PTEROCHITON OCCIDENTALE. *Torr. and Frém.*

An unarmed shrub, one to two feet high, with numerous slender branches, which are clothed with a grayish nearly smooth bark. Leaves alternate or fasciculate, linear oblanceolate, narrowed at the base, flat, entire, covered with a whitish mealy crust. Flowers somewhat racemose, on short pedicels. Fructiferous calyx, with the wings two to three lines wide, semi-orbicular, coriaceo-membranaceous, mealy like the leaves, strongly veined; the margin more or less toothed. Utricle free from the indurated cavity of the perianth, extremely thin and transparent. Seed conformed to the utricle, the conspicuous podosperm passing along its side; the beak pointing obliquely upward.

This is one of the numerous shrubby plants of the Chenopodiaceous family that constitute a large part of the vegetation in the saline soils of the west. The precise locality of this plant we cannot indicate, as the label was illegible; but it was probably from the borders of the Great Salt Lake. It is allied to Grayia of Hooker and Arnott, a shrub of the same family, which was found in several places on both sides of the Rocky Mountains, often in great abundance.

PINUS MONOPHYLLUS. *Torr. and Frém.* (*The nut pine.*)

Leaves solitary, or very rarely in pairs, with scarcely any sheaths, stout and rigid, somewhat pungent; cones ovoid, the scales with a thick obtusely pyramidal and protuberant summit, unarmed; seeds large, without a wing.

A tree with verticillate branches and cylindrical-clavate buds, which are about three-fourths of an inch in length. The leaves are from an inch to two and a half inches long: often more or less curved, scattered, very stout, terete (except in the very rare case of their being in pairs, when they are semi-cylindrical) ending in a spiny tip. Cones about two and a half inches long, and an inch and three-fourths broad in the widest part. The scales are of a light-brown color, thick; the summit obtusely pyramidal and somewhat recurved, but without any point. The seeds are oblong, about half an inch long, without a wing; or rather the wing is indissolubly adherent to the scale. The kernel is of a very pleasant flavor, resembling that of *Pinus Pembra.*

This tree, which is remarkable among the true pines for its solitary leaves, is extensively diffused over the mountains of Northern California, from longitude 111° to 120°, and through a considerable range of latitude. It is alluded to repeatedly, in the course of the narrative, as the *nut pine.*

The Coniferæ of the collection were numerous, and suffered less than most of the other plants. Some of them do not appear to have been hitherto described. There was also an Ephedra, which does not differ essentially from *E. occidentalis*, found in great plenty on the sandy uplands of the Mohahve River.

Description of the Plates.

Plate 1. Arctmoecon Californicum. *Fig.* 8, a stamen, *magnified; fig.* 11, an ovule, *magnified; fig.* 12, capsule, *natural size; fig.* 5, (*a*) stigma, *magnified; fig.* 6, the same cut horizontally, showing the sutures; *fig.* 13, a seed, *magnified; fig.* 14, portion of a hair from the leaf, *magnified; fig.* 7, bristle from the extremity of a leaf lobe, *magnified; figs.* 9 and 10, leaves, *natural size.*

Plate 2. Prosopis odorata. *Fig.* 1, a flower, *magnified; fig.* 2, pistil, *magnified; fig.* 3, cluster of ripe legumes, *natural size.*

Plate 3. Fremontia vermicularis. *Fig.* 1, a very young fertile flower, *magnified; fig.* 2, an ovule, *magnified; fig.* 3, a fertile flower more advanced, *magnified; fig.* 8, a fertile flower at maturity, showing the broad-winged border of the calyx, *magnified; fig.* 7, the same cut vertically; *fig.* 6, the same cut horizontally; *fig.* 5, a seed, *magnified; fig.* 4, embryo, *magnified.*

Plate 4. Pinus monophyllus. *Fig.* 10, a bud, *natural size; figs.* 13, 14, 15, and 16, leaves, *natural size; fig.* 12, section of a single leaf; *fig.* 17, section of a pair of leaves; *fig.* 18, a cone, *natural size; fig.* 19, a scale, as seen from the outside; *fig.* 11, inside view of the same.

I. Note from Professor Hubbard (of the National Observatory, Washington City), describing the instruments used by J. C. Frémont in making the astronomical observations in his third or last expedition, and the methods followed by Professor Hubbard in reducing them.

II. A table of astronomical observations made by J. C. Frémont at the four principal stations determined in this third expedition, namely: 1, The mouth of Fontaine Qui Bouit, on the Upper Arkansas. 2, Southeastern shore of the Great Salt Lake. 3, Lassen's Farm, Deer Creek, in the Valley of the Sacramento. 4, The Three Buttes, Valley of the Sacramento.

