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Task II

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INCIDENCE OF HUMAN DENTAL FLUOROSIS IN THE
RAFT RIVER GEOTHERMAL AREA IN SOUTHERN IDAHO

ABSTRACT

A total of 270 school aged individuals representing 151 families living in the vicinity of the Raft River Geothermal area of Idaho were examined for evidence of dental fluorosis. Of these 132 had some dental anomaly. Fifty-two individuals from 45 families had lesions classified as typical dental fluorosis. Eleven of these, some of which had severe dental fluorosis recently moved into the area from other locations.

Samples of the drinking waters that were likely consumed by the individuals with dental fluorosis were collected for analyses. In most instances the fluoride content of the waters were low and would not account for the tooth lesions.

Possible reasons for lack of correlation are changing of the composition of the water, other sources of fluoride in the diet, and possibly analytical errors.

Additional studies should be made to identify the sources and causes of tooth lesions.

INCIDENCE OF HUMAN DENTAL FLUOROSIS IN THE RAFT RIVER GEOTHERMAL AREA IN SOUTHERN IDAHO

1. INTRODUCTION

1.1 Purpose

Present and potential development of energy from the Raft River basin has raised some questions as to the incidence of dental fluorosis in people living in the area. Long-time residents of the developing geothermal well area tell of area residents with discolored teeth and of domestic livestock with teeth abnormalities that are compatible with the changes characteristic of dental fluorosis.

The major purpose for the study was to determine the incidence and geographic distribution of human dental fluorosis in the general vicinity of the Raft River geothermal area. An attempt was also made to determine the relationship of the fluoride content of culinary water supplies of the area to the incidence of human dental fluorosis.

1.2 Fluorides in Geothermal Waters

High fluoride concentrations are common in geothermal waters of the world. Considerable data on the warm waters from the Raft River area indicate values of 5 to 10 mg/l are common. Conversation with some residents of the area revealed that in the past, individuals have had what was described as dental fluorosis. Some animals were also reported to have had teeth changes that were undoubtedly dental fluorosis. These factors are of concern when releasing geothermal waters.

1.3 Background

Dental fluorosis is the term applied to changes (lesions) found in dental tissues that are induced by ingestion of excessive amounts of fluoride during the period that teeth are forming and calcifying. The condition is usually confined to the permanent teeth, although in areas of marked severity, some instances of deciduous teeth being affected--evidence of placental transmission of fluorine--have been observed. Descriptive terms generally used to describe the gross fluoride induced enamel lesions include:

Mottling (opaque chalky white patches or horizontal striations in the enamel)

Opaque (impervious to light rays--transmitted light)

Chalkiness (dull white appearance)

Hypoplasia (defective enamel or incomplete development)

Hypocalcification (defective calcification)

Susceptibility to dental fluorosis is restricted to a rather sharply defined age group. The reason is that fluorine affects teeth during the period of formation and calcification. This period extends from infancy, when the central incisors may be affected to 16 years of age, when calcification of the crown of the last teeth, the third molars, has been completed. Based on human dentition development studies, the most significant ages, however, are usually 2 to 10 years of age. More severely affected teeth may be discolored (chalky white, creamy yellow or brownish-black), may be subject to rapid attrition (wear), and also may have erosion of enamel from the dentine.

Dental fluorosis results from excessive fluoride intake and not from drinking water that is fluoridated to the recommended level of 1 ppm. Fluorides, in proper amounts, taken during tooth formation years will result in unmarked teeth that are more resistant to decay and wear than those of persons on a low fluoride intake level. Fluoride ingestion at the recommended level (1 ppmF) throughout life may also result in bones that are more resistant to reabsorption or demineralization (osteoporosis) that is often associated with advanced age, particularly in women.

Many species including humans may show typical lesions of dental fluorosis. Sources for the excessive fluoride may include water supplies (especially warm waters), beverages, especially tea, and traces from ingestion of vegetables contaminated by splash from high fluoride soils in which they are grown, vegetables contaminated by industrial atmospheric pollution, and improperly defluorinated dietary mineral supplements. Because of our eating and food preparation habits, most human dental fluorosis in developed countries is caused by drinking water with above the recommended fluoride content. However, fluoride effects are cumulative in nature and all possible fluoride sources should be evaluated if dental fluorosis is discovered in a population.

Dental fluorosis in humans is not a recent discovery. During the last quarter of the 19th century and the first third of our present century, fluorides were recognized as the cause of "Mottled Enamel Disease" both in the United States and worldwide. By 1941 the condition had been recognized on all continents of the world and in approximately 400 areas of 28 states in the United States. The number has continued to increase since that time. Several of the areas identified are in

Idaho, especially near the southern border. Oakley, Idaho deserves special mention as being one of the first two towns in the United States where the high fluoride water supply--dental fluorosis cause and effect relationship was accurately demonstrated.

