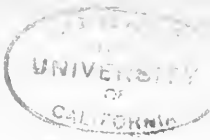

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BUREAU OF SOILS—CIRCULAR No. 73.

MILTON WHITNEY, *Chief of Bureau.*

U. S. DEPARTMENT OF AGRICULTURE,
Washington, D. C., October 3, 1912.

SIR: I have the honor to transmit herewith the manuscript of a report covering investigations of certain nitrate prospects in the Amargosa Valley, California, by E. E. Free, of this bureau, and to recommend that this article be published as Circular No. 73 of the Bureau of Soils.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

NITRATE PROSPECTS IN THE AMARGOSA VALLEY, NEAR TECOPA, CAL.

By E. E. FREE.

INTRODUCTION.

The data outlined in this memorandum were obtained on a very brief reconnoissance in March, 1912. The time available for the study was so short that it was impossible to work out the geology of the region with any exactness or completeness. The views stated below are therefore quite tentative and subject to correction.

The localities examined lie along the line of the Tonopah & Tidewater Railway in California, near the Inyo-San Bernardino County line. The first locality is at the railway station of Morrisons Siding, the second at the station of Sperry. The nearest supply point is Tecopa, Cal.

The work was carried out in the company of Mr. W. G. Luckhardt, then chief engineer of the Tonopah & Tidewater Railway. Acknowledgments are due Mr. Luckhardt and his company for many courtesies and much invaluable assistance.

GEOLOGY.

The exposed rocks of the region seem to belong to two series only. Below is a series of limestones, schists, and quartzites, probably of Cambrian age, and much folded and faulted.

Lying unconformably on these are gravels, sands, and clays of very variable character and usually only slightly indurated. (See fig. 1.) Some of the gravels are cemented by calcium carbonate into a sort of conglomerate resembling some of the "caliches" of Arizona and Texas. Not infrequently the clays are slightly saline, and thin intercalated layers of gypsum are frequent. Near Morrison's ranch gypsum layers up to 18 inches in thickness are intercalated with the clays, and are mined for plaster. The gravel-sand-clay series is believed to be of Tertiary age, though its exact correlation remains uncertain. No fossils were found.

FIG. 1.—Tertiary (?) gravels resting on Cambrian (?) basement, near Morrisons Siding.

This Tertiary (?) series has also suffered a great deal of movement and is now found dipping variously and with a very complex structure, still almost entirely unknown. Since (or during) its disturbance it has been much eroded by the Amargosa and its tributaries, very largely obscuring its original distribution and its relations with the Cambrian (?) basement. (See fig. 2.)

Gravels and sands of present or very recent age occasionally overlie it, with an erosional unconformity between.

GEOLOGICAL HISTORY.

As the writer interprets the history in the light of the meager data now available, it indicates an original uplift which can not be exactly dated, but was certainly Post-Cambrian, followed by a

long period of continued movement and great erosion, the débris being removed from the area. This condition was modified some time in the Tertiary by the origin of a chain of lakes, probably corresponding roughly to the present valley of the Amargosa, in and around which the Tertiary series was laid down. These lakes were similar in general character to the other Tertiary lakes which have been recognized in various parts of Nevada and California.

The succeeding history of the region has been one of the effects of continued crustal movement and of fluctuating climate upon these lakes and their successors. Now drained by overflow or outlet cutting, now inclosed by desiccation or differential uplift, this series

FIG. 2.—Valley of the Amargosa River near Sperry, showing erosion of the Tertiary (?) series.

of lakes and desert valleys has left a record of considerable complexity, which is yet almost entirely unread.

THE NITRATE HILLS.

