

Plumatella nitens, a new species of freshwater bryozoan from North America (Ectoprocta: Phylactolaemata), previously misidentified

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Abstract

Plumatella nitens is a newly recognized species of phylactolaemate bryozoan in North America. It has previously been combined with either *P. repens* or *P. fungosa*, from which it differs primarily by the floatoblast. In *P. nitens* the ventral floatoblast annulus is uniformly narrow with no significant widening at the poles. The dorsal floatoblast fenestra is conspicuously larger than in either *P. repens* or *P. fungosa*. Reticulated ridges on the dorsal fenestra are weak along the margins, becoming unusually prominent in the center. The sessoblast is densely covered with uneven papillae. Spotty sampling so far shows a distribution only in the northern half of North America, including Massachusetts, Michigan, Minnesota, Wisconsin, Ontario, and the northern regions of Illinois, Indiana, and Ohio.

Introduction

The number of reported species of phylactolaemate bryozoans in North America currently totals twenty (Wood, 1991). Recent additions to the list include *Plumatella reticulata* Wood 1988 and *Plumatella recluse* Smith 1992. Both are identified mainly by the morphology of their statoblasts, which are the sclerotized dormant buds formed by all phylactolaemate bryozoans. This paper describes a new *Plumatella* species, *P. nitens*, identified by a distinctive floatoblast and glassy ectocyst.

In recent years there has been a change in the characters used to identify species of freshwater bryozoans. For *Plumatella* species, early workers concentrated largely on colony morphology: whether the colony was compact or repent, branches free or attached, zooids fused or separated, and so forth. The laboratory rearing studies of Toriumi (e.g. 1971) showed many of these features to be easily influenced by environmental conditions and therefore unreliable as species characters.

In general, many species of phylactolaemate bryozoans are distinctive enough to be easily identified at a glance. Significant features include overall colony growth form (such as tubular or globular) and the

shape and size of the statoblasts. However, among the Plumatellidae positive species identification is often impossible without statoblasts. Especially difficult is the cluster of species resembling *Plumatella repens*, including *P. fungosa*, *P. coralloides*, *P. orbisperma*, *P. javanica*, *P. philippinensis*, *P. recluse*, *P. vaihiriae*, *P. vorstmani*, and possibly the species of *Stolella*. All are composed of branching tubules with a relatively clear body wall, reduced keel, similar statoblasts, and variable colony morphology. True genetic differences among several of these species have been demonstrated by enzyme electrophoresis (Mundy & Thorpe, 1979, 1980), but the technique is not refined to the point of identifying unknown species.

Instead, attention has recently focused on the surface morphology of statoblasts for taxonomically significant features. The hard outer statoblast shell is adorned with a variety of tiny bumps, pits, ridges, grooves, and other features. Evidence so far indicates a high consistency of this microstructure within certain *Plumatella* species (Reynolds, 1995). Floating statoblasts (floatoblasts) have a peripheral ring (annulus) of gas-filled cells, which is generally widest on the dorsal, or cystigenic side. The annulus surrounds a clear, central region, known as a fenestra. A suture around

the statoblast periphery marks the joint between the two valves, which separate upon germination.

This paper describes a new species originally classified as *Plumatella repens* or *P. fungosa*, but with consistent features that set it clearly apart from all other described species.

Materials and methods

Colonies in Illinois, Indiana, Ohio, Michigan, and Wisconsin were collected in shallow water along with a thin layer of substrate on which they were growing. The colonies were narcotized with menthol, fixed in 10% formalin, and stored in 70% ethanol with 3% glycerol. For laboratory rearing studies, living statoblasts were stored in water for at least six weeks at 4°C., then brought to 23°C where they germinated within one week. Colonies were reared for eight weeks using methods described by Wood (1989). I also examined preserved specimens from collections in Massachusetts, Michigan, and Minnesota.

I measured all statoblasts with an electronic video digitizer (Fink, 1987), using CODA software by Julian Humphries. Statoblast measurements from 17 sites were combined for statistical analysis by ANOVA (parametric), with confidence limits calculated at 95%.

For examining individual valves, I immersed floatoblasts for one minute in a hot, saturated KOH solution, then mounted them in distilled water and teased apart the valves with needles.