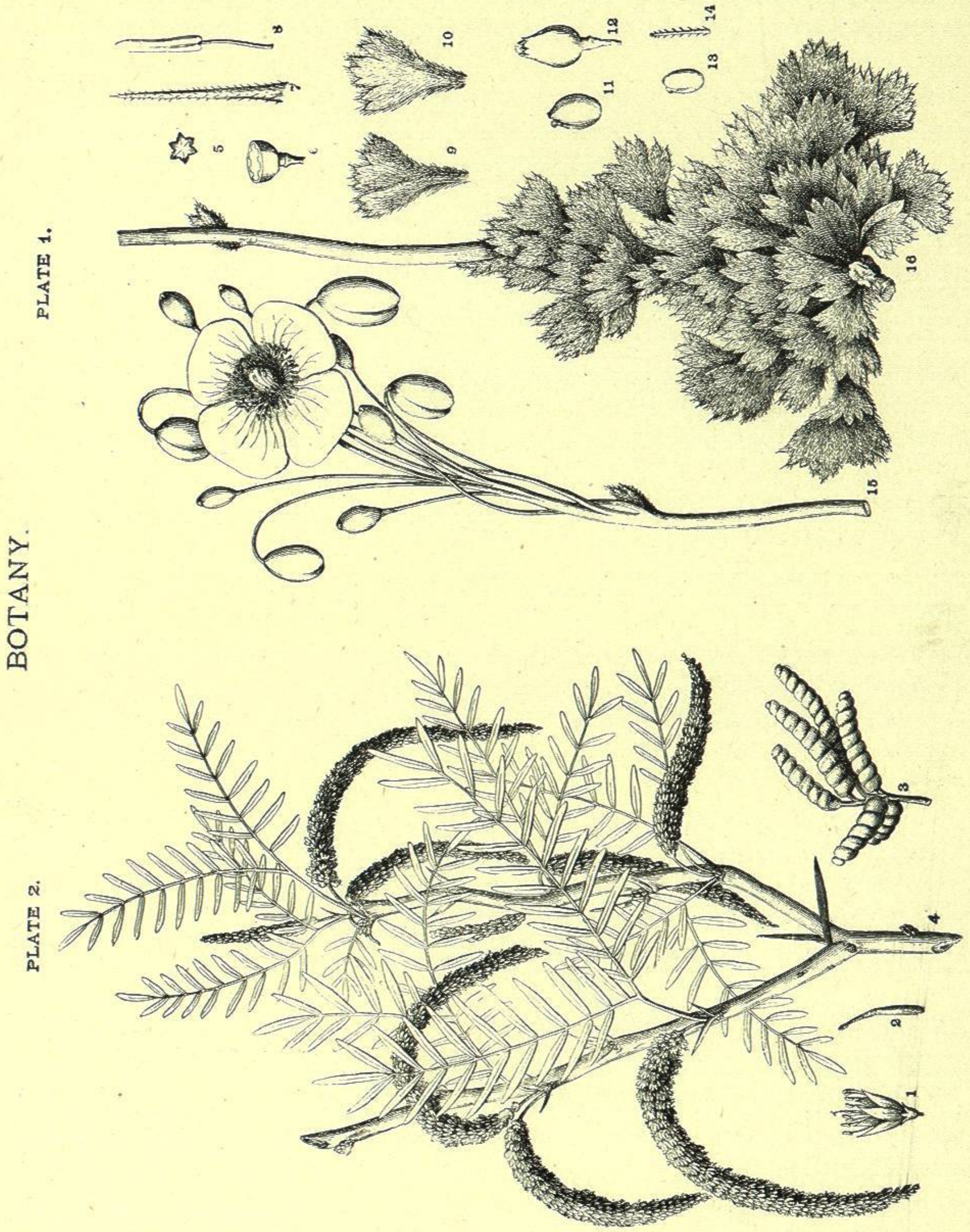
III. A table of latitudes and longitudes, deduced from the foregoing astronomical observations, calculated by Professor Hubbard.

I. Note from Professor Hubbard.

The instruments employed in the determination of astronomical positions were:

A portable transit instrument, by Young, of Philadelphia.
A sextant, by Troughton.
A sextant, by Gambey.
Two pocket chronometers (Nos. 438 and 443), by Appleton.

The transit instrument was made by Mr. William J. Young, of Philadelphia. The length of the telescope was 26 inches, the diameter of the



BOTANY.

PLATE 1. ARCTOMECON CALIFORNICUM.

PLATE 2. PROSOPIS ADORATA.

object glass $2\frac{1}{2}$ inches, and the axis 16 inches between the shoulders. A circle was attached to the instrument, having a diameter of 11 inches, graduated to read to 10 seconds, and furnished with 3 verniers. The stand was of iron, and four feet in height.

