAD SCENARIOS	91
3.3.5.8	HEAVILY-INDUSTRIALISED REGIONS	93
3.3.5.9	MINERALISED AREAS	94
3.3.5.10	DUST MOVEMENT DYNAMICS	94
a)	House structural factors	94
b)	House occupant influences	95
c)	General comments	95
3.3.5.11	DEPOSITING LEAD AND LEAD LOADING DATA	96
a)	Depositing dust lead (leadfall)	96
b)	Lead in dust loading	96
3.3.5.12	HOUSE DUST SOURCE CONTRIBUTORS	97
3.4	ENVIRONMENTAL LEAD LEVELS	99
3.4.1	LEAD INTAKE BY INSPIRATION OF CONTAMINATED AIR	99
3.4.2	LEAD INTAKE BY FOOD	99
3.4.3	LEAD INTAKE BY CONSUMPTION OF SOIL AND DUST	100
3.4.3.1	SOIL	100
3.4.3.2	DUST	101
3.4.4	MAJOR ENVIRONMENTAL COMPARTMENT CONTRIBUTIONS TO BLOOD LEAD	102
3.4.4.1	ENVIRONMENTAL LEVELS: EXPOSURE/EFFECT INDICATORS	102
3.4.4.2	HUMAN EXPOSURE POTENTIAL	103
3.4.5	PATHWAYS TO INTOXICATION	103
3.5	INDICES OF A HISTORY OF LEAD USAGE	104

CHAPTER FOUR LEAD & ITS RELATIONSHIP WITH HUMAN HEALTH - GREY

METAL OR GREY MATTER, THE CHOICE MAY NOT BE OURS	107
4.1 MEDICAL ASPECTS OF LEAD'S TOXICOLOGY - GENERAL	107
4.1.1 PREAMBLE	107
4.1.2 INTRODUCTION.....	108
4.2 LEAD'S INTERACTION WITH THE HUMAN BODY - THE DETAILED.....	110
TOXICOLOGY OF LEAD.....	110
4.2.1 THE ABSORPTION OF LEAD	110
4.2.1.1 GASTRO-INTESTINAL TRACT (GIT) ABSORPTION.....	111
a) Normal physiological absorption variability.....	112
b) Chemical species absorption variability	112
c) The influence of food on absorption	113
d) Age-related absorption variability	114
e) Occupational influences on absorption	114
f) Dietary factors influencing absorption	114
- i) Calcium and Phosphorous	115
- ii) Other trace elements.....	116
- iii) Vitamin D.....	118
- iv) Other dietary factors.....	119
- v) Summary comments.....	119
4.2.1.2 RESPIRATORY TRACT ABSORPTION	120
4.2.2 LEAD'S DISTRIBUTION IN THE BODY	121
4.2.2.1 BINDING SITES, PATHWAYS AND BODY POOLS.....	121
4.2.2.2 SOFT TISSUE STORAGE	122
4.2.2.3 BONE STORAGE	123
4.2.2.4 OTHER LEAD STORAGE SITES	124
4.2.3 ABSORBED LEAD AND ITS EXCRETION OR RETENTION.....	125
4.2.3.1 EXCRETION MECHANISMS	125
4.2.3.2 RETENTION SEQUELAE.....	125
4.2.4 HUMAN HEALTH EFFECTS OF LEAD - OVERVIEW	126
4.2.4.1 INTRACELLULAR AND CYTOLOGICAL EFFECTS	126
4.2.4.2 BODY SYSTEM EVIDENCE OF LEAD'S TOXIC EFFECTS	127
4.2.5 HUMAN HEALTH EFFECTS OF LEAD - SYSTEMS AND ORGANS	129
4.2.5.1 INFLUENCE ON HAEMOPOIESIS.....	129
a) ALA-S effects	132
b) ALA-D effects	132
c) Ferrochelataase effects.....	132
4.2.5.2 LEAD'S EFFECT UPON THE KIDNEY	134
4.2.5.3 EFFECT OF LEAD UPON REPRODUCTION	134
a) Lead and maternal effects	135