For electron microscopy statoblasts were dehydrated in an ethanol series, dried in Peldri II[®] (Ted Pella, Inc.), sputter coated in palladium alloy, and examined with a Philips 500 scanning electron microscope.

Description

PLUMATELLA NITENS, new species

Plumatella repens (Bushnell, 1965)

Plumatella repens (Wood, 1989)

Plumatella fungosa (Smith, 1989)

Plumatella fungosa (in part, Wood, 1991)

The colony is tubular and branching, widely repent on unrestricted surfaces, becoming crowded and compact with contiguous recumbent or upright zooids. The zooids are capable of fusing into a stiffly solid mass. Rope-like strands of fused zooids may extend freely into the water for several centimeters. The young ecto-

cyst is soft, transparent, and undistinctive; becoming relatively stiff, smooth, and shiny; sometimes slightly reddish or amber in color. A keel is usually absent, or else only barely discernible. The rare colonies with a light frosting of particles on the ectocyst display a ragged, transparent, V-shaped region around the zooid tip, with the point of the V drawn out as a transparent band, or furrow, along the zoecial tube. Internally narrowed regions often appear abruptly at intervals along the tubular zoecia; some of these are further constricted by small, incomplete septa. In most specimens such septa are rare or absent, although in laboratory reared colonies they occur between most zooids. The number of tentacles ranges from 38 to 51, with a mean of 42 (53 counts).

Overall the floatoblast is broadly oval to nearly round, and the annulus relatively narrow on both valves. The dorsal fenestra is large and truncated at the poles by annular encroachment (Figures 1a and 1c). This contrasts sharply with floatoblasts of *Plumatella repens* (Figure 1b) or *P. fungosa*, in which the dorsal fenestra is relatively small and the annulus is distinctly wider at the poles. Tubercles at the fenestra margin in *P. nitens* become flatter towards the center, often disappearing entirely (Figures 1c and 1d). Reticulation is faint at the fenestra margin, becoming increasingly elevated and prominent at the center (Figures 1c and 1d). Polar grooves in the annulus at either end of the fenestra are deep and conspicuous, their length varying between 0.2 and 0.3 times the floatoblast width (Figures 1c and 1d). The floatoblast dorsal annulus has tubercles present only on the inner margin where the annulus folds over to meet the fenestra; distal to this margin the tubercles become abruptly lower, blending into the smooth, slightly lumpy surface of the annulus (Figure 1f). An extremely faint dorsal reticulation is sometimes seen in scanning micrographs. On the floatoblast ventral fenestra high tubercles at the margin become lower toward the center, but seldom disappear entirely; reticulation is generally uniform throughout, the enclosed areas becoming smaller towards the center. There is usually a raised point at the center of the fenestra. The floatoblast ventral fenestra is narrow and nearly uniform in width, but otherwise much like the dorsal annulus. A continuous cord marks the suture between the valves, and short lateral ribs appear at close intervals with either an opposite or alternate arrangement (Figure 1f). The sessoblast frontal valve is densely covered with tall, rounded papillae of varying height; the lamella bears the raised, reticulated lines

