Some evidence was found for the presence of cycloisoprenoid structures in the higher-boiling fractions. A white solid material crystallized from the cycloparaffin fraction. The white solid, which represents about 0.1 per cent of the bitumen, had a melting point of 292–297° C., had a molecular weight by mass spectra of 412 ($C_{30}H_{52}$), and was only slightly soluble in hot benzene. Mass spectral data showed large m/e peaks of 191 and 137 suggesting the presence of two ring systems connected by a carbon chain. The extremely high melting point of this material suggests the presence of bridge carbon atoms. A ring system similar to camphane would account for the m/e 137 peak and a camphane ring fused to a saturated ring would account for the m/e 191 peak.

CONCLUSIONS

Normal paraffins, ranging in carbon number from 13 to 33, have been identified in a bitumen from Colorado oil shale. These n-paraffins contain a predominance of odd over even carbon numbers similar to bitumens from recent and ancient sediments.

Five isoprenoid compounds, representing 3.4 per cent of the bitumen, were identified as phytane (2,6,10,14-tetramethylhexadecane), pristane (2,6,10,14-tetramethylpentadecane), 2,6,10-trimethylpentadecane, 2,6,10-trimethyltridecane, and 2,6,10-trimethyldodecane. It seems of particular importance to origin considerations that these isoprenoid structures represent such a high portion of the total bitumen.

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Vanadium and Nickel in Crude Petroleum of South American and Middle East Origin

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NUMEROUS surveys have been published concerning the inorganic constituents occurring in petroleum of United States origin (*1, 4, 6*), but only a limited number of analyses of petroleum from other producing areas have been reported (*2, 3, 5*). A more complete survey of the vanadium and nickel content of petroleum of South American and Middle East origin is reported in Table I.

A relationship of density to vanadium content in the crude petroleum of Western Venezuela has been found. The correlation is:

$$\log(\text{PPM Vanadium}) = 3.04 - 0.03\ ^{\circ}\text{API}$$

It must be emphasized that this relationship applies only to Western Venezuelan petroleum and even in those, occasional exceptions are noted.

The analytical methods used were essentially those of Wrightson (*7*) which were modified slightly to include an iron separation step when required. In analysis of crude petroleum, dry ashing was less troublesome and gave results equivalent to those obtained when sulfuric acid coking was used (*3*).

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Table I. Vanadium and Nickel Content of South American and Middle East Petroleum

	Gravity °API	P.P.M. Vanadium	P.P.M. Nickel
Western Venezuelan Crudes			
Bachaquero Heavy	13.2	390	45
Bachaquero	16.6	370	46
Bachaquero Light	35.4	49	5.5
Barinas	25.9	165	43
Boscan	10.6	1400	100
Cumarebo	47.8	0.7	0.8
Lagunillas Heavy	17.6	300	38
La Rosa Medium	23.9	230	24
Mara	29.5	220	18
Mototan # 7	19.7	390	43
Taparito	17.2	450	40
Tia Juana Light	31.9	100	11
Tia Juana Medium	25.6	200	22
Tia Juana Heavy	18.2	300	25
Urdaneta[a]	11.3	430	
Eastern Venezuelan Crudes			
Cachipo[a]	34.3	14	3.3
Guanipa	32.7	110	27
Jusepin	31.9	26	5.5
Oficina Light	35.3	57	6
Oficina Heavy	31.5	62	14
Pedernales	21.7	230	87
Pilon[a]	9.7	510	98
Quiriquire	16.5	95	16
San Joaquin	45.9	0.6	0.2
Temblador	20.6	56	35
Tigre	26.5	160	28
Tucupita	15.7	84	45
Other South American Crudes			
Bahia (Brazilian)	39.6	0.6	2.5
Bacuranao (Cuban)	30.1	21	6
Middle East Crudes			
Agha Jari (Iranian)	33.9	36	
Ain Dar (Arabian)	33.9	51	10
Ain Zalah (Iraqi)	32.1	95	15
Bai Hassan (Iraqi)	33.3	19	
Gach Saran (Iranian)	31.0	114	
Jambur (Iraqi)	39.2	6	
Kirkuk (Iraqi)	36.3	30	11
Kuwait	32.3	30	6
Qatar	42.2	3	0.4
Safaniya (Arabian)	27.1	80	
Shedgum (Arabian)	34.3	18	
Uthmaniyah (Arabian)	30.0	51	9
Wafra (Neutral Zone)	24.1	52	7
Zubair (Iraqi)	36.4	20	4

[a] Designates samples taken at well head. The remainder are commercial production whole crudes.

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