areas studied the spiders are extremely patchy in their distribution. Often one finds only one colony within several km^2. Sometimes a tree or a few neighboring trees may carry 10–50 colonies, but the next patch of colonies is normally many km away. While it is obvious that neighboring trees become colonized by spiders walking over silk bridges [6], the inter-patch distances are far beyond the spiders' walking range. From the colonies' pattern of distribution one would predict a method of dissemination paralleling that of plant seeds; i.e. the spiders should be carried off either by other organisms (phoresia), or by the wind.

During field work in November 1984 near Hluhluwe, Natal, we observed two *S. mimosarum* colonies, situated 2.50 m above ground in an isolated, 4-m-tall *Acacia* tree. At that time of the year most individuals are sexually mature, adult males as well as egg cocoons are found. On November 22, a number of conspicuous silk threads were seen leading from one colony nest to various branches and up to the very top of the tree. Two silvery threads, about 1-m-long, projected in a whiplike fashion from the uppermost branch, slowly moving with the air. Such threads are typically spun by spiders about to travel by air [7]. At 12:15 p.m. (shadow-temperature 29 °C) a single female *Stegodyphus* sailed slowly over the grassland, driven by a barely perceptible breeze. It was about 2 m above ground, hanging upside down under 3–4 silk threads, 60–80 cm long, one of them forming a closed loop. These threads carried no cribellar silk. We caught the female 18 m away from the colony tree. It was a fully grown female with a 10 mm total body length. Females of this size weigh between 85 and 150 mg (the largest females found were 12 mm long). This female was kept isolated; it laid eggs 2 weeks later in the laboratory and then died. It had not spun a dense cocoon [5], and the eggs were found dried up.

In captivity we have seen adult male and female *S. mimosarum* in "tip-toe" stance on exposed branches, spinning long threads, as if preparing for an aerial excursion [7]; but we have not yet seen a male flying.

There are two earlier records of ballooning *Stegodyphus*. Both concern the South Indian species *S. sarasinorum* Karsch and refer to young, immature spiders. According to [8] "the young ones may sometimes be detected while on their aerial voyages to near or distant places as the wind permits". Jacson and Joseph [9] witnessed immatures of the fourth to eight instar climbing to the tip of tree branches, lifting the abdomen and spinning a thread until being carried off by the wind; "in some cases a number of spiderlings may be parachuted by one gossamer". Jambunathan added that accidentally an adult female, "while in the act of web-building, may be carried away by the wind" [8]. The female we observed had, however, prepared a typical air-travel device to get blown away with the wind.

Thus, aerial travelling does occur in two species of eresid spiders, being highly social spiders. It is a means of dispersal preceded by "tree-topping" and gossamer spinning behavior, seen in immature spiderlings as well as mature females. Ballooning of adults had not been recorded for a social spider, nor for a member of the Eresidae up to now.

Aerial dispersal of groups of spiderlings on one gossamer may lead to foundation of a new colony. Aerial dispersal of single females of a social spider would make sense if such females were founders of new colonies and, therefore, were fertilized prior to taking off. That singles were blown together in a kind of air rally to form a new colony is very unlikely. Earlier observations have shown that single emigrant female *S. mimosarum* can set up new colonies by their offspring [5]. Genetically this should lead to founder effects and increased inbreeding, i.e. to marked genetic differences between local populations or even to incipient subspeciation. This is presently being tested by allozyme protein electrophoresis.

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A Compound Replacing a Natural Pheromone Component of the Spruce Bark Beetle

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In this communication we provide first evidence that the natural pheromone component 2-methyl-3-buten-2-ol of the spruce bark beetle *Ips typographus* (L.) can be efficiently replaced by another compound, 2-methyl-3-butyn-2-ol.

I. typographus is one of the most harm-

ful insect pests of Norway spruce throughout the Palearctic range of this tree species. Like many other bark beetles, it releases a pheromone when boring in the phloem of its host. Two components of the pheromone, (*S*)-cis-verbenol and 2-methyl-3-buten-2-ol, strongly attract flying spruce bark beetles when blended [1, 2], while the single substances are much less attractive. (*S*)-cis-Verbenol is an oxydation product of the host monoterpene α-pinene. No host precursor has been found for 2-methyl-3-buten-2-ol. Laboratory studies have indicated that the production of 2-methyl-3-buten-2-ol is induced by hormones in the beetles [3].
(*S*)-cis-Verbenol and other compounds released by *I. typographus* such as trans-verbenol and ipsdienol, are also found in other bark beetle species. The only bark beetle species, in which 2-methyl-3-buten-2-ol has been found, are *I. typographus* and *I. (Orthotomicus) erosus* (Wollaston) [4]. A similar compound, 3-methyl-3-buten-1-ol, has been identified in *I. cembrae* (Heer) [5]. Such beetle-produced behavioral chemicals cannot usually be replaced by structurally related substances. Among ants and termites, however, synthetic analogues to trail pheromones can elicit responses similar to those to the pheromones themselves [6].