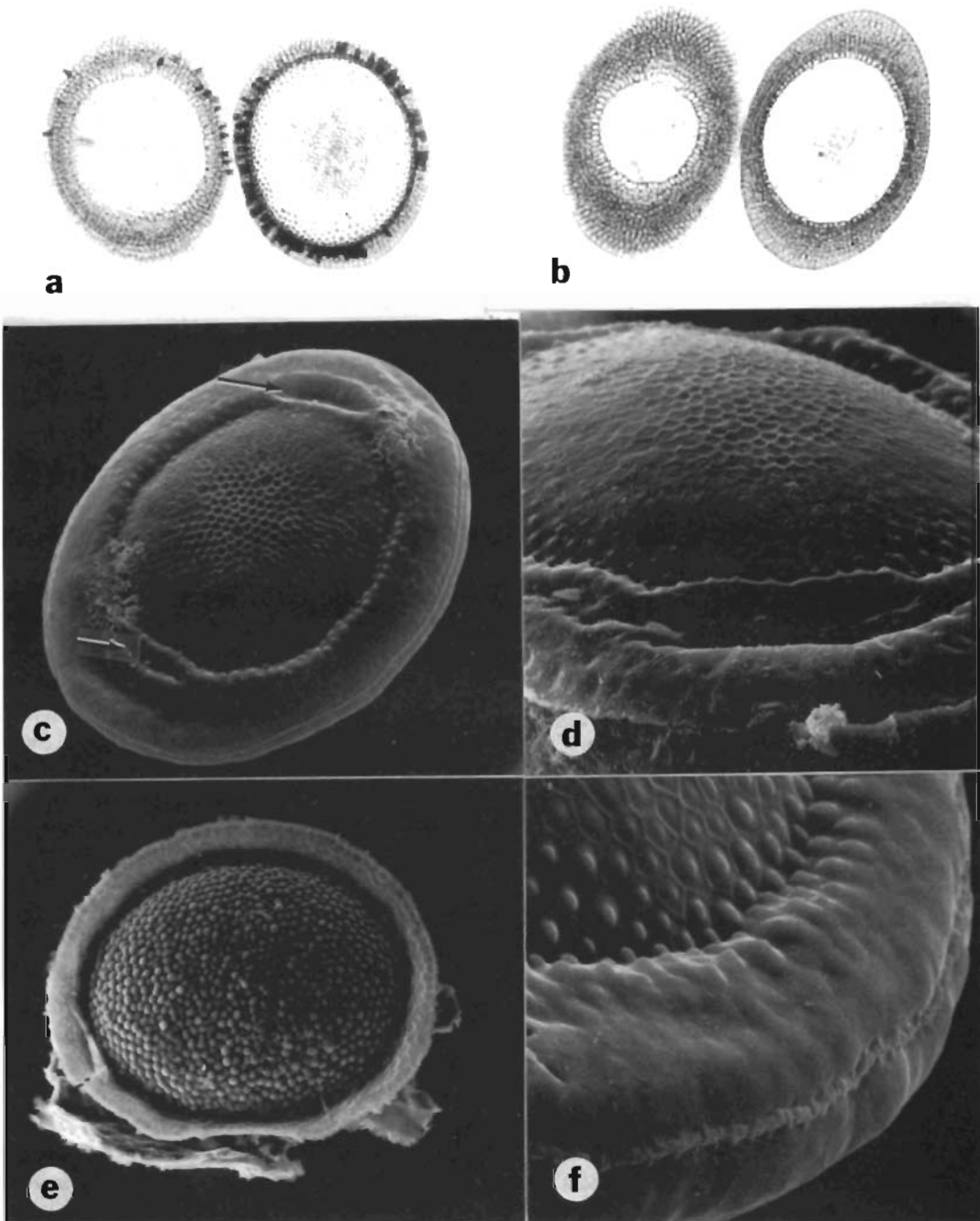


Figure 1. Statoblast details. (a) Separated valves of *P. nitens* from Shabbona Lake showing the large dorsal fenestra (left) and the uniform ventral annular width (right), $\times 100$; (b) Separated valves of *Plumatella repens* from Lake Wildwood Haven, Fulton County, IL, showing the relatively small dorsal fenestra (left) and a distinct widening of the polar annulus on both valves, $100 \times$; (c) SEM micrograph showing dorsal side of *P. nitens* floatoblasts from the Hoosic River, Massachusetts, with deep polar grooves (arrows) and the characteristic central reticulation, $230 \times$; (d) SEM micrograph of *P. nitens* floatoblast from Shabbona Lake, showing an oblique view of the dorsal surface, $460 \times$; (e) Sessoblast of *P. nitens* from Shabbona Lake, $120 \times$; (f) Floatoblast of *P. nitens* from Shabbona Lake showing the suture zone between valves marked by a raised cord and an opposite arrangement of lateral ribs, $1250 \times$.

typical of the genus (Figure 1e).

Type Material: The holotype was collected June 30, 1990 at Shabbona Lake, DeKalb County, Illinois; latitude 41° 44' 19"N, longitude 88° 51' 9"W, deposited at the National Museum of Natural History (Smithsonian), in Washington, D.C., USNM No. 16061. A paratype from the same collection is deposited at the Illinois Natural History Survey, Springfield, Illinois.

