These investigations found that in over two-thirds of U.S. outbreaks of multiple-drug-resistant *Salmonella* infections that had a defined source, such bacteria came from food animal populations. It is known that *Salmonella* are commonly transmitted in food animal products, and our analysis shows that multiply resistant *Salmonella* are also frequently transmitted from animals to man. In fact, animal origins were discovered more commonly in outbreaks involving antimicrobial-resistant *Salmonella* than in outbreaks involving antimicrobial-sensitive strains. Thus, it appears to us that animal-to-man transmission of resistant *Salmonella* is not a rare event.

The case fatality rate for patients with identified infections with multiply resistant *Salmonella* was 4.2 percent, 21 times higher than the case fatality rate associated with antimicrobial-sensitive *Salmonella* infections. The explanation for this difference in fatality rates is not known. The fatalities in these investigations were among the old and the very young. Patients at the extremes of age may be more likely to die of salmonellosis, and these patients may have underlying conditions that would lead to antimicrobial or other drug therapy which could complicate or predispose to infection with resistant bacteria. In any case, antimicrobial-resistant *Salmonella* did not appear to be less virulent than antimicrobial-sensitive strains, and the public health significance of multiply resistant *Salmonella* should not be minimized.

We conclude that antimicrobial-resistant enteric bacteria frequently arise from food animals and can cause serious infections in humans.

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6 February 1984; accepted 12 June 1984

Favositid Tabulates: Evidence for Poriferan Affinity

Abstract. *Calcitic pseudomorphs of desma-like siliceous spicules found in the calcareous skeleton of a Devonian thamnoporid support the proposal of poriferan origin of at least some favositid Tabulata. These favositids arose from a group of Ordovician lithistid demosponges that adapted to toxic calcium excess in shallow, tropical marine environments by developing calicoblasts within the pinacoderm, supplementing their primary siliceous spicular skeletons with basally secreted calcium carbonate. They are tentatively recognized as an order of the subclass Sclerospongiae (class Demospongiae).*

Reports of peculiar modern sponges with mixed siliceous-calcareous skeletons called sclerosponges or coralline sponges (*1–4*) renewed an old discussion (*5*) on the possible poriferan affinities of such enigmatic marine fossils as chaetetids, stromatoporoids, and favositids. New observations stimulated by these discoveries have provided conclusive evidence for the sclerosponge nature of some Paleozoic (*6*) and Mesozoic (*7*) chaetetids. The poriferan origin of stromatoporoids and favositids is still a matter of considerable controversy. Stromatoporoids in a broad sense are apparently a systematic hotchpotch representing such distant groups as cyanobacteria (*8*), sponges (*9*), and coelenterates (*10*). For the favositids, however, poriferan (*11*) and zoantharian (*12*) models have been discussed, but for neither model is there satisfactorily conclusive evidence.

The finding of distinct spicules within the skeletal elements of a Devonian specimen (*13*) of *Thamnopora reticulata* (de Blainville) directly supports suggestions of the poriferan nature of some favositids. The specimen comes from Middle Devonian silty marls correlating to lithological complex XVII of the Skalska Series exposed by trenching near Skały village in the eastern part of the Holy Cross Mountains, Poland (*14*). At this locality *Th. reticulata* is associated with abundant solitary and colonial rugose corals and trilobites of Givetian age. An inner shelf environment is envisaged, characterized by a higher influx of terrigenous material.

The internal morphology of the *Th. reticulata* specimen (Fig. 1, A and B) is similar to other thamnoporids. The branchlike calcitic skeleton consists of upwardly radiating tubes, subangular to subcircular in cross section, connected with rare tunnel-like mural pores. Poorly developed septal spines project into the lumen of some tubes partitioned occasionally by tabulae. The lumen of the tubes and the thickness of tube walls (smaller in the branch center), increase considerably near the branch surface. Tube openings are situated normal to the surface; their outermost parts are obscured. The outer interskeletal spaces are filled with porous, weakly translucent, reddish, iron-rich marly sediment; the inner interskeletal spaces are occupied by sparry calcite. A similar pattern of skeletal organization characterizes other arborescent and massive favositids (*15*); the main differences being the variability of the tube shape and diameter, the number and arrangement of tabulae and mural pores, and the presence or absence of septal spines and ridges (squamulae).