Of the sextants, the one by Gambey, a new instrument, was most frequently used. The other, by Troughton, is the same that was carried in the previous exploration, and was now only used in observing at night, its divided arc being more readily illuminated than that of the other. The index errors of both were carefully and often determined, in order that any possible change of adjustment might be readily detected.

The sextant observations consist of single altitudes of a star or the sun for time, and of Polaris or a star in the south, for latitude. They have been reduced in the usual manner, the formulæ being too well known to need quoting. All the latitudes, and the several links of the chain of longitudes connecting the primary stations, depend upon the data thus furnished. In deducing the differences of longitude, in order to obviate, so far as possible, all error arising from eccentricity of the sextant or any like cause, comparison has been made, when practicable, with observations in the same quarter of the heavens.

The rates of the chronometers depend entirely upon sextant observations. The comparison of these rates, determined at different times and under different circumstances of climate and usage, has shown that but one of the chronometers (No. 438) was entitled to confidence. All differences of longitude from the principal stations have therefore been determined by this one, and the results thus obtained are, as will hereafter be seen, highly satisfactory. The following are the observed rates, deduced, with but a single exception, from altitudes of the sun; the sign + indicates a gaining rate:

Locality.	Dates of Observation.	Rate of 443.	Rate of 438.
		s.	s.
Bent's Fort	August 3 to August 15, 1845	+ 2.020	+ 3.386
Camp at Salt Lake	October 14 to October 20, 1845	+ 0.883	3.317
Laguna Farm	February 11 to February 19, 1846 ..	-- 1.754	2.146
	March 30 to April 14, 1846	....	2.193
	April 14 to May 22, 1846	....	+ 2.980

The whole route has been divided into three distinct lines. The first, commencing at Bent's Fort, extends to the camp of January 4, 1846. The chronometers were then for a time subjected to a rapid travel over a rough road, and their rates were thereby changed. The second line commences with the Laguna Farm, between which and the camp of January 4th no observations were made, and extends to the camp of March 30th to April 14th, where the chronometers stopped, and another change of rate took place. The last line extends from this camp to that of June 7th, after which date no more longitudes were determined.

By combining the above rates for the same line, giving to each a weight equivalent to the number of days elapsed between the observations on which it depends, we get the following:

Rates of chronometer No. 438.

	s.
August 21, 1845, to January 4, 1846	+ 3.363
February 18, 1846, to March 30, 1846	+ 2.175
April 14, 1846, to June 7, 1846	+ 2.980

The transit instrument has given, by moon culminations, the longitudes of four camps with an accuracy much more than sufficient for ordinary geographical purposes. These camps being connected, as we have already seen, by chronometric differences, an excellent check of the whole work is thus afforded. When we remember that an error of one second of time in the observed transit of the moon induces an average error in the resulting longitude of the place of nearly seven minutes of arc, the agreement of these independent determinations, thus referred to the same point, is unexpectedly great. The following is the method by which the transit observations have been reduced:

An estimated longitude for each of the camps in question gave the means of computing, with sufficient accuracy, the "tabular mean time of transit" of the stars observed; their places in the heavens being taken from the catalogue of the British Association. The "observed mean time of transit" was next to be obtained. Where the passage of the star over all the wires had been observed, the mean, reduced to the middle wire, gave at once the time sought. For the purpose of correcting imperfect transits, a determination of the equatorial intervals of the transit wires was necessary. These wires were originally seven in number; their intervals are given below (I.). They were broken out after October 21, 1845, and were replaced by a set of five (II.), which in their turn were broken, and the last set (III.) inserted. Of these last the second wire was broken before the commencement of observations, and the reduction of the mean to the middle wire of course includes the correction for the deficiency. The following, then, are the adopted intervals of the several wires and the mean of the whole from the middle wire:

No.	Dates.	A.	B.	C.	Mean.	E.	F.	G.
		s.	s.	s.	s.	s.	s.	s.
I.	Aug. 12 to Oct. 21, 1845	+ 55.49	+ 36.78	+ 18.52	+ 00.69	− 18.12	− 34.63	− 53.18
II.	April 14 to April 23, 1846.	....	36.59	17.99	00.00	18.14	36.45	....
III.	June 4 to June 6, 1846 ...	+ 54.96	....	+ 18.84	− 05.17	− 17.41	− 35.19	− 51.95

From this table the corrections to the mean of wires for imperfect transits have been deduced by dividing the sum of the intervals for the wires observed by the product of the number of wires into the cosine of the star's declination. In the single case of an imperfect transit of the moon, allowance has been made for the moon's motion during the interval of time indicated by the correction.

In deducing the instrumental and chronometer errors by comparison of the observed and computed times of transit, the formula of M. Hansen has been employed.

