TABLE I.
Oxygen Consumed by Bacteria in Raw Sea Water Treated with Hydrocarbons.

Hydrocarbon	Initial dissolved O_2 content, mg/1	Dissolved O_2 after 14 days, mg/1	O_2 consumed 14 days, mg/1	O_2 consumed oxidizing hydrocarbon, mg/1
None (Control)	8.46	5.99	2.47	—
Crude oil	8.50	0.00	8.50	6.03
Petroleum ether	8.57	0.00	8.57	6.10
Kerosene	8.60	1.72	6.88	4.41
Gasoline	8.60	0.00	8.60	6.13
Toluene	8.64	0.00	8.64	6.17

They do not require hydrocarbons for their growth.

Marine hydrocarbon-oxidizing bacteria may influence the formation, accumulation and storage of petroleum or its products. Hydrocarbons which may be produced by the reduction of sapropel in marine sediments may be oxidized by such bacteria *in situ* as rapidly as they are formed, thereby preventing their accumulation in detectable quantities. As a matter of fact, traces of complex compounds such as polyene pigments and their allies are about the only hydrocarbons found in recent sediments with the exception of methane. The abundance of hydrocarbon-oxidizing bacteria in storage tank water suggests that they may play a role in the decomposition of petroleum products. Marine bacteria which oxidize natural and synthetic rubber, $(C_5H_8)_x$, have been described elsewhere by the authors.[5]

It is still indeterminate whether hydrocarbons are utilized in an anærobic environment although there is some evidence that certain substances such as nitrate and possibly sulfate may serve as hydrogen-acceptors in the absence of free oxygen. Low concentrations of hydrocarbons appear to be oxidized quantitatively to carbon dioxide and water, but with larger concentrations, methane and organic acids have been detected as end-products. Adsorbing the hydrocarbons on sand has proved to be a satisfactory method of providing for the dispersion of the hydrocarbons which are virtually insoluble in water thereby rendering them more susceptible to bacterial attack.

5 ZoBell, C. E., and Grant, C. W., *Science*, 1942.

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Amino Acid Fermentations by Anaerobic Bacteria.

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Although many anærobic bacteria decompose proteins and the products of protein hydrolysis, only a few species are known to be able to satisfy their energy requirements by the fermentation of single amino acids or other nitrogenous compounds. These species are *Clostridium tetanomorphum* and *Cl. cochlearium*[1,2] which ferment glutamic acid and *Cl. acidi-urici* and *Cl. cylindrosporum*[3,4] which ferment uric acid and some other purines. Possibly *Cl. botulinum,*[5] *Cl. sporogenes,*[6] and *Cl. tetani*[7] should also be in-

1 Barker, H. A., *Enzymologia*, 1937, **2**, 175.

2 Barker, H. A., *Arch. f. Mikrobiol.*, 1939, **10**, 376.

3 Barker, H. A., and Beck, J. V., *J. Bact.*, 1942, **43**, 291.

4 Barker, H. A., and Beck, J. V., *J. Biol. Chem.*, 1941, **141**, 3.

5 Clifton, C. E., *J. Bact.*, 1940, **39**, 485.

6 Hoogerheide, J. C., and Kocholaty, W., *Biochem. J.*, 1938, **32**, 949.

7 Clifton, C. E., *J. Bact.*, 1942, **44**, 179.

cluded in this group since cell suspensions of all 3 species can decompose single amino acids anærobically. However, it is not yet certain that these decomposition reactions can satisfy the energy requirements for growth of these bacteria.

Recent work in this laboratory has resulted in the discovery of 2 additional obligately anærobic bacteria that derive energy by the fermentation of single amino acids. Both organisms undoubtedly represent new species.

The first organism is a spindle-shaped, spore-forming, motile, Gram-negative rod which ferments alanine, serine and threonine as well as lactate and pyruvate. Methionine, valine, cysteine and aspartate are also attacked but much more slowly. Other amino acids and carbohydrates are not fermented.

The fermentation products are very similar to those produced by the genus *Propionibacterium* since all C_3 substrates give rise to propionic and acetic acids approximately in accordance with the following equations:

$$3\ CH_3CHNH_2COOH + 2\ H_2O \rightarrow 3\ NH_3 + 2\ CH_3CH_2COOH + 1\ CH_3COOH + 1\ CO_2$$

$$3\ CH_2OHCHNH_2COOH + 1\ H_2O \rightarrow 3\ NH_3 + 1\ CH_3CH_2COOH + 2\ CH_3COOH + 2\ CO_2$$

$$3\ CH_3CHOHCOOH \rightarrow 2\ CH_3CH_2COOH + 1\ CH_3COOH + 1\ CO_2 + H_2O$$

$$3\ CH_3COCOOH + 1\ H_2O \rightarrow 1\ CH_3CH_2COOH + 2\ CH_3COOH + 2\ CO_2$$

Threonine, however, gives butyric instead of propionic acid as the characteristic product:

$$3\ CH_3CHOHCHNH_2COOH + H_2O \rightarrow 3\ NH_3 + 2\ CH_3CH_2CH_2COOH + 1\ CH_3COOH + 2\ CO_2$$

The second organism is a Gram-negative coccus that ferments glycine readily. Very few other amino acids are attacked and none is decomposed as rapidly as glycine. The organism may therefore prove useful for the identification and estimation of this amino acid. The fermentation of glycine proceeds approximately in accordance with the equation:

$$4\ CH_2NH_2COOH + 2\ H_2O \rightarrow 4\ NH_3 + 3\ CH_3COOH + 2\ CO_2$$

Under certain conditions, a considerable amount of hydrogen (as much as 0.35 moles per mole of glycine fermented) is also produced, while the carbon dioxide is increased and the acetic acid decreased.

Since the above reactions are carried out by growing cultures as well as by cell suspensions there can be no doubt that they provide the main energy source for these bacteria.

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Preparation and Partial Analysis of a Pancreatic Protein Material of Unusual Growth-Promoting Properties.

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During the course of an investigation of the chemistry of beef pancreas, two protein materials were prepared. The experiments described in the following paper[1] indicate that one of these (P-1) has unusual growth-promoting properties as tested with white rats.

Preparation. Frozen beef pancreas was finely minced and treated for 24 hr with acid 90% 3A alcohol (30 gallons of alcohol and 1 liter of concentrated hydrochloric acid for each 100 lb of pancreas). The insoluble residue was centrifuged off and thoroughly washed with 70% 3A alcohol (28 gallons of alcohol for the residue from 100 lb of glands). After separation with the centrifuge, the air-dried insoluble material was

[1] White, A., and Sayers, M. A., PROC. SOC. EXP. BIOL. AND MED., 1942, 51, 270