2. MATERIALS AND METHODS

2.1 Survey Approvals

The potentially sensitive nature of the study dictated that permission and/or approval for the study be obtained from several sources.

Because of the public health aspects of this study, study personnel and most of the persons evaluated were in different but neighboring states, public health officials of the two states (Utah and Idaho) were advised of the proposed project. All persons concerned expressed their interest and fully sanctioned the study. Copies of correspondence between project personnel and state health departments are included in Appendix A.

The school system of Cassia county, Idaho where the geothermal site is located seemed to provide the best, all inclusive organization to contact the public school-aged youngsters who were to be included in the survey. Personal contacts were made with Mrs. Naomi Paskett, area adult education coordinator, from Malta, Idaho; Mr. Glendon Jones, Principal of the Malta elementary school; and Mrs. Doris Jones, teacher at the Almo School. Mr. Jones contacted Mr. Rodney Hall, principal of the secondary school in Malta and explained the project. Local support was assured by all the people contacted. Approval was requested from Mr. Harold Blauer, superintendent of Cassia County school district

151, headquartered in Burley, Idaho, by letter (Appendix A). Superintendent Blauer gave his verbal approval in a telephone conversation.

Parental permission for the clinical dental examinations of the school children was obtained by Mr. Jones, Mr. Hall and Mrs. Jones.

2.2 Survey Methods

The studies were conducted by a team including Dr. J. L. Shupe, Dr. Clyde F. Hurst, Dr. H. B. Peterson and Research Associate A. E. Olson. The oral examinations were made by Dr. Hurst who is a practicing dentist with a long-time professional interest in water fluoridation. A total of 270 individuals were examined and the findings recorded on individual cards.

Teeth were classified according to a numerical code of 0-5, with 0 meaning normal and 5 equating with severe fluoride induced damage. The criteria used in making the various numerical designations were slight variants from the original classification standards first proposed by Dr. J. Trendley Dean, a dentist associated with the United States Public Health Services.

All teeth were examined and those with abnormalities and lesions were rated and recorded. The form used was devised to include all basic information needed from each survey participant. A facsimile of the individual information card is shown here:

In this study the individuals are identified by number only. The key to individual identifications has been retained by Dr. Shupe.

Incisor teeth of selected individuals were photographed on both color slide film and on black and white negative film. Individuals photographed were selected because of the type of lesions involved,

DENTAL FLUOROSIS SURVEY

Number _____

Name _____ Date _____

Address _____

Parent's Name _____

Telephone Number _____ Photo Number _____ Birthdate _____

Present Source of Drinking Water _____

Previous Sources of Drinking Water _____

Dental Classification: _____ Remarks _____

Examined by _____

regardless of whether the clinical history indicated the lesion may have developed locally or in another geographic region. Photos were also taken of some nonfluoride induced dental lesions for visual comparisons.

Where excessive fluoride intake from some source was indicated by dental fluorosis, visits to the families were made. Additional clinical histories were obtained. Samples of their culinary water supplies were collected in plastic bags for fluoride determinations. Most of the sampling was repeated a second time to verify results. The samples

were analyzed by two separate laboratories using the specific ion electrode method.

The homes of the individuals examined ranged geographically from Sublett on the East to Almo and Elba on the West; from Yost, Utah on the South to Raft River and near Declo on the North. Individual numerical dental ratings were given. A brief description of the interpretation of numerical values is given:

- 0 Normal. Smooth, translucent, glossy white appearance of enamel; tooth normal shape and size.
- 1 Questionable effect. Some deviation from normal, exact cause may or may not be determinable; cause may be metabolic (nutritional, some diseases, high fever, prolonged use of some antibiotics, or others); may have enamel flecks but not typical mottling.
- 2 Slight Fluoride effect Slight mottling of enamel; best observed as horizontal striations with transmitted light; may have slight staining; no increase in normal rate of wear.
- 3 Moderate fluoride effect. Definite mottling; large areas of opaque chalky white enamel or generalized mottling of entire tooth; tooth may have a slightly increased rate of wear and may be stained.
- 4 Marked fluoride effect. Definite mottling, hypoplasia, and hypocalcification; may have pitting of enamel; with use, tooth will have increased rate of wear and may be stained or discolored.
- 5 Severe fluoride effect. Definite mottling, hypoplasia, and hypocalcification; with use tooth will have excessive increase in rate of wear and may have erosion or pitting of enamel. Tooth may be stained or discolored.

3. RESULTS

3.1 Individual Ratings

In Table 1 is recorded the findings from each individual examination showing the identification number, the home address and a key to the identification of the color slides and photographic prints.