Traces of pseudomorphosed (calcified) primary siliceous spicules (Fig. 1C) occur in a few places of the calcareous skeleton and are limited to its outermost zone, close to the contact with the surrounding reddish sediment. The intramural location of the spicules leaves no doubt as to their primary association with the walls of the tubes. Although examination of spicules in thin section makes a precise determination of their shape difficult, they can easily be identified as irregular megascleres generally called desmas, characteristic for assigning modern and fossil siliceous sponges to the order Lithistida (class Demospongiae) (*16*). Two types of megascleres have been recognized: (i) smooth, tetractine-like desmas with forked rays and an average thickness of 12 to 13 μm and maximum length of about 250 μm and (ii) monaxon-like desmas, 5 to 20 μm thick and more than 100 μm long, with slightly curved main axis, irregular swellings, and indistinct lateral offshoots. Compared with spicules known in the lithistids, the former correspond with tetraclone and the latter with megaclone or rhizoclone types of megascleres. The spicules are arranged into a loose irregular meshwork representing a preservational relict of a probably much denser primary spicular lattice. They are built of microgranular low-magnesian calcite (microspar) slightly lighter in transmitted light than the surrounding, similarily granular and mineralogically identical skeletal substance. Irregular spots of pyrite grains are visible both within the spicules and the calcareous background. The distinct appearance of the spicules on the granular calcareous background is due to their higher transparency and thin micritic linings on their external borders, distinctly darker in transmitted light than the spicule interiors and the surrounding skeletal material.

Favositids are common and well-known Paleozoic fossils (*15*) occurring in various shallow-water marine sediments ranging from pure carbonate offshore biogenic mounds to highly terrigenous carbonate onshore banks (*17*). The rarity of spicules in favositids may be a diagenetic and preservational phenomenon. The preservation of spicules in the specimen of *Th. reticulata* described here is probably the result of prolonged selective action of epigenetic leaching processes such as saturation of soil surrounding the thamnoporid skeleton with acidic meteoric water that easily penetrated the porous, iron, organic-rich, terrigenous sediment entombing the specimen. The karstic solution corroded and penetrated the peripheral zone of the calcareous skeleton that enclosed the calcitic pseudomorphs of the primary siliceous spicules, which were dissolved and replaced by calcium carbonate during early diagenesis.

A similar process has been recorded in modern sclerosponges in which relatively fast dissolution of the siliceous spicules and their subsequent replacement by carbonate minerals is a common phenomenon (*1, 2*). Calcite, pyrite, or even secondary silica may replace primary siliceous (opaline) spicules and the possible mechanism responsible for such a replacement has been described in various fossil sclerosponges (*6, 7*). The corroding solution that etched the specimen of *Th. reticulata* exposed the primary mineralogical and microstructural inconsistencies between the calcareous skeleton and the early diagenetically calcified siliceous spicules, which are masked in typically preserved favositids by a uniform recrystallization of the whole skeleton, giving them a micrograular or fibrous appearance (*18*). A selective response to leaching processes of the otherwise homogenous-looking skeletal microstructure in this specimen is indirect evidence for the primary siliceous character of the spicules. Had they been originally calcareous, their disclosure through corrosion phenomena would not be evident.

The limitation of desma-like spicules to modern and fossil lithistid demosponges and the lack of calcareous counterparts in any known group of calcareous sponges (*16*) is another strong argument for the primary siliceous nature of the spicules in *Thamnopora*. Some superficial similarity of spicules in *Thamnopora* to sclerites occurring in some Octocorallia can also be refuted. The latter are loosely distributed within the coral soft parts, usually at the base of tentacles and in the body wall between the septa, and they never form a rigid skeletal structure (*19*).