b) Lead and paternal effects	135
c) In utero lead contamination	135
4.2.5.4 LEAD'S TOXICITY TO THE DEVELOPING NERVOUS SYSTEM	137
a) Central nervous system effects of lead	138
b) Peripheral nervous system effects of lead.....	139
c) Neurobehavioural/neuropsychological effects of lead.....	140
d) Developmental CNS toxicity of lead	143
4.2.5.5 CARDIOVASCULAR TOXICITY OF LEAD	145
4.2.5.6 GASTROINTESTINAL TOXICITY	146
4.2.5.7 IMMUNE SYSTEM EFFECTS	146
4.2.5.8 GENOTOXIC EFFECTS.....	147
4.2.5.9 CARCINOGENIC EFFECT OF LEAD	147
4.2.5.10 TERATOGENIC/GAMETOTOXIC EFFECTS OF LEAD	148
4.2.5.11 SUMMARY	148
CHAPTER FIVE PRELIMINARY INVESTIGATIONS	150
5.1 INTRODUCTION	150
5.2 DUST LEAD CONTENT - ESTABLISHING THE METHODOLOGY	151
5.3 INITIAL HOME VACUUM CLEANER BAG GRAB SAMPLES	151
5.3.1 SAMPLES ACQUIRED FROM PORT PIRIE RESIDENCES	152
5.3.2 OUT-OF-TOWN SAMPLES	154
5.4 BULK DUST PARTICLE SIZE RANGE AND LEAD CONTENT	155
5.4.1 DUST PARTICLE SIZE RANGE - SIEVING TECHNIQUE.....	155
5.4.2 DUST PARTICLE SIZE RANGE LEAD CONTENT	159
5.5 SAMPLED DUST PARTICLE SIZE DETERMINATION - LASER TECHNIQUE	163
5.5.1 METHODOLOGY	164
5.5.2 RESULTS	164
5.5.2.1 VACUUM PUMP/VACUUM CLEANER DATA COMPARISON.....	164
a) Vacuum pump and filter data (P Suite data)	165
b) Vacuum cleaner data (D Suite data)	166
c) P and D suite comparisons	166
d) Particle size relationship with lead content of dust	171
5.5.2.2 District differences	172
5.5.2.3 Influence of distance from smelter on particle size.....	172
5.5.2.4 House aspect - facing smelter versus facing away	173
CHAPTER SIX VACANT HOUSE SOIL ASSESSMENT	174
6.1 INTRODUCTION	174

6.2	OBJECTIVES	175
6.3	INITIAL OBSERVATIONS AND SITE DESCRIPTION.....	175
6.4	SAMPLING PROTOCOL AND LOCATION	176
6.5	RESULTS	177
6.5.1	SOIL LEAD AND ZINC LEVELS.....	177
6.5.2	SOIL CONTAMINANT LEVELS: HOME BY HOME COMPARISONS.....	179
6.5.3	SOIL CONTAMINANT LEVELS: BY DISTANCE FROM SMELTER	181
6.5.4	SOIL CONTAMINANT HOME CONCENTRATION GRADIENTS	183
6.5.5	SOIL CONTAMINANT LEVEL BY HOME AREA	185
6.5.6	HOUSE ASPECT: FACING SMELTER VERSUS FACING AWAY.....	189
6.5.7	VACANT HOME SOIL LEAD/ZINC RELATIONSHIP.....	191
6.5.7.1	CORRELATION BETWEEN SOIL LEAD AND ZINC VALUES	191
6.5.7.2	SOIL LEAD AND ZINC RATIOS	193
6.5.8	CONCLUDING REMARKS	194
 CHAPTER SEVEN WITHIN-HOUSE DEPOSITED DUST		196
7.1	INTRODUCTION	196
7.2	RESEARCH OBJECTIVES	197
7.3	METHODOLOGY.....	198
7.3.1	SAMPLE ACQUISITION	198
7.3.2	SAMPLE ANALYSIS	199
7.3.3	SAMPLING DETAILS.....	199
7.4	STATIC DUST - SUMMARY RESULTS.....	200
7.5	PRELIMINARY OBSERVATIONS	201
7.6	CONCERNS REGARDING OPERATOR DIFFERENCES	202
7.7	DISTRICT DIFFERENCES	203
7.8	MAIN ROOM DIFFERENCES.....	205
7.9	ROOMS FACING VERSUS FACING AWAY	206
7.10	HOUSE BY HOUSE COMPARISON	208
7.11	HOUSE CONTAMINATION WITH DISTANCE FROM SMELTER	210
7.12	CONTAMINATION DUE TO FIREPLACE PRESENCE.....	211
7.13	FLOOR SURFACE DIFFERENCES	213
7.14	CARPET TYPE AND CONDITION	216
7.14.1	CARPET PILE DIFFERENCES.....	216
7.14.2	CARPET WEAR LEVELS	217
7.15	BETWEEN ROOM DIFFERENCES	218
7.16	WITHIN-ROOM DIFFERENCES - LOCATION IN (MAIN) ROOMS.....	220
7.16.1	FIREPLACES	224
7.16.2	WINDOWS	225
7.16.3	DOORWAYS.....	227