3.2 Geographic Areas

Individuals having definite dental lesions that were apparently fluoride induced were next listed and grouped according to the geographic location of their homes. The results are shown in Table 2. Under the remarks column are listed pertinent facts about other family members examined, and also previous living locations.

3.3 Photographic Records

Black and white photographic records of selected cases are shown on pages 19 to 23. These represent examples of not only fluoride induced lesions, but also those typical of excessive antibiotic use at critical dental development stages, and some other lesions from unknown causes. It is noted that several of the individuals shown with the most severe fluoride induced dental lesions are not natives of the Raft River basin. Two copies of the colored slides taken of each of the 21 individuals photographed are included with the contractor's report.

3.4 Water Samples

Analyses of culinary water supplies for families having individuals that had definite fluorotic dental lesions are shown in Table 3.

Data in Table 4 shows the fluoride content in the water with the dental classifications of individuals examined who had consumed the water at least part of the time during the period of tooth formation and calcification.

TABLE 1
IDENTIFICATION, LOCATION AND DENTAL CLASSIFICATION
OF THE INDIVIDUALS EXAMINED

Individual Identification Number	Home Location	Dental Classi- fication	Photographic Slide and Print Identification
1	Malta	1	
2	Malta	0	
3	Elba	0	
4	Malta	1	
5	Naf	0	
6	Malta	0	
7	Malta	0	
8	Malta	0	
9	Malta and Naf	1	
10	Naf (Yost Rt.)	1	
11	Malta Star Rt.	1	
12	Almo	0	
13	Malta	0	
14	Albion	0	
15	Malta	0	
16	Almo	2	
17	Elba	0	
18	Malta	0	
19	Malta Star Rt.	1	
20	Naf (Yost Rt.)	2	
21	Almo	2	
22	Elba	1	
23	Malta	0	
24	Malta	0	
25	Malta	1	85-01
26	Almo	1	
27	Malta	0	
28	Malta Star Rt.	1	
29	Elba	1	
30	Malta	0	
31	Malta	0	
32	Almo	1	
33	Naf	0	
34	Malta	0	
35	Declo Star Rt.	1	

TABLE 1
(Continued)

Individual Identification Number	Home Location	Dental Classi- fication	Photographic Slide and Print Identification
36	Malta	0	
37	Declo Star Rt.	2+	85-02
38	Malta Sublett Rt.	0	
39	Malta	0	
40	Malta	0	
41	Elba	1	
42	Malta	0	
43	Malta Sublett Rt.	1	
44	Malta Star Rt.	2	
45	Elba	1	
46	Malta	0	
47	Malta Sublett Rt.	0	
48	Naf	1	
49	Declo Star Rt.	0	
50	Declo Star Rt.	2	
51	Declo Star Rt.	1	
52	Declo Star Rt.	0	
53	Malta	0	
54	Malta	0	
55	Malta	1	
56	Malta	1	
57	Malta	0	
58	Malta	4-	85-03
59	Malta	2	85-04
60	Malta	0	
61	Raft River	2	
62	Naf	0	
63	Malta	1	
64	Malta	1	
65	Malta Sublett Rt.	0	
66	Malta	0	
67	Elba	2	
68	Malta	0	
69	Naf-Yost Rt.	0	
70	Elba	0	

TABLE 1
(Continued)

Individual Identification Number	Home Location	Dental Classi- fication	Photographic Slide and Print Identification
71	Malta	0	
72	Malta	2	
73	Naf	0	
74	Declo Star Rt.	1	
75	Elba	0	
76	Malta	0	
77	Malta	0	
78	Almo	0	
79	Almo	0	
80	Malta	0	
81	Declo Star Rt.	2	
82	Malta	1	
83	Malta	0	
84	Sublett	1	
85	Malta	0	
86	Elba	1	
87	Naf	1	
88	Malta	0	
89	Declo Star Rt.	1	
90	Malta	0	
91	Malta Clover Lane	1	
92	Malta	0	
93	Malta Star Rt.	4	85-05
94	Malta	3	85-06
95	Sublett Rt.	0	
96	Almo	0	
97	Malta	0	
98	Malta	0	
99	Elba	1	
100	Malta	2	
101	Malta Sublett Rt.	1	
102	Declo Star Rt.	0	
103	Elba	1	
104	Malta	0	
105	Malta	0	

TABLE 1
(Continued)

