some difficulty associated with defining and determining exactly the background ratio in rainwater.

Krey (*6*), who estimated the particle size distribution of ^{238}Pu from the debris of the SNAP-9A generator by an autoradiographic technique, concluded that the diameters of the particles ranged from 5 to 58 nm with an arithmetic mean of about 10 nm. Such small particle size explains the very slow increase in the ratio in deposition in the Northern Hemisphere, as predicted by Harley (*7*). Our results seem to indicate that the arrival of ^{238}Pu from the SNAP-9A generator in the Northern Hemisphere occurred appreciably earlier than expected. One possible explanation is that some larger particles were also produced by the generator burnup and that these subsided rather rapidly, resulting in the earlier transfer of debris from the Southern to the Northern Hemisphere. The fact that comparatively constant values of the ratio were obtained in the period from the latter half of 1964 to the end of 1965 seems attributable to isotopic dilution by nuclear debris produced in the 1964 and 1965 nuclear explosions, such as the first and the second Chinese explosions.

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Hydrocarbons of Blue-Green Algae: Geochemical Significance

Abstract. *The hydrocarbon compositions of 11 species of blue-green algae are simple and qualitatively similar. Three marine coccoids contain only monoenoic and dienoic C_{19} hydrocarbons. Hydrocarbons of the remaining eight species are C_{15} to C_{18}. Hydrocarbons of higher molecular weight (C_{20} or more) were not detected. Blue-green algae do not appear to be the source material for the long-chain (greater than 20 carbons) hydrocarbons found in ancient sediments.*

Because blue-green algae are primitive organisms with the ability to grow in environments that favor the preservation of organic matter, such as hypersaline or reducing environments, they are often suggested as source material for the organic matter associated with ancient sediments. We have studied the composition of the lipids of blue-green algae in order to determine relationships among them, and to define their potential as geological source material. The fatty acid compositions are simple (*1*). The hydrocarbon patterns are even simpler than the fatty acid patterns.

The conditions used to grow the pure cultures of algae are given in Table 1. *Trichodesmium* was collected from a large unialgal surface bloom which occurred near Port Aransas in the Gulf of Mexico. The sample used in this study is from the same bloom for which the fatty acid pattern was reported (*1*). The algal mat was part of an extensive blue-green community (nearly a pure culture) growing in a few centimeters of water on a mud flat near Port Aransas. The mat was collected prior to the dehydration which occurs later in the summer, and the algae appeared to be healthy.

The analytical procedure was designed to detect hydrocarbons containing from 14 to 34 carbon atoms. The cells were harvested by centrifugation or by a plankton net in the case of *Trichodesmium*. The moist cells were transferred to a separatory funnel and shaken with a few milliliters of methanol for 5 minutes. An equal volume of hexane was added and the mixture was shaken for 15 minutes. The hexane layer was transferred to a 10-ml flask and evaporated to 0.5 ml under a stream of dry nitrogen. The sample was placed on a silica gel column (Woelm activity I) which had been washed with hexane. The hydrocarbons were eluted with 50 ml of hexane. The hexane was evaporated to 0.5 ml with a nitrogen stream and set aside for analysis. The hydrocarbons were identified and measured by gas chromatography on columns of Apiezon L, SE-30, and FFAP. Standards of the saturated and monoenoic hydrocarbons were used to obtain retention times. Standard dienoic hydrocarbons were not available. The identifications of these polyunsaturated molecules are based on the shift in elution order on Apiezon L compared with FFAP and on the fact that hydrogenation of the samples yielded only a single saturated (C_{19}) hydrocarbon.

The hydrocarbon compositions of the blue-green algae were very simple (Table 2). The hydrocarbons constituted between 0.05 and 0.12 percent of the dry weight of the cells. The three marine coccoids contain only normal C_{19} molecules with one or two double bonds. The remaining organisms contain normal hydrocarbons in the C_{15} to

Table 1. Growth conditions of blue-green algae. All organisms were grown in test tubes with continuous gassing with 1 percent CO_2 in air. Illumination was 3300 lu/m² provided by fluorescent lamps. At harvest, cell concentrations were approximately 0.5 mg (dry weight) per milliliter.

Organism	Code name	Growth conditions	
		Temp. (°C)	Medium*
Trichodesmium erythaeum	Trico	†	Bloom
Coccochloris elabens	17A	39	ASP-2
Microcoleus chthonoplastes	BA-1	39	ASP-2
Nostoc muscorum G.‡	NM	30	C
Agmenellum quadruplicatum	PR-6	39	ASP-2
A. quadruplicatum	BG-1	39	ASP-2
Plectonema terebrans	SP-31	30	ASP-2
Oscillatoria williamsii	Mev	39	ASP-2
Lyngbya lagerhaimii	Mont	30	ASP-2
Anacystis nidulans ‡	Ana. n.	39	C
A. nidulans ‡	TX-20	39	Cg-10
Algal mat		†	

* For medium C, see (*5*); for medium ASP-2, see (*6*). † Natural. ‡ Culture was obtained from J. Graham, University of Texas, Austin. The other cultures are marine isolates of our laboratory (*6*). The Ana. n. cells were grown and lyophilized in Austin; TX-20 was grown in our laboratory on a different medium (*7*).

Table 2. Hydrocarbons of blue-green algae (percentage of composition). The letters tr indicate trace, that is, less than 5 percent.

