determine the mechanism of this efficient transfer process are in progress.

This work was supported by an NSF grant to the International Decade of Ocean Exploration.

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Received June 27; revised July 15, 1974.

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Origin proposed for non-protein amino acids in meteorites

The amino acids that have been identified in several meteorites[1,2] can be divided into two classes: those present in proteins and those which are not. The presence of the non-protein amino acids, D- and L-β-aminoisobutyric acid and β-alanine, is described as evidence for the indigenous origin of meteorite amino acids and against terrestrial contamination[1]. It is implied that these β-amino acids arise by prebiotic condensation of ammonia, methane, hydrogen, water and other simple primordial molecules[3]. The β-amino acids and other amino acids can arise from simple molecules by Fischer–Tropsch synthesis in the laboratory. Hydrogen, carbon dioxide and ammonia were heated to high temperatures in the presence of natural catalysts expected to be present in the solar nebula[4].

In other experiments, thermal synthesis of amino acids occurred in a simulated primitive atmosphere of methane, ammonia and water, followed by acid hydrolysis of the products. β-Alanine was obtained in high yield, relative to other amino acids, and the straight-chain compound, β-amino-n-butyric acid[5]. These amino acids were postulated to arise respectively from hydrolysis of β-aminopropionitrile and the nitrile intermediate arising from addition of ammonia to crotononitrile. Evidence for this route was the identification of succinic acid and N-methyl-β-alanine which are likely hydrolysis products of nitrile intermediates. Production of β-aminoisobutyric acid was not reported in these experiments[5].

β-Aminoisobutyric acid is a rare amino acid with a curious distribution in nature. It has been isolated only from human urine[6], iris bulbs[7], flatworms[8] and edible mussels[9]. Man is probably the only mammalian species to excrete D-(—)β-aminoisobutyric acid[10] though there is chromatographic evidence for its presence in rabbit urine[11]. Metabolic experiments suggest that the pyrimidine base thymine, from nucleic acid catabolism, is the precursor of β-aminoisobutyric acid in the human[12-14]. Similarly, metabolic production of β-alanine in rat liver is from the pyrimidine uracil[15].

By analogy with these known reaction sequences catalysed biologically, I suggest that heterocyclic compounds could also act as precursors for the β-amino acids found in meteorites. In this case, scission of the ring of heterocyclic compounds formed prebiotically would occur under the catalytic conditions of extremes of temperature and radiation thought to occur in space.

The purines, adenine and guanine, and a substance resembling uracil have been detected in the Orgueil meteorite[16]. Xanthine, thymine, uracil and derivatives have also been obtained experimentally by mimicking supposed prebiotic conditions[4].

This chemical route to certain non-protein amino acids described above would presumably give racemic mixtures of both stereoisomers, for example, both D-, and L-β-aminoisobutyric acid, as found in meteorites[1]. It would be interesting to know if thymine, dihydrothymine, uracil and related compounds, when heated under supposed prebiotic conditions, did give traces of the β-amino acids.

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Received July 4, 1974.

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Evidence for downwind flights by host-seeking mosquitoes

The behaviour of flying insects which make use of airborne chemicals in their search for food, oviposition sites or sexual partners can be separated into two phases, the search flight bringing them into contact with the attractant plume and the approach flight leading them to its source[1,2]. The second phase is characterised by upwind orientation in response to the appropriate chemical stimuli[3-6]. Mosquitoes are known to fly upwind as they approach a warm-blooded host[7-9]. For most insects relatively little is known of the pattern of the preceding search flight which Haskell[2] described as 'wandering', but where the wind is light it may be upwind[1]. Experiments in West Africa have shown that the majority of mosquitoes entered flight traps from the downwind side, that is they appeared to have been flying upwind, regardless of the presence or absence of a host (ref. 10 and W. F. Snow, unpublished). Here we report experiments that unexpectedly provide evidence for the opposite type of behaviour.

If the search flight is in a generally upwind direction, it should be possible to divert mosquitoes round a host by setting up a barrier on the downwind side and so provide a measure of protection from their attacks. The barrier would need to be sufficiently far away for the mosquitoes to encounter it before they detected the presence of the host, so that directed responses towards the host would not be elicited. This distance was estimated by Gillies and Wilkes[11] to be less than 18 m for a host the size of a man. A host stationed at this distance upwind