Individual Identification Number	Home Location	Dental Classi- fication	Photographic Slide and Print Identification
106	Naf-Yost Rt.	0	85-07
107	Malta	2	
108	Malta	1	
109	Declo Star Rt.	0	
110	Malta	0	
111	Malta	0	85-08
112	Malta	0	
113	Almo	0	
114	Malta Sublett Rt.	2	
115	Elba	0	
116	Malta	0	
117	Elba	0	
118	Naf	0	
119	Malta	0	
120	Malta	1	
121	Malta	2	
122	Almo	0	
123	Naf	1	
124	Malta	0	
125	Malta	0	
126	Malta	0	85-09
127	Malta	0	
128	Malta	2	
129	Malta	2+	
130	Declo Star Rt.	1	
131	Malta Sublett Rt.	0	
132	Declo Star Rt.	0	
133	Malta	3	
134	Malta	1	
135	Declo Star Rt.	3	
136	Declo Star Rt.	1	85-09
137	Vista, Star Rt.	0	
138	Malta	0	
139	Yost	3+	
140	Malta Star Rt.	0	

TABLE 1
(Continued)

Individual Identification Number	Home Location	Dental Classi- fication	Photographic Slide and Print Identification
141	Malta	0	
142	Malta	0	
143	Malta	2	
144	Malta Star Rt.	1	
145	Malta	0	
146	Malta	0	
147	Malta	2	
148	Yost	0	
149	Malta	2	
150	Naf	1	
151	Malta	0	
152	Malta	2	85-10
153	Elba	1	
154	Malta	2	
155	Naf Clear Creek	1	
156	Malta	0	
157	Naf Yost Rt.	1	
158	Naf	1	
159	Malta	1	
160	Malta	1	
161	Malta	0	
162	Sublett	0	
163	Sublett	0	
164	Malta	2	
165	Naf Yost Rt.	0	
166	Elba	3	
167	Sublett	0	
168	Malta	0	
169	Malta	0	
170	Malta	0	
171	Malta	2	
172	Sublett	0	
173	Malta	1	
174	Malta	2	
175	Malta	0	

TABLE 1
(Continued)

Individual Identification Number	Home Location	Dental Classi- fication	Photographic Slide and Print Identification
176	Elba	2+	
177	Malta	0	
178	Malta	0	
179	Malta	0	
180	Malta	0	
181	Malta	2	
182	Malta	0	
183	Malta	1	
184	Yost	0	
185	Malta	0	
186	Naf Yost Rt.	0	
187	Malta	3	85-11
188	Malta	0	
189	Malta	0	
190	Elba	0	
191	Malta	0	
192	Malta Star Rt.	0	
193	Malta	0	
194	Malta	0	
195	Malta	2	
196	Malta	0	
197	Malta	0	
198	Malta	0	
199	Malta Sublett Rt.	2	
200	Malta	0	
201	Malta	0	
202	Malta	1	85-12
203	Naf	0	
204	Naf Yost Rt.	1	
205	Naf	2	
206	Elba	1	
207	Elba	1	
208	Malta	1	
209	Malta	2	85-13
210	Elba	2	

TABLE 1
(Continued)

Individual Identification Number	Home Location	Dental Classi- fication	Photographic Slide and Print Identification
211	Malta	2	
212	Malta	1	
213	Naf	0	
214	Malta	1	
215	Malta	2	
216	Malta Star Rt.	0	
217	Almo	1	
218	Malta	1	
219	Malta	1	
220	Almo	1	
221	Declo Star Rt.	1	
222	Declo Star Rt.	0	85-14
223	Malta	2	
224	Almo	0	
225	Naf	1	
226	Sublett Rt.	0	
227	Elba	1	
228	Malta	0	
229	Elba	0	
230	Malta	0	
231	Malta	0	
232	Declo Star Rt.	1	
233	Yost	1	
234	Malta	0	
235	Malta	2	
236	Malta	2	85-15
237	Malta	2	
238	Malta	1	85-16
239	Sublett Rt.	1	
240	Malta	1	
241	Malta	0	
242	Malta	1	
243	Almo	1	
244	Malta	3	85-17
245	Malta	0	

TABLE 1
(Continued)

Individual Identification Number	Home Location	Dental Classi- fication	Photographic Slide and Print Identification
246	Malta	1	
247	Malta	1	
248	Malta	0	
249	Naf	1	
250	Declo Star Rt.	1	
251	Elba	0	
252	Malta	1	
253	Elba	1	85-18
254	Malta	2	
255	Malta	2	
256	Naf Yost Rt.	0	
257	Malta	0	
258	Malta	0	
259	Malta	2+	85-19
260	Elba	0	
261	Sublett Rt.	1	
262	Almo (Gap)	3	85-20
263	Almo	2	
264	Elba	2	
265	Almo	1	
266	Almo	3	
267	Almo	1	85-21
268	Elba	0	
269	Elba	0	
270	Elba	0	

