

by algal filaments. In other cases the optimum conditions might be (as suggested to me by Robert P. Sharp) those existing when the playa has been well soaked, frozen, and has just begun to thaw, thus yielding a thin surface layer of thoroughly saturated mud supported by frozen ground below.

Last, it should be reported that a tissue paper-like film was peeled off some of the tracks, especially at spots where it looked as though the rock had stopped for awhile (and in many instances had also changed direction). In the laboratory J. D. Lauder milk was able to revive this "pond paper," and he reports it is the blue-green alga *Microcoleus* sp. Similar fibers permeate the curled mud flakes occurring outside the tracks. *Microcoleus* filaments are described as having a "... homogeneous sheath of an extremely gelatinous nature" (3). Perhaps this material is an important Department of Geology, Pomona College lubricant.

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References

1. MCALLISTER, J. F., and AGNEW, A. F. *Bull. Geol. Soc. Amer.*, **59**, 1377 (abstr.) (1948).
2. KIRK, L. G. *J. Sediment. Petrol.*, **22**, (3), 173 (1952).
3. SMITH, G. M. *The Fresh-water Algae of the United States*. New York: McGraw-Hill, 578 (1950).

S-Acetyl Pantetheine (Acetyl LBF)¹

THE importance of acetyl coenzyme A (1-3) (acetyl CoA) as a biological acetylating agent, together with the description of other S-acetyl compounds (4, 5) possessing acetylating power for such acceptors as hydroxamic acid, has prompted us to attempt the synthesis of acetyl pantetheine (acetyl LBF), which may be viewed as a model compound of acetyl CoA. S-acetylthiophenol ($C_6H_5SCOCH_3$), which was employed by Wieland and Bakelmann for the preparation of acetyl glutathione (5), was found satisfactory for the synthesis of acetyl LBF.

Pantetheine was prepared through condensation of β -aletheine (N- β -alanyl-2-aminoethanethiol) with (—)-pantoyl lactone (6). A mixture of 12.9 g acetylthiophenol in 30 ml methanol and 5 ml water was adjusted to pH 3.0 with hydrochloric acid. The solution was added to 2.4 g of freshly prepared pantetheine (kept in the reduced state under nitrogen) in a methanol solution. The homogeneous mixture was allowed to stand at room temperature for 5 hr under nitrogen. The solvent was then distilled off *in vacuo*. Excess thiophenol was removed by three successive ether extractions. The residue after extraction was dried overnight in a vacuum desiccator at 0.01 mm pressure. Yield, 2.0 g of pale yellow oil. The active acetyl content corresponded to the bound pantothenic acid, as shown in Table 1. These data

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TABLE 1
THE ACETYL AND PANTOTHENIC ACID CONTENT
OF ACETYL LBF*

	Acetyl (7) (μ mols)	Bound pantothenic acid (8) (μ mols)	Molar ratio of pantothenic acid to acetyl
Found	178	180	1.01
Theoretical	189	189	1.00

* 60.4 mg of the product was dissolved in water for analyses.

revealed that the product was about 95% pure. It readily acetylated hydroxamic acid. Acetyl LBF was at least as active as LBF in supporting the growth of *Lactobacillus bulgaricus*. This was presumably due to hydrolysis to LBF. Acetyl LBF gave a positive nitroprusside test (in NaCN and concentrated NH_4OH) slowly upon standing, in contrast to the immediate reaction produced by LBF.

By the same method acetyl CoA in purity of about 60% was obtained from a sample of CoA, 75% pure. The further study of the preparation, as well as the biological behavior of acetyl LBF and acetyl CoA, is in progress.²

References

1. LYNEN, F., and REICHERT, E. *Angew. Chem.*, **63**, 47 (1951).
2. LYNEN, F., REICHERT, E., and RUEFF, L. *Ann.*, **574**, 1 (1951).
3. STADTMAN, E. R. *J. Biol. Chem.*, **196**, 535 (1952).
4. BADDILEY, J., and THAIN, E. M. *J. Chem. Soc.*, 3425 (1951).
5. WIELAND, T., and BAKELMANN, E. *Angew. Chem.*, **64**, 59 (1952).
6. KING, T. E., STEWART, C. J., and CHELDELIN, V. H. *J. Am. Chem. Soc.* (in press).
7. LIPMANN, F., and TUTTLE, L. C. *J. Biol. Chem.*, **158**, 505 (1945).
8. NIELANDS, J. B., and STRONG, F. M. *Arch. Biochem.*, **19**, 287 (1948).

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² J. Baddiley and E. M. Thain have prepared acetyl LBF through reaction of the sodium salt of pantetheine with acetyl chloride. (See communication following.)

It has been shown that certain thiolacetates acetylate amines under very mild conditions (1). As this was of interest in connection with the mode of action of coenzyme A, the compounds examined were acetyl derivatives of 2-mercapto-ethylamine and its β -alanyl amide. This series has now been extended to include S-acetylpantetheine, the synthesis of which is described here.