Table 1. Catches of *Ips typographus* in drainpipe traps baited with one of three attractive blends; means of 25 replicates

	Commercial lure	2-Methyl-3-butyn-2-ol + (*S*)-cis-verbenol	2-Methyl-3-buten-2-ol + (*S*)-cis-verbenol
Mean	572.9	507.0	543.5
S.D.	224.4	234.1	275.6

The attractivity of three blends was evaluated in Uppland, Sweden, in field experiments using drainpipe traps. Special glass dispensers were prepared with one of two blends: (*S*)-cis-verbenol + 2-methyl-3-buten-2-ol and (*S*)-cis-verbenol + 2-methyl-3-butyn-2-ol. The proportion of (*S*)-cis-verbenol was 5% by weight of the mixture. The release rate in the field was ca. 50 mg of substance per day. The above blends were compared to a standard lure (Celamerck plastic bag dispenser containing 1500 mg of 2-methyl-3-buten-2-ol, 70 mg of (*S*)-cis-verbenol, and 15 mg of racemic ipsdienol).

A total of 40630 spruce bark beetles were caught. The mean catches and the standard deviations for the three treatments were very similar (Table 1). An analysis of variance confirmed that there were no significant differences between treatments.
The volatile substances produced by *I. typographus* have been thoroughly studied by several investigators, and it is unlikely that 2-methyl-3-butyn-2-ol would have been overlooked. Consequently, it cannot be considered as a natural pheromone component. Nevertheless, it can efficiently replace the pheromone component 2-methyl-3-buten-2-ol in blends used to attract *I. typographus*.

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Naturwissenschaften Buchbesprechungen

Sicht und Einsicht. Von H. von Foerster. Wiesbaden: Vieweg 1985. 231 S., DM 78,–.
Das vorliegende Buch bietet eine Sammlung von Aufsätzen, die sich (im Untertitel) als „Versuche zu einer operativen Erkenntnistheorie" versteht. Der Autor stammt aus Wien (er wurde dort 1911 geboren), studierte technische Physik und kam 1949 in die USA, also in dem Jahr, als die Wissenschaft der Kybernetik geboren wurde. Er trug selbst dazu bei und schloß sich einem Kreis von Forschern an, die „Kreiskausal geschlossene und rückgekoppelte Mechanismen in biologischen und sozialen Systemen" untersuchten, wie sie damals Kybernetik definierten. Er konnte in Urbana (Illinois) ein Biological Computer Laboratory einrichten, das bis 1976 bestehen blieb. Es wurde mit der Emeritierung von Foersters geschlossen. Die Arbeiten dieses Laboratoriums konzentrierten sich auf Fragen der Wahrnehmung, des Lernens und des Gedächtnisses. Die Ergebnisse – sie liegen auf insgesamt 14000 Druckseiten vor – sind bis heute noch nicht in ihrer Tragweite ausgeschöpft.
Die Beiträge des vorliegenden Buches entstanden zu verschiedenen Gelegenheiten zwischen den Jahren 1960 und 1976. Sie behandeln (unter anderem) eine „Molekular-Ethologie: ein unbescheidener Versuch semantischer Klärung" und die „Kybernetik einer Erkenntnistheorie". 1973 hielt von Foerster seine heute bereits klassische Vorlesung „On Constructing a Reality" („Über das Konstruieren von Wirklichkeiten"), die in dem vorliegenden Buch neu übersetzt vorliegt. In diesem Beitrag stellt von Foerster die These auf, daß die Umwelt, so wie wir sie wahrnehmen, unsere Erfindung ist. Er arbeitet eindrucksvoll heraus, daß unsere verschiedenen Sinneszellen für die Qualität von Außenreizen an sich blind sind; sie sprechen nur auf Quantität an. Was wir faktisch erleben, machen wir selber: „Auch wenn wir dies überraschend finden, sollte es uns doch nicht verwundern: ‚da draußen' gibt es nämlich in der Tat weder Licht noch Far-