Etymology. The name *nitens* is the present participle of the Latin verb meaning 'to shine', in reference to the glassy ectocyst.

Dimensions: Critical statoblast measurements are given in Table 1. For comparison, corresponding measurements for *Plumatella repens* appear in Table 2.

Distribution. *Plumatella nitens* is currently known in North America from Massachusetts west into Illinois and Minnesota, and north as far as Georgian Bay and the upper peninsula of Michigan (Figure 2). All but two of the known occurrences are above the 41st north parallel.

Specimens. We have examined material from the following locations: In ILLINOIS – Cook Co., Maple Lake; DeKalb Co., Shabbona Lake; Kankakee Co., Bird Park Quarry; Lake Co., Deep Lake; Stephenson Co., Lake Le-Aqua-Na; Will Co., Lake Renwick (all collected by T. Marsh and T. Wood). In INDIANA – Noble Co., Bear Lake and Crooked Lake (all collected by T. Wood). In OHIO – Columbiana Co., Highlandtown Wildlife Ponds; Defiance Co., Oxbow Lake; Lake Co., Holden Arboretum Blueberry Pond; Montgomery Co., Unnamed pond at Harshman Road and Brandt Pike; Ottawa Co.; Lake Erie (Lost Ballast and Starve Islands) (all collected by T. Wood). In MICHIGAN – Alger Co., Kingston Lake (coll. T. W. Porter); Barry Co., Crooked Lake (coll. T. Marsh and T. Wood); Chippewa Co., Bass Lake; Isabelle Co., Hall Lake; Kalamazoo Co., Gull Lake; Livingston Co., Indian Lake (all coll. by J. Bushnell). In MASSACHUSETTS – Berkshire Co., Hoosic River below Cheshire Reservoir (collected by D. Smith). In MINNESOTA – Carver Co., Lake Waconia (collected by G. Proulx). In WISCONSIN – Gogebic Co., Paul Lake (collected by L. Wood).

Habitat. *Plumatella nitens* occurs exclusively in lentic habitats where it grows mostly on old wood and veg-

etation. The Massachusetts specimens were on old concrete. Living colonies with statoblasts have been found from June through early October. At the time of collections in Illinois the water temperatures were 24 °–28.5 °C, the pH was 7.9 to 8.6, and the conductivity ranged from 240 to 680 mhos. *Fredericella indica* occurred with *P. nitens* at seven out of sixteen sites in Illinois and Ohio, which is more than twice as often as any other bryozoan species. Other bryozoan species seen to occur in the same lake as *P. nitens* include *Cristatella mucedo*, *Fredericella australiensis*, *Lophopodella carteri*, *Pectinatella magnifica*, *Plumatella casmiana*, *P. emarginata*, *P. fruticosa*, *P. fungosa*, *P. orbisperma*, *P. repens*, *P. reticulata*, and *Pottsiella erecta*. At four sites in Illinois *P. nitens* was the only bryozoan species found.

Discussion

It is tempting to dismiss the *P. nitens* floatoblast as an environmentally induced phenotype of *P. repens*. When Toriumi (1970) reared *P. repens* at low temperatures the colonies produced floatoblasts similar in proportions to those of *P. nitens*. The absence of *P. nitens* in more southerly (and warmer) states would be consistent with this idea. However, in Ohio and Illinois our collection dates ranged from June through September with no change in floatoblast morphology. We also reared both *P. repens* and *P. nitens* in the laboratory in the same container, presumably under identical conditions. In each case the second generation of floatoblasts matched the first, both in critical dimensions and in surface ultrastructure. Thus the morphological evidence for two distinct species is fairly strong.

Were it not for its characteristic floatoblast, *P. nitens* would be hard to distinguish from *P. repens* or *P. fungosa*. In all three species the colonies have mostly hyaline, tubular zooecia. Septa may be frequent or entirely absent. The arrangement of zooids ranges from widely open to densely compact. There is little or no keel or furrow. All three species produce large quantities of floatoblasts, and their sessoblasts are very similar.