TABLE 2
IDENTIFICATION, LOCATION, DENTAL CLASSIFICATION, AND REMARKS
OF INDIVIDUALS WITH A CLASSIFICATION OF 2 OR MORE (DENTAL FLUOROSIS)

Location	Individual Identifica- tion Number	Classi- fication Number	Remarks
Naf & Yost	48	2	
	205	2	moved to area within past 6 months
	20	2	one other family member with "1" dental classification
	139	3+	
<hr/>			
Malta	174	2	another family member with "1" dental classification
	72	2	moved from Pocatello at 4 years of age
	215	2	moved to Malta at 9 years of age. still spends part of year in Soda Springs area
	100	2	moved to Malta in 1976
	147	2	one other family member with "1" dental classification
	244	3	one other family member with "2" dental classification
	237	2	one other family member with "2" dental classification
	94	3	moved to Malta one year ago from Raft River
	259	3+	antibiotics also contributed to discoloration
	143	2	one other family member with "1" dental classification
	129	2+	
	209	2	
	164	2	
	187	3	moved here 1 year ago (7 years) from Nevada. Two other family members also with "3" classification
	107	2	moved here from Utah 5 years ago (6 years of age)
	171	2	also 1 family member with "1" dental classification
	236	2	
	152	2	first 4 years spent at Idahome, Idaho. One other family member also with dental classification of "2"

TABLE 2
(Continued)

Location	Individual Identifica- tion Number	Classi- fication Number	Remarks
Malta (Cont.)			
	121	2	
	255	2	
	149	2	
	128	2	one other family member also with dental classification of "2"
	154	2	
	181	2	
	235	2	

Malta-Sublett Star Rt.	199	2	one other family member with dental classification of "1"
	114	2	
	44	2	

Almo	266	3	twin had dental classification of "1"
	21	2	one other family member had dental classification of "1"
	263	2	one other family member had dental classification of "1"
	16	2	
	262	3	two older brothers also had dental fluorosis

Elba	67	2	one family member with dental classification of "1" (recently moved to area from Utah)
	210	2	two family members had "1" dental classification
	176	2+	recently moved here from Burley, Idaho
	166	3	lived in Utah from birth to 2-1/2 years of age
	264	2	

Declo Star Rt.	135	3	moved here at age 7 from North Dakota
	37	2+	antibiotic effect also evident
	93	4	three other family members with dental fluorosis. Moved recently from New Mexico.

85-01 13 year old female; teeth normal except for severe hypoplasia of lower first bicuspid; dental classification 1.

85-02 15 year old male; teeth appear to have both fluoride induced horizontal opaque chalky white striations and antibiotic induced brownish-gray discoloration; history supports clinical findings; dental classification 2+

85-03 12 year old female; marked dental fluorosis; note large opaque discolored areas; dental classification 4; individual raised outside of Raft River area until 11 years of age.

85-04 12 year old female; fluoride induced changes plus mechanical injury with subsequent root canal work; note horizontal opaque chalky white striations, dental classification 2+ plus injury.

85-05 11 year old female; marked fluoride induced changes with pitting and erosion of enamel; dental classification 4; fluoride lesions induced prior to moving to the Raft River basin area.

85-06 10 year old female; moderate fluoride induced dental lesions; note diffuse opaque chalky white areas; dental classification 3.

85-09 7.5 year old male; moderate dental fluorosis; note diffuse opaque discolored areas; dental classification 3+.

85-12 17 year old male; antibiotic induced dental changes; note brownish-gray discoloration; dental classification 1.

85-20 16.5 year old female moderate dental fluorosis; note horizontal opaque chalky white striations; dental classification 3; as seen with front lighting.

85-20 Same teeth shown in above picture but viewed with small light placed behind the teeth to show different densities of horizontal hypoplastic striated areas.

TABLE 3
FLUORIDE CONTENT OF WATER, RAFT RIVER AREA mg/l

Sample Number	Commercial Laboratory		U.S.U.	Referee Lab.
	8/2/78	8/23/78	8/23/78	8/23/78
1		.34	.25	.24
2	6.7	4.4	-	5.05
3	.3	.3	.12	
4	.58	.48	.84	
5	.3	.3	.28	
6	.3	.3	.38	
7	.3	.46	.45	
8	.47	.60	.74	
9	.3	.3	.21	
10	.33	.35	.42	
11	.43	.45	.50	
12	.46		.56	
13	.47	.33	.50	
14	1.10	.90	1.40	
15	.50			
16	.54	.55	.80	
17	.41	.52	.22	
18	.42	.47	.66	
19	.3	.3	.22	
20	5.48	5.6	-	5.55
21	.56	.73	.76	
22	.34	.37	.39	
23	.56	.42	.90	
24	.53	.37	.84	
25	.36	.46	.38	
26	<.3		.19	
27	.3	.3	.12	
28	.3			
29	.3	.3	.32	
30	.3	.3	.40	
31	.3	.3	.19	.20
32	.6	.3	.68	
33	.3	.3	.47	
34	.34	.3	.52	
35	.3			
36	.35	.3	.52	
37	.42	.3	.62	
38	.3	.3	.38	
39	.3			
40	.55			
41	.57	.3	.82	
42	1.10	.58	-	3.14
43	.95	.3	1.1	
44	.37	.3	.46	
45	1.75	.3	-	2.54
46	.95	.3	1.5	

