mixed tyuyamunite and carnotite, then there must be present 35 per cent of these two minerals. As, however, special tests showed that both tyuyamunite and carnotite are insoluble in ammonium carbonate solution whereas the material analyzed dissolves therein with great ease and readiness, the assumption that the lime and potash present are due to these two minerals is disproved. It is not known whether the lime and potash are derived from the gangue or belong to the uvanite. The ratios deduced on the basis of either assumption are the same.

Ratios of uvanite analysis

NEGLECTING $CaO + K_2O$				COMBINING $CaO + K_2O$ WITH UO_3			
UO_3	0.139	or 1.91	or 2×0.96	UO_3	0.150	or 2.05	or 2×1.03
V_2O_5	0.208	or 2.86	or 3×0.95	V_2O_5	0.208	or 2.84	or 3×0.95
H_2O	1.106	or 15.22	or 15×1.01	H_2O	1.106	or 15.11	or 15×1.01

The formula derived for uvanite is $2UO_3.3V_2O_5.15H_2O$.

Analysis of another mineral from the south side of Temple Rock, Emery County, Utah, which occurs in shaley sandstone as small greenish-yellow, glistening scales, has shown it to be like uvanite, a hydrous uranium vanadate. Further investigation is being made to determine whether it is a new species or a variety of uvanite.

Pascoite[2] has been found in small quantity on the Crescent No. 3 claim, Crescent Creek, Henry Mountains, and at a number of other places in southeastern Utah, as an efflorescence (already mentioned) and in cavities in fossil wood.

ZOOLOGY.—*The relation between recent crinoids and the temperature of their habitat.* AUSTIN H. CLARK, National Museum.

I have already discussed at considerable length[1] the relation between the recent crinoids and the temperature of the water in

[1] Une étude philosophique de la relation entre les crinoïdes actuels et la température de leur habitat. Bulletin No. 294 de l'Institut Océanographique. Monaco, 1914.

[2] Hillebrand, W. F., Merwin, H. E., and Wright, F. E. Hewettite, metahewettite and pascoite, hydrous calcium vanadates. Proc. Am. Philos. Soc., **53**: 31–54. 1914.

which they live; but there are one or two points upon which further emphasis may well be placed by presentation in a somewhat different light.

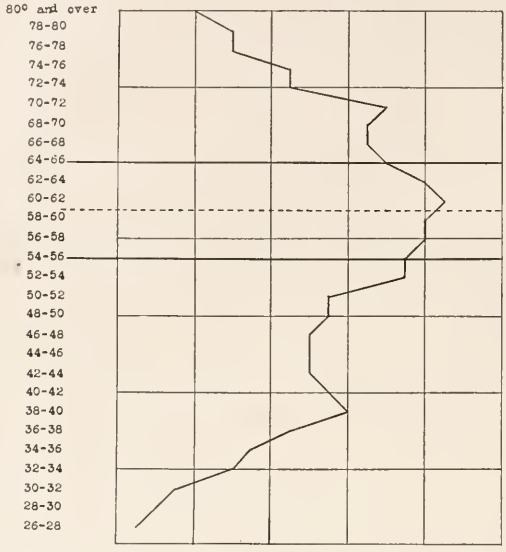

Fig. 1. The frequency of the families of recent crinoids at different temperatures.

The number of crinoid families occurring within the several divisions of 2° F. (fig. 1) which collectively make up the entire range of the class is as follows:

80° and over	4	52°–54°	15
78°–80°	6	50°–52°	11
76 –78	6	48°–50°	11
74°–76°	9	46°–48°	10
72°–74°	9	44°–46°	10
70°–72°	14	42°–44°	10
68°–70°	13	40°–42°	11
66°–68°	13	38°–40°	12
64°–66°	14	36°–38°	9
62°–64°	16	34°–36°	7
60°–62°	17	32°–34°	6
58°–60°	16	30°–32°	3
56°–58°	16	28°–30°	2
54°–56°	15	26°–28°	1