These similarities explain how *Plumatella nitens* could have been so often observed by others but not recognized as a different species. In my 1989 monograph of Ohio bryozoans, I failed to interpret the features of *P. nitens* as distinct from those of *P. repens*. Bushnell (1965) described *P. nitens* as *Plumatella repens* and provided excellent photos of floatoblasts and a septum. It is likely that the natural popula-

Table 1. Critical measurements of *Plumatella nitens* floatoblasts from thirteen sites in Illinois, Indiana, and Ohio. Dimensions are expressed in micrometers.

Floato measurements	Maximum	Minimum	Mean	Number of measurements
Overall length	382	272	327 ± 4	152
Overall width	307	207	256 ± 4	152
Overall length/width	1.53	1.06	1.28 ± 0.02	152
Dorsal fenestra length	232	145	193 ± 5	82
Dorsal fenestra width	224	138	179 ± 4	82
Dorsal fenestra length/width	1.41	0.91	1.08 ± 0.02	82
Ventral fenestra length	307	202	255 ± 5	70
Ventral fenestra width	237	160	206 ± 4	70
Ventral fenestra length/width	1.42	1.11	1.24 ± 2	70

Table 2. Critical measurements of *Plumatella repens* floatoblasts from eighteen sites in Illinois. Dimensions are expressed in micrometers.

Floato measurements	Maximum	Minimum	Mean	Number of measurements
Overall length	418	290	339 ± 3	430
Overall width	275	185	231 ± 2	430
Overall length/width	1.78	1.25	1.47 ± 0.01	430
Dorsal fenestra length	221	107	157 ± 4	245
Dorsal fenestra width	181	99	141 ± 3	245
Dorsal fenestra length/width	1.57	0.84	1.11 ± 0.01	245
Ventral fenestra length	284	170	223 ± 3	218
Ventral fenestra width	274	134	178 ± 2	218
Ventral fenestra length/width	1.55	0.91	1.26 ± 0.01	218

tion detailed by Bushnell (1966) was also *Plumatella nitens*, not *P. repens*. In a collection of Michigan bryozoans at Michigan State University, six of the six specimens labelled '*Plumatella repens*' had all the features of *P. nitens*. I have not yet seen specimens of what I would consider *Plumatella repens* from Michigan. In Massachusetts a specimen of *P. nitens* was identified by Douglas Smith as *P. fungosa* based on the strong mutual adherence of the zooids. However, the floatoblast leaves no question that this is *P. nitens* (Figure 1d).

So far there is no evidence of *P. nitens* outside North America. From the British Museum (Natural History) we have examined British specimens of *Plumatella repens* (Nos. 1937.8.9.19, 1908.3.26.6, 1909.7.25.8) *P. fungosa*, (Nos. 1911.12.17.1, 1917.1.1.2, 1971.2.16.1) and *P. coralloides* (Nos. 1934.4.6.1, 1917.1.1.17, 1971.2.16.2) without finding any floatoblast resemblance to *P. nitens*. The scanning electron micrographs of European *Plumatella* floatoblasts (Mundy, 1980; Geimer & Massard, 1986; Franz, 1992)

also lack the surface microstructure characteristic of *P. nitens*. Similarly, the drawings of Kraepelin (1887) and Jullien (1885) illustrate floatoblasts that are relatively more oval and with wider polar annulus than occurs in *P. nitens*. On the other hand, Allman (1856) illustrates in Plate 5, Figure 7a stylized floatoblast of '*Plumatella repens*' with an annulus of uniform width exactly as it might occur in *P. nitens*. Allman reviews the confusing synonymy associated with *P. repens* but does not describe the floatoblast in any detail. Unfortunately, our attempts to locate Allman's bryozoan specimens have been so far unsuccessful, and the collection may no longer exist.