As mentioned, the presence of desma-like spicules in favositids relates them with lithistids, a polyphyletic group of the class Demospongiae known from the late Cambrian onward (*16*). Conversely, the mixed siliceous-calcareous skeleton links favositids directly with the recently designated class Sclerospongiae (*2*), a group of curious modern sponges that secrete a compound skeleton of siliceous spicules, spongin, and calcium carbonate. The spicule types occurring in these poriferans suggest a close relation to various groups of demosponges, and the recognition of the Sclerospongiae as a class has been questioned (*20*). It has been proposed to consider sclerosponges as a subclass of the Demospongiae, grouping demosponges that supplement their spicular siliceous skeleton with bas-

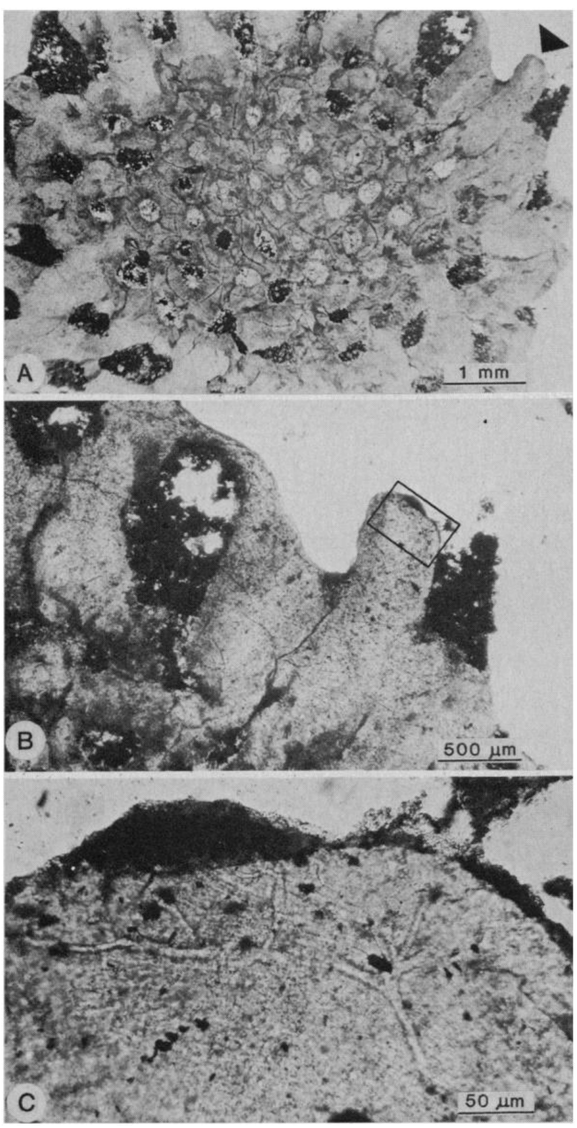

Fig. 1. Spiculated favositid *Thamnopora reticulata* from the Middle Devonian of the Holy Cross Mountains, Poland. Transmitted light photomicrographs of the thin section ZPAL T.XV/1. (A) The internal morphology of a skeletal branch in transverse section; (B) enlarged fragment of the same section (arrowed in A) showing the corroded skeletal surface and the site (quadrangle) enclosing traces of spicules; (C) highly magnified area from (B) with distinct calcitic pseudomorphs of desma-like siliceous spicules entrapped in the calcareous skeletal substance.

ally secreted calcium carbonate. Favositids can be recognized therefore as an order of Demospongiae. They originated in the early Phanerozoic, probably from a lithistid stock of demosponges. This presumably happened during the Ordovician when some lithistid invaded trophically attractive but calcium oversaturated areas of the epicontinental seas (*21*). In response to high calcium stress they developed calicoblasts within the pinacoderm, thus neutralizing the toxic calcium excess by secreting it as calcium carbonate. Such a suggestion seems to be supported by observations (*22*) made on the recent sclerosponge *Merlia normani* Kirkpatrick, which secretes a calcareous skeleton that may be absent in specimens growing in presumably less calcium saturated waters. In that respect sclerosponges appear to be interesting model organisms in studies on calcareous biomineralization and on the origin of calcareous hard parts in general (*23*).