Denoting by L the latitude of the place.
" " D the declination of the star.
" " Z the zenith distance of the star.
" " i the correction of instrument for error of level.
" " n the correction of instrument for deviation at the pole.
" " c the correction of instrument for error of collimation.

Then the reduction of the observed transit to the meridian has the form

$$i \sec L - n \sin Z \sec L \sec D + c \sec D.$$

The value of one division of the level tube accompanying the instrument was unknown; and the instrument itself being in California, this value could not be determined; but, knowing from the observing-books that the axis was always kept as nearly horizontal as possible, we may neglect the constant term i sec L, or rather may include it in the chronometer correction, and this without affecting the observed right ascensions.

Denote also by A the computed mean time of star's transit.
" " " T the observed mean time of star's transit.
" " " ΔT the correction of the chronometer.

Then every observation will give an equation of the following form:

$$O = T + \Delta T - A - \sin Z \sec L \sec D\, n + \sec D\, c.$$

Or for brevity:

$$O = T + \Delta T - A - a\,n + b\,c.$$

putting a and b for the co-efficients of n and c. By help of this formula approximate values were obtained for n and c from two or more observations. These were generally taken on different days, and the equations furnished by them were only limited by the condition that the value of c should remain constant for these days, allowance being afterward made for the error of this assumption. The values of n and c thus obtained were substituted in the equation furnished by each observation. The mean of the chronometer corrections thus determined being compared with the individual results, a new set of equations of condition was arranged, of the following form:

$$O = d\Delta T - a.\ dn + b.\ dc.$$

where $d\Delta T$ is the residual quantity obtained by the above comparison. The solution of these differential equations by the method of least squares gave the corrections of n and c, which, applied to the assumed, gave the most probable values. The assumed and adopted n and c are given below. The application of these final values to the original equations gave now the most probable chronometer correction, and this, applied to the corrected transit of the moon's limb, gave the mean time of transit, and finally the right ascension.

Table of Assumed and Adopted Values of n and c.

Date.	Assumed.		Adopted.	
	n	c	n	c
	s.	s.	s.	s.
August 21, 22, 1845	+ 3.702	− 3.237	+ 3.702	− 3.237
October 20, 1845	+ 1.633	− 3.237	+ 1.343	− 3.062
April 14, 1846	+ 1.02	+ 0.183	+ 1.648	+ 0.890
April 16, 1846	+ 52.07	+ 0.183	+ 52.265	− 0.084
June 4, 1846 }	+ 0.574	− 0.145	+ 0.574	− 0.145
June 5, 1846 }			+ 0.689	− 0.183

The following longitudes were assumed as the basis of the comparison of the observed with the tabulated moon culminations:

	h.	m.	s.
I. August 22, 1845	6	58	30
II. October 20, 1845	7	29	31
III. April 14, 1846	8	08	20
IV. June 4, 1846	8	01	52

By help of these the moon's Æ and hourly motion at transit were computed from the moon-culminating list of the Nautical Almanac, using fourth differences. A comparison of the computed Æ with that observed gave the numerator—the hourly motion being the denominator—of the fraction expressing the correction of the assumed longitudes. Those corrections, and the resulting longitudes, are as follows:

	m.	s.	h.	m.	s.
I.	+ 0	15.52	6	58	45.52
II.	− 1	15.65	7	28	15.35
III.	− 0	37.54	8	07	42.46
IV.	+ 4	36.70	8	06	28.70

Camps I. and II., as well as III. and IV., being connected by chronometric differences, it becomes important to test the results above given by a comparison of the two differences. We have then

	m.	s.	m.	s.
By lunars	29	29.83	1	13.76
By chro.	29	33.83	1	10.67
L–C		− 4.00		+ 3.09

The chronometric difference is adopted as the most exact—apportioning the errors of the other among the longitudes by lunars, remembering that Camp II. is determined by a single culmination, while at each of the others two were observed, we should now have, were the lunar tables correct, the best system of longitudes. Mr. S. C. Walker states that a correction of the present residual errors of the lunar tables would increase all the longitudes depending upon moon culminations by about six seconds of time. Adding, therefore, six seconds to the above corrected longitudes, we get finally, as the basis of the whole work, the following adopted longitudes.

	h.	m.	s.	°	′	″
I. Mouth of the Fontaine-qui-bouit, August 22, 1845	6	58	50.72 =	104	42	41
II. Camp at Salt Lake, October 14th, 20th	7	28	24.55 =	112	06	08
III. Lassen's Farm, Deer Creek, April 14, 1846	8	07	46.92 =	121	56	44
IV. Buttes, Sacramento Valley, June 4, 1846	8	06	36.24 =	121	39	04

Upon these and the sextant observations is based the accompanying table of latitudes and longitudes.

J. S. Hubbard.