When a solution of pantetheine in methanol was treated with 1 M sodium methoxide followed by exhaustive removal of solvent *in vacuo*, an S-sodio derivative was obtained. To a suspension of this in anhydrous dioxan was added 1 M acetyl chloride with vigorous shaking at room temperature. After stand-

ing for $\frac{1}{2}$ hr the solvent was removed *in vacuo*, the residue dissolved in chloroform and filtered. Evaporation of solvent left a resin consisting of almost pure S-acetylpantetheine. (Found: C, 47.8; H, 7.5; N, 8.5. $C_{13}H_{24}O_5N_2S$ requires C, 48.6; H, 7.5; N, 8.7%.) It was shown to be homogeneous by paper chromatography in the following solvents: butanol-water (R_F 0.73), amyl alcohol-water (R_F 0.70), butanol-acetic acid-water (R_F 0.82). The product was demonstrated on paper by spraying with ammonia solution prior to the cyanide-nitroprusside spray.

This material was indistinguishable from a sample of S-acetylpantetheine synthesized in a different way by King, Stewart, and Cheldelin (2). It acetylated hydroxylamine with great rapidity at room temperature in dilute solution.

References

1. BADDILEY, J., and THAIN, E. M. *J. Chem. Soc.*, 3425 (1951).
2. KING, T. E., STEWART, C. J., and CHELDELIN, V. H. (See preceding communication.)

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Pleistocene Corals at Lake Worth, Florida

A COLLECTION of corals believed to be of Pleistocene age has been obtained in Lake Worth, Fla., some 60 miles north of Miami, the northern limit of the living reefs. The coral-bearing zone is buried under sand at a depth of 30 or 40 feet above sea level. Fragments of corals were first found in January 1950 by John H. Irons, of Lake Worth, while he was hunting shells on the spoil bank made by a large suction dredge operating near the western shore of Lake Worth, about half a mile north of the bridge connecting the town of Lake Worth with Palm Beach. He has kindly agreed to my publishing this note.

Mr. Irons' interest was aroused because the corals were thoroughly impregnated with calcite or aragonite, a mode of preservation quite different from that of the geologically younger mollusks on the spoil bank. He has continued to search systematically for fossil corals and has accumulated several hundred specimens, which range from small heads to masses weighing more than 100 pounds. Although the corals are recrystallized, the details of structure of many are plainly visible through the clear crystal, and the beauty of the specimens is thereby enhanced.

A representative assortment of corals from the Irons collection was examined by John W. Wells, of Cornell University, a specialist on corals. It included ten species representing eight genera, and several additional species have since come to light. Nearly all the species identified by Dr. Wells are common in the Pleistocene and living reefs of the Florida Keys and the West Indies. The Lake Worth corals are particularly interesting because of their occurrence north of their present range in Florida. No comparable Pleistocene reef has previously been discovered north of the keys, which are themselves based on a massive Pleistocene reef, the Key Largo limestone.

That the fossil corals at Lake Worth are Pleistocene seems obvious, but to determine to which part of the Pleistocene they should be referred needs further consideration. The occurrence is about half a mile west of the Palm Beach peninsula and about 50 feet below its summit. This peninsula appears to have accumulated as an offshore bar during Pamlico time, when sea level stood 25' higher than now. The corals are probably older than the Pamlico.

A further indication of antiquity is the fact that the corals are buried under 20' of sand. The lower part of this sand may be contemporaneous with the bar, but the upper part was probably deposited in Silver Bluff time, for the dredged area lies just east of the Silver Bluff shoreline. Silver Bluff and Pamlico time together are believed to span the time of deposition of the Peorian loess.

The corals could not have lived during the preceding Illinoian (third) glacial stage, for the area was then presumably dry land. Moreover, the sea water at this latitude was then probably too cold for these tropical corals. During the Yarmouth (second) interglacial stage conditions would have been more favorable for the growth of corals. All of southern Florida was then submerged, and the water over the site where the corals grew may have been as deep as 170' at the beginning of the Yarmouth, or as shallow as 70' near its close. This range of depth is quite suitable for corals, though rather deep for massive reefs (1). The Yarmouth, then, seems to be the latest time for the growth of corals at Lake Worth.

In terms of coastal-terrace chronology, the Yarmouth is supposed to comprise the interval from the formation of the Okefenokee terrace (sea level about 140' above the present) to the Talbot (sea level 42'), the intervening steps being the Wicomico at 100' and the Penholoway at 70' (2).

The Lake Worth corals probably form part of the limestone composing the "rim of the Everglades," which must be older than the Pamlico, because it supports (at West Palm Beach) a sand bar of the Talbot formation. This limestone has been interpreted (3) as a facies of the Anastasia formation, which consists typically of coquina. The corals may be contemporaneous with the deposition of the Key Largo limestone, which is the southern extension of the "rim of the Everglades" and which has been correlated with the Anastasia. The coral heads may have been firmly cemented with other organisms into a massive reef, but this is not certain, because the entire collection was recovered from dredgings.

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References

1. VAUGHAN, T. W. *Corals and the Formation of Coral Reefs*. Smithsonian Inst. Rept. for 1917, 197 (1919).
2. COOKE, C. W. *Sedimentary deposits of Prince Georges County and the District of Columbia*. Maryland Board Natl. Resources, Dept. Geol., Mines and Water Resources Bull. 10, 43 (1952).
3. ———. *Geology of Florida*. Florida Geol. Survey Bull. 29, 270 (1945).