7.16.4	FIREPLACE/WINDOW/DOOR COMPARISON	229
7.17	HALLWAYS AND HOUSE MAIN (FRONT) ENTRANCES	229
7.17.1	HALLWAY MAIN ENTRANCES	229
7.17.2	HALLWAY CONTAMINANT GRADIENTS	230
7.18	WINDOW SILL AND WELL	233
7.19	ROOMS FACING WALKWAY VERSUS OPPOSITE	234
7.20	SUMMARY OF CONTAMINANT DISTRIBUTION WITHIN ROOMS	234
7.21	POST-CLEANUP STATIC DUST ASSESSMENT	236
 CHAPTER EIGHT WITHIN-HOUSE DEPOSITING DUST		239
8.1	INTRODUCTION	239
8.2	RESEARCH OBJECTIVES	239
8.3	METHODOLOGY	240
8.3.1	DUSTFALL-COLLECTING TECHNIQUE	242
8.3.2	ADDITIONAL DUSTFALL ASSESSMENT	242
8.3.3	SAMPLING STRATEGY	242
8.4	SAMPLE ANALYSIS	243
8.5	DUST DEPOSITION RESULTS	244
8.5.1	INTERNAL DUSTFALL COLLECTION - SUMMARY DATA	244
8.5.2	DUSTFALL COLLECTION, ROUND BY ROUND	246
8.5.3	DUST DEPOSITION: DISTRICT COMPARISON.....	250
8.5.3.1	ALL ROUNDS COMBINED	250
8.5.3.2	DISTRICT DIFFERENCES ACCORDING TO HOUSE STATUS	252
8.5.3.3	DISTRICT DIFFERENCES ROUND BY ROUND	258
8.5.3.4	LEADFALL/DUSTFALL DISTRICT RELATIONSHIP - INDIVIDUAL COLLECTION ROUNDS	260
8.5.4	DUSTFALL HOME BY HOME	261
8.5.5	SAMPLING LOCATION DISTANCE FROM SMELTER.....	264
8.5.6	DUST DEPOSITION DIFFERENCES BY ROOM.....	265
8.5.6.1	ROOM TYPE	266
8.5.6.2	MAIN ROOM DIFFERENCES	268
8.5.7	PRESENCE OF A FIREPLACE IN A MAIN ROOM.....	272
8.5.8	WINDOW VERSUS CENTRE OF ROOM LOCATION	273
8.5.9	DEPOSITING DUST GRADIENTS FROM A WINDOW INTO A ROOM	276
8.5.10	ROOMS ADJACENT TO WALKWAY VERSUS ROOMS OPPOSITE	278
8.5.11	DEPOSITING DUST CHARACTERISTICS - AWAY VERSUS FACING	279
8.5.11.1	GENERAL INVESTIGATION	279
8.5.11.2	DISTRICT DIFFERENCES FACING VERSUS FACING-AWAY	281
a)	Port Pirie West	281
b)	Solomontown	281