The indications of nitrate have been found in low, rounded hills formed of the clay strata of the Tertiary (?) series above mentioned. (Figs. 3 and 4.) Always these hills have been greatly eroded, and their surface is composed of a loose, structureless clay formed by the weathering of the original stratified clays. This coating of loose material is from 10 to 30 inches deep and below it lie the tilted stratified clays, these being occasionally exposed by recent erosion. The loose surface clay is seldom noticeably saline, but occasional salt efflorescences are visible where shallow holes and the like have caused a local concentration of rain water. The underlying

stratified clays are sometimes nonsaline, but more often show thin films and crusts of salt in the cracks formed by drying. These clays

FIG. 3.—Typical clay hills (nitrate material), near Morrisons Siding.

were penetrated only a few inches and the nature of their deeper lying portions remains unknown.

FIG. 4.—Clay hill (nitrate material) near Morrisons Siding, showing stratification of clays.

The samples taken for chemical examination comprise three classes:

1. The surface clay formed by the disintegration of the original stratified clays.

2. The salt efflorescences from the surface of this material.

3. The material of the underlying stratified clays in its original condition.

The chemical data follow:

Chemical analyses of materials containing nitrates.

Description.	Field number.	Depth.	Sodium nitrate ($NaNO_3$)	Sodium chloride (NaCl).	Sodium sulphate (Na_2SO_4).
1. Loose surface materials:		*Inches.*	*Per cent.*	*Per cent.*	*Per cent.*
Hill at Morrisons Siding, east slope	254	0 to ½	0.19	.....	.....
Do	255	1 to 2	.22	.....	.....
Hill at Morrisons Siding, south slope	265	1 to 2	2.75	4.17	3.54
2. Salt efflorescences:					
Gypsum deposit, Morrison's ranch	245	Surface	.22	.....	.....
Hill at Morrisons Siding—					
Northeast base	253	do	.11	.....	.....
Top, east side	258	do	.24	.....	.....
Top, center	259	do	.14	.....	.....
Top, south side	262	do	.24	.....	.....
South slope	263	do	.47	.82	5.03
South base	267	do	.18	.....	.....
Wash at south base	268	do	.12	.00	17.42
Do	269	do	.12	.00	14.44
Hill at Sperry—					
Northwest base	276	do	.02	.....	.....
North slope	277	do	.06	.00	6.00
Top	278	do	.56	.....	.....
Wash at southwest base	281	do	.18	.00	7.58
3. Underlying stratified clays:					
Hill at Morrisons Siding—					
Northeast base	252	8	.30	.....	.....
East slope	256	4 to 8	1.36	2.28	1.62
South slope	266	10	12.28	7.25	.58

Two things are indicated by these analyses, first, that the significant nitrate contents are in the underlying clays rather than in the efflorescences and, second, that sodium chloride and nitrate are associated, those samples in which nitrate is very low being nearly pure sodium sulphate.

THE ORIGIN OF THE NITRATE.

The data now at hand are too meager to permit the formation of a complete theory as to the origin of the materials. It seems probable, however, that at times during the Tertiary period of variable lakes, there existed single playas or marshes in which the conditions were favorable for the life and growth of bacteria capable of producing nitrates from animal matter or from the air. The clays of the playa bottom became more or less impregnated with the nitrate so formed, producing the material of the beds as found. The other salts associated with the nitrate were probably supplied by mineral decay in the usual way.

THE VALUE OF THE DEPOSIT.

The commercial value of the deposit is quite problematical. It can be considered fairly certain that the surface material, either with or without salt efflorescence, is worthless.

The only hope of profitable utilization lies in finding an original clay stratum of sufficiently high nitrate content and sufficient extent to warrant the establishment of a refining plant. If, for instance, it were possible to locate a large body of material similar in composition to Sample No. 266, of the above table, the property would have unquestionable value. The material of this sample was almost certainly original, stratified clay in place. It is possible that it had been somewhat enriched in nitrate by surface concentration, but the writer does not consider this very probable.

The amount of the material, however, is entirely unknown and could be determined only by systematic exploration of the deposit. The value of the property will depend upon this question and upon the possible existence elsewhere in the area of similarly rich clay strata.

The direct utilization of the nitrate clays as fertilizer has been frequently suggested, but their association with considerable proportions of chloride of sodium would render this at best very doubtful and probably impossible.

Approved.

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *October 8, 1912.*

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