all the .3's are less than .3

TABLE 4
THE RELATION OF WATER FLUORIDE CONTENT TO
INDIVIDUAL DENTAL CLASSIFICATIONS OF FAMILIES

Water Sample Number	F Content USU Analysis mg/l	Individual Numbers	Dental Classifications
1	.25	139	3+
2	*5.5	21, 220	2,1
3	.12	199	2(formative years on a different source)
4	.84	264, 270	2,0
5	.28	86, 210, 253	1,2,1
6	.38	67, 153, 260	2,1,0
7	.45	67, 153, 260	2,1,0
8	.74	164	2
9	.21	20, 203, 204	2,0,1
10	.42	117, 166	3,0
11	.50	76, 154	0,2
12	.56	76, 154	0,2
13	.50	76, 154	0,2
14	1.40	59, 237	2,2
15	*.50	259	2+
16	.80	63, 171	1,2
17	.22	94, 137	3,0
18	.66	30, 209	2,0
19	.22	no school aged children involved	
20	*5.54	not used for domestic consumption	
21	.76	31, 128, 223	0,2,2
22	.39	31, 128, 223	0,2,2
23	.90	119,149	0,2
24	.84	255	2
25	.38	121	2
26	.19	129	2+
27	.12	112, 173	2,1

TABLE 4
(Continued)

Water Sample Number	F Content USU Analysis mg/l	Individual Numbers	Dental Classifications
28	*.3	236	2
29	.32	174, 213, 248	2,1,0
30	.40	64, 147	1,2
31	.19	143, 214, 228	2,1,0
32	.68	166, 195, 244	0,2,3
33	.47	98, 181	0,2
34	.52	72	2
35	*.3	94, 137	3,0
36	.52	44, 196	2,0
37	.62	15, 107, 127	0,2,0
38	.38	46, 152, 254	0,2,2
39	*.3	235	2
40	*.55	262	3
41	.82	262	3
42	*3.14	262	3
43	1.1	32, 263	1,2
44	.46	16	2
45	*2.54	113, 266, 267	0,3,1
46	1.5	no school aged children involved	

* Samples not run at U.S.U. Laboratory.

4. DISCUSSION OF RESULTS

The 270 individuals examined represented 151 families presently living in the area of study. 132 children had some dental anomaly because they had a classification of something other than the normal "0". 52 of the aforementioned 132 youngsters, from 45 families, had lessions that were classified as being typical of some degree of dental fluorosis.

Interviews with 11 of the individuals some of which had the most distinctive and severe dental fluorosis seen in the study revealed that these people had lived, until recently, in other areas of the United States. No water samples being consumed by these people from the Raft River area were collected since the problem source was not local.

The 46 water samples collected for analysis were mostly normal culinary sources. In two instances, water sources normally used for irrigation were collected and analyzed. These sources were being used temporarily because regular culinary wells had dried up. Two water sources were sampled, not because of apparent current fluoride exposure by anyone but because of past histories of previous inhabitants having what was undoubtedly dental fluorosis.

Some families with children evidencing dental fluorosis had moved about some in the area and had different culinary water sources during the critical periods of dental development. Where possible these sources were all collected and identified as to time period involved.

The incidence of persons in this study having a questionable or number "1" dental rating is rather high. However, the list of metabolic disturbances that have been shown to induce the focal opacities that

are often characteristic of such teeth is continually increasing. Some diseases, high fevers, trauma, and some antibiotics and other similar causes can induce dental anomalies if they occur at a critical time in a tooth's formation and calcification. The relative isolation of some of these people to professional medical care may influence the treatment and care of some individuals. Extended usage of certain antibiotics, especially tetracyclines, can adversely affect calcifying enamel.

Evaluation of all clinical and analytical records from this study does create some complex questions. Why is there such a low correlation of dental fluorosis and fluoride content of culinary water supplies? Normally these people would be ingesting most of their fluoride intake in the water they drink. The analytical results to date do not indicate that there is enough fluoride in most of the waters sampled to induce the dental changes seen. In fact, most of the water samples do not contain fluoride as high as the levels recommended by both the American Dental Association and the American Medical Association. Based on average ambient air temperatures, the recommended fluoride levels in drinking water in the United States ranges from 0.7 to 1.2 mg/l. These levels have not been shown to induce lesions in the teeth. It was observed that many of the children in the study with slight dental fluorosis had, on the average, fewer dental caries than did their peers with "normal" teeth.