Organism*	15:0 †	16:0	17:0	17:1	br18 ‡	18:0	19:1	19:2
Trico	tr	2	95	1		1		
Ana. n.	21	5	68	5				
Mev	9	tr	91	tr		tr		
TX-20	6	2	90	2		tr		
BA-1	2	4	92			2		
Mont	1	4	86	1	8			
NM	1	2	83	1	10			
17A				1		1	85	13
PR-6							92	7
BG-1							98	2
SP 31	6	3	90	1		tr		
Mat §	2	2	36	4	11	1	8	

* See Table 1 for species names. † The numbers before the colon indicate the numbers of carbon atoms; the numbers after the colon, the numbers of double bonds. ‡ The identifications of the branched C_{18} compound(s) (br18) are tentative, based only on estimated gas-liquid chromatography retention times and hydrogenation data. § The mat was more complex than the pure cultures. In addition to small amounts of br18 molecules it contained 32 percent of C(17:2), a molecule not found in the pure cultures, and 1 percent of C(19:0).

C_{18} range either saturated or with one double bond. *Nostoc* and *Lyngbya* contain significant amounts of a C_{18}, branched-chain hydrocarbon. Similar amounts of a branched alkane were reported for *Nostoc* sp. and tentatively identified as 7,9-dimethylhexadecane (*2*). Our pattern for *Anacystis* agrees with that reported recently (*2, 3*). The olefins of high molecular weight (more than C_{20}) reported (*4*) for *Anacystis montana* were not found in any of our samples. A special effort was made to detect hydrocarbons in the C_9 range in the case of *Trichodesmium*. The fatty acids of this bloom of *Trichodesmium* consisted of 50 percent C_{10} chains with no unsaturation (10:0). The fact that no C_9 or C_{10} hydrocarbon was detected suggests that fatty acids are not the precursors of hydrocarbons either by decarboxylation or reduction.

The comparative data on the hydrocarbons and fatty acids (*1*) define the role of blue-green algae as source material for the organic matter found in ancient sediments. The blue-green algae surveyed could supply only very simple (C_{12} to C_{20}) hydrocarbons and fatty acids to sediments.

Neither the biological function nor the significance of the restricted pattern of biosynthesis of hydrocarbons in blue-green algae are understood.

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Adrenal Tyrosine Hydroxylase: Compensatory Increase in Activity after Chemical Sympathectomy

Abstract. *Destruction of peripheral sympathetic nerve endings with 6-hydroxydopamine causes a disappearance of cardiac tyrosine hydroxylase, accompanied by a twofold increase in adrenal tyrosine hydroxylase and a small increase in phenylethanolamine-N-methyl transferase. No change in adrenal catecholamine content occurs under these conditions.*

6-Hydroxydopamine (6-OH-DA) selectively destroys postganglionic sympathetic nerve endings in various species (*1, 2*). These morphological changes are accompanied by a long-lasting depletion of norepinephrine in sympathetically innervated organs and by an impaired uptake of H^3-norepinephrine (*2*).

The rate of synthesis of the sympathetic neurotransmitter norepinephrine is determined mainly by the activity of tyrosine hydroxylase (*3*). This enzyme hydroxylates tyrosine to dihydroxyphenylalanine (*4*), which is subsequently decarboxylated to dopamine, the immediate precursor of norepinephrine. In the adrenal gland a further step occurs—norepinephrine is methylated to epinephrine by phenylethanolamine-*N*-methyl transferase (PNMT).

Administration of 6-OH-DA almost completely destroys adrenergic nerve endings in the rat heart, but appears to leave the adrenal medulla intact (*2*). Therefore the activity of tyrosine hydroxylase in these two organs was examined after chemical sympathectomy with 6-OH-DA. We report that after this treatment the tyrosine hydroxylase activity in the rat heart disappears and that this enzyme in the adrenal gland is markedly increased.

Male Sprague-Dawley rats (100 to 125 g) were given two intravenous injections of 6-OH-DA (100 mg/kg in 0.01*N* HCl) at 8-hour intervals, and were killed 16 or 40 hours after the second injection by a blow on the head. The hearts and adrenal glands were rapidly removed and chilled on cracked ice. The adrenal glands were homogenized in 2.0 ml of 0.25*M* sucrose and centrifuged at 27,000*g* for 10 minutes. The hearts were blotted dry, minced with an Arbor tissue press, and centrifuged at 105,000*g* for 20 minutes. To remove compounds that interfere with the determination of tyrosine hydroxylase activity in the rat heart, we passed samples of the supernatant over Sephadex G-10 columns (3 cm long) equilibrated with 0.25*M* sucrose. Portions of the effluent from the heart or supernatant fraction of the adrenal gland were used to estimate protein (*5*) and tyrosine hydroxylase (*6*); PNMT was determined in the adrenal gland supernatant fraction by a previously described method (see *7*). Epinephrine and norepinephrine were determined by the procedure of Anton and Sayre (see *8*).

Sixteen hours after the second injection of 6-OH-DA cardiac tyrosine hydroxylase activity had decreased to almost 15 percent of control values (Fig. 1), whereas the enzyme activity in the adrenals was markedly increased, whether expressed as activity per protein, unit weight, or pair of adrenals (Fig. 2). At this time cardiac catecholamines were no longer detectable (con-