According to the extent of their respective temperature ranges (fig. 2) the families of recent crinoids group themselves as follows:

1°– 6° (including families with one record only)	4		
6°–12°	1	24°–30°	4
12°–18°	2	30°–36°	7
18°–24°	3	36°–42°	2

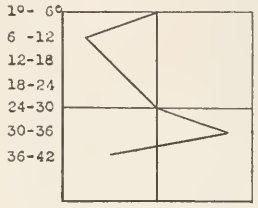

Fig. 2. Distribution of the families of recent crinoids according to their thermal ranges.

In the comatulids (fig. 3), although the Oligophreata and the Macrophreata are represented by the same number of families, six, between 50° and 55°, the families of the Macrophreata predominate at all temperatures below this, and the families of the Oligophreata at all temperatures above; but the total number of the families of the Macrophreata in excess of the total number of the families of the Oligophreata occurring below 55° is only two, while the total number of the families of the Oligophreata in excess of the total number of the families of the Macrophreata occurring above 55° is six. This indicates that the differentiation of new crinoid types is chiefly, if not entirely, confined to the warmer portions of the oceans.

There is a gradual increase in the number of the families of the Oligophreata from 30°–35°, where one only is represented, to 60°–65°, where there are six, and then a more gradual decrease as the temperature increases.

Among the families of the Macrophreata there is an increase, at first more abrupt than in the case of the Oligophreata, from 25°–30°, where one family is represented, to 50°–65°, where there are six, and then a decrease, at first much more abrupt than among the families of the Oligophreata, as the temperature increases. Thus in the Oligophreata we find the largest number of

Fig. 3. Thermal distribution of the families of recent crinoids; the zone of maximum representation is between 55° and 65°, especially between 60° and 65°; it is probably within these temperatures that the very rich post-palaeozoic fauna was developed.

families between 60°–65°, in the Macrophreata between 55°–65°, the number in the case of the families of the Oligophreata diminishing gradually as the temperature increases, and the number in the case of the Macrophreata decreasing gradually as the temperature diminishes.

Examining the total for all the comatulid families, we find the largest representation between 55° and 65°, with the emphasis between 60° and 65°. The only stalked crinoids of which we have

a sufficient knowledge (the Pentacrinitida and the Bourgueticrinidae) are also found at these temperatures, while three of the others (the families Apiocrinidae, Phrynocrinidae and Plicatocrinidae) are found below, and one (Holopodidae) is known only from above.

Among the comatulids we are without sufficient data in regard to five families (Himerometridae, Stephanometridae, Tropiometridae, Ptilometrinae and Atelecrinidae); but one of these (Ptilometrinae) is actually known from this temperature, while the four others are without doubt found here, if we may judge from the mean temperature of the sea at the depths at which they are known to live. At least all except four, and with little doubt all, of the comatulid families are found between 55° and 65°, and not only these, but also the two dominant families of the stalked crinoids (Pentacrinitida and Bourgueticrinidae). Thus it appears that the range of temperature between 55° and 65° (12.78° and 18.33°C.) represents the temperature most suitable for the recent crinoids.

There are certain very interesting attributes of the crinoids which are found between the temperature limits of 55° and 65°; they are all of medium size, none being very large and none very small, and they are all conservative in their characters, with never a large number of arms—usually ten only. This would appear to indicate that the range of temperature between 55° and 65° represents the temperature physiologically most suitable for the crinoids, a temperature which tends to maintain a phylogenetical conservatism and to suppress any tendency toward the extreme type of development characteristic of the crinoids of the warm water, as well as that characteristic of the crinoids of the cold water.

So far as can be seen, it is with recent species found between these temperatures that the fossil crinoids best agree, and thus the suggestion may be made that it was principally, if not entirely, within this temperature range that the crinoids of the post-palaeozoic fauna, which was characterized by a very great development of the present dominant order, the Articulata, were developed.