There are theories that might, in part at least, help to explain what might have happened to these people with otherwise unexplained dental fluorosis. Fluoride effects are cumulative in nature. While

it is usually expected that humans consume the major portion of their fluoride intake in drinking water, other sources can contribute. Fluorine is ubiquitous in nature and therefore there is normally at least some in all foods. Some vitamin preparations prescribed for infants and children now contain fluorides. These formulations are most often based on the assumption that there is a low fluoride level in other intake sources. Even the oft promoted fluoride-containing toothpastes may contribute a little fluoride to total intake. It is conceivable that under some conditions all of the possible sources, added together, could amount to enough to induce slight dental fluorosis.

In some cases, individual variability could be a factor in the expression of dental fluorosis. As individuals, we vary greatly in our biological response to many stimuli. This variability may also be a factor in the familial differences seen in the clinical studies. Several families, with more than one child examined, showed ranges of as much as 0-3 in the dental classification for no readily apparent reason.

Hydrologic changes in the Raft River basin have been considerable during the past two years. Reduced precipitation and subsequent increased irrigation by area ranchers have lowered the water table considerably. Some people reported that the taste of their culinary water had changed, indicating a change in chemical composition. With all of these rather abrupt changes, it is entirely possible that the culinary samples collected in 1978 do not represent the actual chemical composition of the same wells several years ago when the child's teeth were

examined in the survey could have been affected. Other trace elements such as copper, may also be an influencing factor. It must again be emphasized that only the fluorides ingested during the period of tooth formation and calcification will induce dental fluorosis.

The total composition of and inclusions in the water samples can also vary. There are also analytical problems with fluoride testing. Other ions may bind fluorine and interfere with accurate analytical procedures. The results in this report were all obtained with specific ion electrode methods. Experience has shown that this method consistently gives lower values than the long time standard Willard and Winters distillation/colorimetric analytical method. Complexing and interfering ions might have modified the results obtained in this study. Time did not permit further study on this problem.

The possible reasons for the lack of high correlation between clinical data and analytical results of respective water supplies is intriguing. Based on factual information relating to fluoride induced dental lesions, one would have to assume that the survey indicates some of the children ingested more fluoride than the water analyses indicate.

5. THE FUTURE

This study has shown that there is a need for further evaluation of the sources of fluorides and the incidence and etiology of human dental fluorosis in the Raft River basin of Southern Idaho.

Culinary water sources should continue to be analyzed for fluorine. Additional determinations should be made not only for fluorine but also for other elements or ions in the water that might

either enhance or suppress the effect of fluorine on developing teeth.

Other sources of fluorides should be closely evaluated to ascertain their exact relationship to the total problem.

There is little specific information in the literature about absorption rates of various fluoride compounds in water on various vegetation and vegetables when these waters are applied in various ways under different atmospheric conditions.

APPENDIX

Social Services

Scott M. Matheson, Governor, State of Utah
Anthony W. Mitchell, Ph.D., Executive Director

March 22, 1978

John T. Ashley, M.D.
Director of Health
Idaho State Division of Health
Statehouse Mail
Boise, Idaho 83720

Dear John:

I have recently been talking to a group of scientists from Utah State University who are studying the mineral content of geothermal waters in the Almo - Malta - Raft River area in Idaho and Northern Utah. Some interesting findings in animals have been noted there in regard to fluoride and other minerals.

Dr. LeGrande Shupe asked if I would write you to invite your cooperation and request that, if your staff are interested in working with them, you get in touch with him. They would like to work with the Idaho Health people in the study.

Dr. Shupe is a personal friend of mine, an excellent investigator and a former member of our State Air Pollution Control Committee. He has a strong interest on the effects of fluoride on man, animals and plants.

Dr. Shupe would be interested in your response and he can be reached along with his associate Dr. Clyde Hurst at the Department of Veterinary Science, Utah State University, Logan, Utah.

I appreciate your past assistance.