The adaptive evolutionary trend to secrete a basal calcareous skeleton was repeated several times in geological history by various groups of demosponges producing highly homeomorphic calcareous structures that differ strongly in spicule character (for example, among massive sclerosponges: *Acanthochaetetes, Tabulospongia, Favosites* s.l., *Merlia*, and *Chaetetopsis*; among arborescent sclerosponges: *Thamnopora* and *Neuropora*). Reversed trends resulting in sclerosponge taxa with almost identical spicule character but differing significantly in the morphology of the calcareous skeleton are also known (for example, *Hispidopetra, Boswellia, Chaetetopsis*). Both phenomena make the taxonomic treatment of fossil sclerosponges in which spicules are only exceptionally preserved extremely difficult. This may account for the enormously complicated taxonomy of favositids, consisting of hundreds of poorly defined species and genera. The discovery of further spiculated favositids will help in establishing a sound classification and phylogeny of the group.

The discovery of spicules in the favositids does not imply that other, less abundant groups of Tabulata are sclerosponges. Nevertheless, reexamination of such tabulate "corals" as halysitids, syringoporids, and several related groups may throw new light on their affinities, particularly if collected from strongly leached horizons.

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17 October 1983; 17 May 1984

Direct Demonstration of Impaired Functionality of a Purified Desensitized β-Adrenergic Receptor in a Reconstituted System

Abstract. *Long-term exposure of various cell types to β-adrenergic agonists such as isoproterenol leads to an attenuated responsiveness ("desensitization") of the adenylate cyclase system to further challenge with these agonists. The turkey erythrocyte model system was used earlier to show that a covalent modification of the receptor (phosphorylation) is associated with this process. The functionality of the "desensitized" β-adrenergic receptor was assessed by implanting purified β-adrenergic receptor preparations from control and desensitized turkey erythrocytes into phospholipid mixtures and then fusing them with receptor-deficient cells (*Xenopus laevis *erythrocytes). Desensitized β-adrenergic receptors showed a 40 to 50 percent reduction in their ability to couple to the heterologous adenylate cyclase system, comparable to the reduction in their functionality observed in their original membrane environment. These results demonstrate the utility of recently developed receptor reconstitution techniques for assessing the functionality of purified receptors and show a direct link between a covalent modification of a membrane-bound receptor and its impaired functionality in a reconstituted system.*

A general property of many eukaryotic cells is an adaptive process whereby the cell becomes progressively less responsive to a hormone or drug with time. Such processes have been variably referred to as "desensitization," "tolerance," or "tachyphylaxis" and have been reported to occur in systems in which the biological responses are mediated by adenosine 3′,5′-monophosphate (cyclic AMP) (*1*), as well as in those in which the hormonal responses are independent of this cyclic nucleotide (*2*). Among the hormone-responsive adenylate cyclase systems, the most widely studied example has been the adenylate cyclase-coupled β-adrenergic receptor, which mediates the stimulatory effects of catecholamines on physiological functions in heart, smooth muscle, and other tissues (*3*). This system consists of at least three components: the β-adrenergic receptor–binding protein, which binds hormones and triggers the biological response; the nucleotide regulatory protein (N or G/F), which binds guanine nucleotides; and the catalytic moiety of the adenylate cyclase, to which the guanine nucleotide protein binds, thereby coupling the agonist-receptor complex to the effector molecules (*4*).

Although the detailed mechanisms of hormone-promoted desensitization remain to be unraveled, in the β-adrenergic