Plumatella nitens brings to three the number of *Plumatella* species known to form colonies in which the zooids sometimes fuse together. The other two species, *P. casmiana* and *P. fungosa*, both occur within part of the North American range of *P. nitens*. However, in *P. casmiana* the uniquely short branches and distinctive statoblasts make this unlikely to be mistaken for

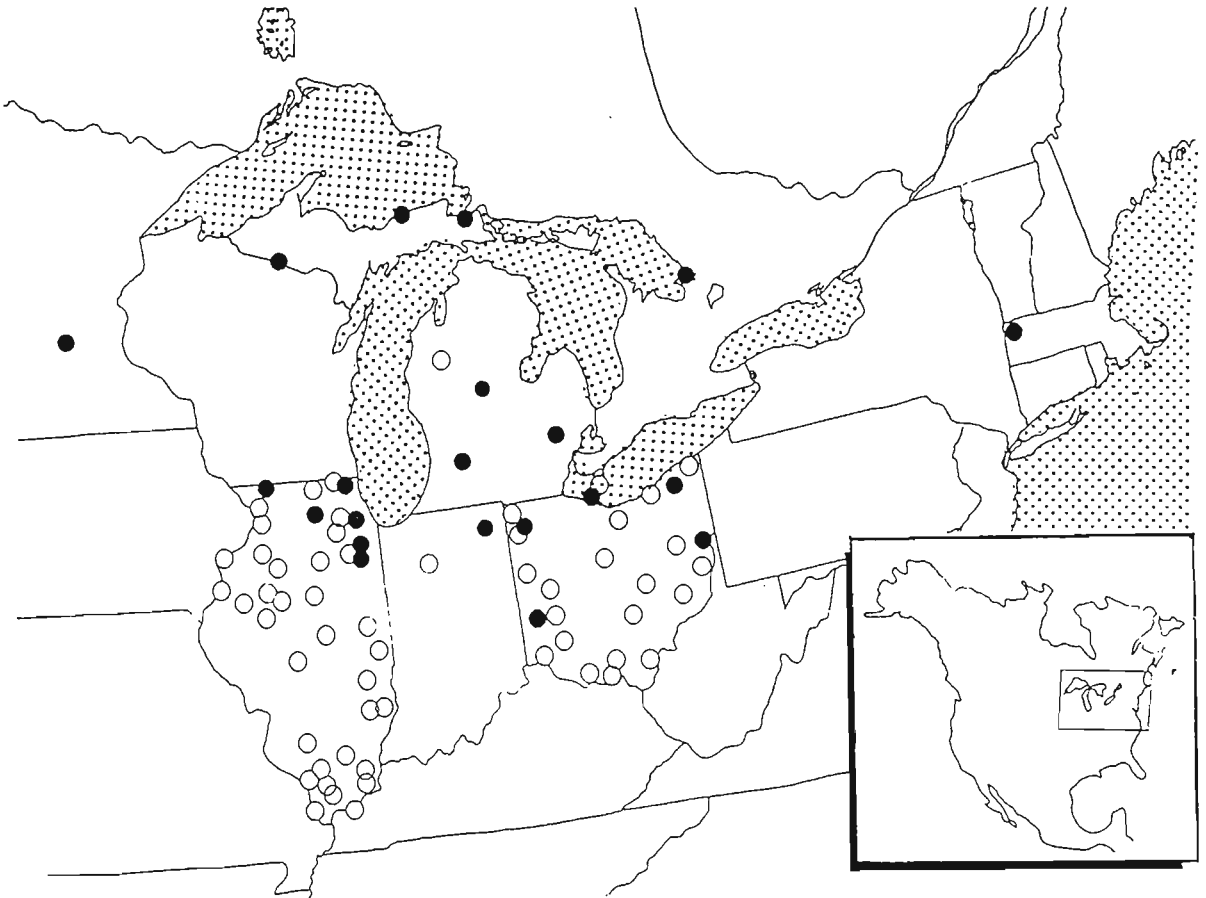


Figure 2. Map showing the known distribution of *Plumatella nitens* in North America. Closed circles indicate sites where the species has been documented; open circles indicate known collection sites at which the species was not found.

any other species (Wood, 1989). Floatoblasts of *P. fungosa* resemble those of *P. repens* (Figure 1b) but they are distinctly asymmetrical in lateral view, with one valve strongly convex and the other nearly flat; and both the annulus and fenestra bear a reticulated surface pattern as seen with scanning electron microscopy (Wood, 1989; Geimer & Massard, 1986, 1987).

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