Sincerely,

Lyman J. Olsen, M.D., M.P.H.
Director of Health

cc: Dr. Shupe

Division of Health
Lyman J. Olsen, M.D., M.P.H.
Director of Health

150 West North Temple, Suite 474
P.O. Box 2500, Salt Lake City, Utah 84110
801-533-6111

STATE OF IDAHO

DEPARTMENT OF HEALTH AND WELFARE

DIVISION OF HEALTH STATEHOUSE BOISE, IDAHO 83720

March 27, 1978

RECEIVED

APR 1 1978

Lyman J. Olsen, M.D., M.P.H.
Director of Health
150 West North Temple, Suite 474
P.O. Box 2500
Salt Lake City, UT 84110

OFFICE OF DIRECTOR
UTAH STATE HEALTH DIVISION

Dear Lyman:

Thank you for your note regarding studies of mineral content in geothermal water in southern Idaho. I have asked Dr. Lee Stokes, Administrator, Division of Environment, to initiate contact with Dr. Shupe. Dr. Stokes is responsible for all environmental programs in the department.

It may be useful to ask Dr. Shupe to initiate a direct contact with Dr. Stokes in the near future. I am certain that their direct contact will be most useful.

I have recently resigned my position as State Health Officer. Although our direct contacts were few, I want to express my admiration of the quality of health program I have seen in Utah. I also appreciate the leadership you have provided through ASTHO.

Thank you for your recent note.

Sincerely,

A handwritten signature in cursive script, appearing to read "John T. Ashley".

John T. Ashley, M.D.
State Health Officer

JTA:rm

cc: Dr. Lee Stokes

March 28, 1978

Dr. Floyd W. Frank, Dean
Veterinary Medicine
Department of Veterinary Science
University of Idaho
Moscow, Idaho 83843

Dear Floyd:

For sometime a group of scientists from Utah State University have been studying problems of management of geothermal waters for agricultural use. These studies have been primarily limited to the western United States. They would like to obtain some additional background information regarding the effects of some toxicants in geothermal waters on vegetation, animals and people.

One areas where they would like to obtain some biological background data are in the Almo, Malta and Raft River areas in Southern Idaho, close to the Utah border. Dr. John T. Ashley, Director of Idaho State Division of Health has been informed of the program. Dr. Clyde Hurst, a dentist will examine some people of the areas who are willing to cooperate. Dr. Howard B. Peterson will examine and evaluate the vegetation. Arland Olson and myself will examine and evaluate some of the animals in the areas.

We want to inform you of the contemplated investigations, so that you would know of such activities.

I enjoyed the mid-winter Idaho Veterinary Meetings last January in Sun Valley.

Hope all is well. Best regards.

Sincerely,

James L. Shupe, D.V.M.
Professor

JLS:jc

COPY

University of Idaho

Office of the Dean
Veterinary Medicine
Moscow, Idaho 83843

April 6, 1978

James L. Shupe
Department of Animal, Dairy
and Veterinary Sciences
Utah State University
Logan, UT 84322

Dear Jim:

I appreciate receiving your letter of March 28th, concerning involvement of Idaho in studies of problems of management of geothermal waters for agricultural use. Your group has made a real contribution in assisting Idaho in this area in the past. We will look forward to continued assistance and cooperation. Please keep me advised concerning your findings.

Very truly yours,

Floyd W. Frank, Dean
Veterinary Medicine

FWF/bt

UTAH STATE UNIVERSITY · LOGAN, UTAH 84322

COLLEGE OF AGRICULTURE

DEPARTMENT OF
ANIMAL, DAIRY AND
VETERINARY SCIENCES

April 26, 1978

Mr. Harold Blauer
Superintendent
Cassia County School District 151
Burley, Idaho 83318

Dear Mr. Blauer,

Some personnel from Utah State University have been studying the utilization of waters from the geothermal wells in Utah and Idaho. As part of this study we have been asked to evaluate some youngsters in your district for any evidence of dental fluorosis from any of the water sources presently being used for culinary purposes in the Almo and Raft River Valley areas.

State health department directors from Utah and Idaho have been contacted on this evaluation and given their approval. Correspondence is enclosed.

Mr. Glendon Jones, Principal of the Malta School and Mrs. Doris Jones at Almo have been contacted about allowing Dr. Hurst, a dentist with our research group, to conduct a dental evaluation survey before the close of school this spring. They were both agreeable but emphasized that permission must come from your office and probably from the parents.

It has also been suggested that if permission is granted for this survey, a news release describing the study could be sent to the Burley "Southern Idaho Press" and a note sent home with each child.

We would greatly appreciate your approval and cooperation in this project. If your approval is given we will do our best to keep our disruption of busy school activities to a minimum. It is unlikely that all students will be observed. Some may be selected based on the information we obtain from analysis of waters used by the families. Because of the time element involved, we would appreciate an early reply.

Thank-you very much for your consideration.

Sincerely,

J. L. Shupe
Dr. J.L. Shupe, D.V.M.
Professor

Mr. Blauer was contacted by phone on May 8, 1978 and pledged his support and cooperation for the project.

Enclosures (3)
JLS/rm