8.5.11.3	SUMMARY COMMENTS	282
8.6	POST-CLEANUP DUST DEPOSITION	283
8.6.1	INITIAL DATA INTERPRETATION	283
8.6.2	FURTHER POST-CLEANUP DATA INTERPRETATION	286
8.7	DUSTFALL COLLECTION IN EXTERNAL STRUCTURES	287
 CHAPTER NINE LEAD-IN-AIR STUDY		289
9.1	INTRODUCTION	289
9.2	DUST ENTRY INTO BUILDINGS	290
9.3	INDOOR/OUTDOOR AIR LEAD CONCENTRATION RATIOS	291
9.4	RESEARCH OBJECTIVES	294
9.5	SAMPLING STRATEGY	294
9.6	METHODOLOGY	295
9.6.1	SAMPLING EQUIPMENT	295
9.6.2	OPERATING CONDITIONS	296
9.6.3	SAMPLING PROTOCOL	297
9.6.4	SAMPLE CHEMICAL ANALYSIS	298
9.7	RESULTS	298
9.7.1	PRELIMINARY EXPERIMENTATION	298
9.7.2	MAIN RESEARCH COMPONENT	298
9.7.3	TEMPERATURE TO AIR LEVEL COMPARISON	299
9.7.4	OCCUPIED VERSUS VACANT HOUSES	300
9.7.5	HOUSE ASPECT: FACING THE SMELTER OR FACING AWAY	301
9.7.6	POST-CLEANUP AIR STUDY	302
9.7.7	RELATIONSHIP BETWEEN LEAD-IN-AIR AND LEADFALL LEVELS	303
9.7.7.1	PREAMBLE	303
9.7.7.2	EXPERIMENTAL RESULTS	304
 CHAPTER TEN GENERAL DISCUSSION		306
10.1	INTRODUCTION	306
10.2	PRELIMINARY RESEARCH	308
10.3	DUST SAMPLING TECHNIQUES	309
10.3.1	DEPOSITED DUST	309
10.3.2	DEPOSITING DUST	310
10.3.3	CONTAMINATION INDICATORS: STATIC DUST VERSUS DUSTFALL	310
10.4	CONTAMINANT DUST DISTRICT DIFFERENCES	310
10.5	CONTAMINANT LEVEL VARIATION WITH DISTANCE FROM SMELTER	312
10.6	HOME SPATIAL VARIABILITY OF LEAD CONTAMINATION	313

10.6.1	SOIL	313
10.6.2	STATIC DUST.....	314
10.6.2.1	MECHANISMS OF DUST ENTRY	315
a)	Windows	315
b)	Doorways	316
- i)	Main external doorways	316
- ii)	Hallway to room doorways	316
c)	Windows versus doorways as potential entry points	317
d)	Fireplaces	319
10.6.3	DEPOSITING DUST	320
10.6.3.1	MECHANISMS OF DUST ENTRY	320
a)	Windows	320
b)	Main entrance doorways.....	321
c)	Fireplaces	322
CHAPTER ELEVEN	CONCLUSION AND RECOMMENDATIONS	331
11.1	CONCLUSION	331
11.2	RECOMMENDATIONS	334
APPENDICES		337
APPENDIX ONE		
	ANALYTICAL PROCEDURES	337
APPENDIX TWO		
	PRELIMINARY DUST DIGEST METHOD ESTABLISHMENT.....	339
APPENDIX THREE		
	QUALITY CONTROL PROTOCOL AND RESULTS	343
APPENDIX FOUR		
	ROBERT KEHOE, LEAD & HEALTH RESEARCH IN THE USA	349
APPENDIX FIVE		
	HOME ACTIVITIES DISTRIBUTING LEAD AROUND THE HOME	350
APPENDIX SIX		
	STANDARDISATION OF SAMPLING AND ANALYSIS TECHNIQUES	351
APPENDIX SEVEN		
	AAS OPERATING CONDITIONS AND QUALITY CONTROL	352
APPENDIX EIGHT		
	BULK DUST SIEVING DETAILS	356

APPENDIX NINE	
VACUUM PUMP DUST-COLLECTION SYSTEM	357
APPENDIX TEN	
VACUUM PUMP DUST COLLECTION METHOD PROTOCOL	361
APPENDIX ELEVEN	
PARTICLE-SIZING DUST PROCESSING TECHNIQUES	362
APPENDIX TWELVE	
PYKNOMETRY DETAILS	364
APPENDIX THIRTEEN	
INITIAL TESTING OF XRF CAPABILITIES	365
APPENDIX FOURTEEN	
HANDPIECE AND TUBING DUST RETENTION	369
APPENDIX FIFTEEN	
STATIC DUST COLLECTION VALIDATION STUDY	374
APPENDIX SIXTEEN	
POTENTIAL DUSTFALL COLLECTION APPROACHES	377
APPENDIX SEVENTEEN	
DEPOSITING DUST COLLECTION PROTOCOL	384
APPENDIX EIGHTEEN	
COLLECTED DUST ANALYSIS METHODOLOGY	388
APPENDIX NINETEEN	
VACUUM PUMP, ROTAMETER, AND GAS METERS	391
CHAPTER TWELVE BIBLIOGRAPHY	395

THESIS ABSTRACT

The world's largest single-line lead smelter situated at Port Pirie in South Australia has continued its smelting operation for more than 100 years. This has resulted in a continuous distribution of lead in the form of dust into the local environment. Clearly, an environmental problem of disturbing proportion has existed for perhaps a century, this being manifest in the context of human/lead contact, with sinister health sequelae for populations at risk. Accepting the role of lead-bearing dusts as being the vehicle for carriage of the toxin to, primarily, children, research was directed toward demonstrating spatial variability in dust lead contamination patterns both statically and dynamically within the confines of vacant test houses, thus eliciting specific entrance pathways.

Contaminant levels in existing house surface dust, depositing dust and air-suspended dust both indoor and outdoor were examined as also home soils proximate to the dwelling structure. For such research, some novel sampling equipment was designed and utilised, evidence being presented to suggest the appropriateness of use of such sampling equipment. Lead levels in dust and soil are high, particularly house dust (eg $>6,000\mu\text{g}\cdot\text{g}^{-1}$). This contamination by lead-bearing dust at household level appears widespread within the areas investigated, the source of the dust and the lead present being closely related. Test houses appear to be easily penetrated by contaminant dust, and further, appear to retain such dust, representing a focus of contamination. The bulk of the dust-contained lead within the house lies in the hand-adherent particle size range.

Within-house lead level spatial variability is apparent, windows and external doorways being demonstrated as major contaminant entry points. Rooms with open fireplaces are slightly more contaminated than those without, although fireplaces *per se* appear not to be major entry points for leaded dust. Houses exhibit almost an order of magnitude greater lead-bearing dust deposition rates under open windows and doors format than closed, hallways revealing the greatest levels of room contamination.

Surface soil contamination appears to be more a recent and on-going phenomenon rather than an historical artefact, spatial variability at home level reflecting this contemporary nature and also, as for deposited house dusts, suggesting source directionality. Lead levels in air and depositing dust appear largely independent of soil lead levels, soils being suggested as a poor indicator of inside home contamination levels. Contaminated depositing dusts within the home appear to be more newly-entering and contemporary than simply re-entrained and historical.

The bulk of surface dusts sampled in the vacant houses would appear to have deposited there during the house vacancy period, previous foot tracking being suggested as a minor pathway for home contamination in both vacant and occupied houses. Rates of leaded dust deposition in "de-dusted" houses are very similar to control uncleaned houses soon after house cleaning. Thus the value of comprehensive systematic house de-dusting as part of a community lead intervention program would appear to be questionable.