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Delusory Parasitosis

Nancy C. Hinkle

THE CALLER SAYS THAT SHE IS BEING ATTACKED by invisible mites. The attack has been going on for months and she has visited a half dozen physicians, but none was able to help her. Two prescribed Kwell lotion (see Glossary), but the sensations persist. She has treated her skin with alcohol, vinegar, Lysol, bleach, kerosene, and various home remedies. She has boiled her bed linens and clothing daily. She can describe the life cycle of the pest and has been able to extract specimens from some of the wounds. She offers to send you samples. She says the irritation is driving her crazy and you are her last hope. How do you respond?

At some time nearly everyone experiences a sensation of something burrowing in, crawling on, or pricking the skin (Potter 1992). These tactile perceptions may be caused by a variety of causes, because different stimuli evoke the same limited range of neurocutaneous responses. The conviction that insects are crawling on, biting, or burrowing in the skin, when no arthropod is involved, is termed "delusory parasitosis." The medical profession defines "delusion" as referring to "a fixed belief" unswayed by evidence to the contrary. By comparison, the term "illusion" refers to situations in which the individual perceives stimuli as produced by arthropods but acknowledges other explanations once they are demonstrated. Although there are some problems with terminology, delusory parasitosis is the phrase used most commonly in the literature, so will be perpetuated here.

These cases typically are bewildering to pest control operators, professional entomologists, and medical professionals, who shuffle these sufferers back and forth. Physicians examining the patient determine that the lesions were produced by an insect and recommend calling a pest control company to have the patient's house treated. Conscientious pest control operators perform an inspection and are unable to locate a pest, so refuse to make an insecticide application (St. Aubin 1981).



ALAN KAHAN

Table 1. Common attributes of DP sufferers^a

- A. Most common in older people (Lyell 1983, Webb 1993, Trabert 1995, Goddard 1995, White 1997)
- B. Disproportionately female (St. Aubin 1981, Lyell 1983, Webb 1993, Trabert 1995)
- C. Exhibit behaviors such as:
- (1) quitting their jobs (Monk and Rao 1994, Goddard 1995)
 - (2) burn/destroy furniture (St. Aubin 1981, Lyell 1983, Gieler and Knoll 1990, Goddard 1995)
 - (3) abandon homes (Waldron 1962, Lyell 1983, Driscoll et al. 1993, Goddard 1995)
 - (4) obsessive laundering/dry cleaning (St. Aubin 1981, Lyell 1983) boil clothing and bed linens (Ebeling 1978)
 - (5) use pesticides dangerously/repeatedly (Lyell 1983, Goddard 1995, White 1997); repeated applications of insecticides to body (Monk and Rao 1994); have used Kwell®, Elimite® (Webb 1993)
 - (6) use home remedies (St. Aubin 1981, Lynch 1993):
 - a. gasoline (St. Aubin 1981, Koblenzer 1993, Monk and Rao 1994)
 - b. kerosene (St. Aubin 1981, Lynch 1993)
 - c. other solvents (St. Aubin 1981, Lynch 1993)
 - d. harsh cleaning compounds (St. Aubin 1981, Lyell 1983)
 - (7) mutilate body attempting to remove offending vermin (St. Aubin 1981, Lyell 1983, Zanol et al. 1998)
- D. Provide skin scrapings, bits of debris (in paper, small jars) (Pomerantz 1959, Waldron 1962, Lyell 1983, Goddard 1995) "One characteristic sign in delusory parasitosis is the complainant's eagerness to provide samples of their alleged parasites in small containers" (May and Terpenning 1991). Samples provided in adhesive tape, plastic bags, or vacuum bags (Webb 1993, Koblenzer 1993, White 1997) "there are millions of them"—yet specimen cannot be obtained
- E. Can provide extensive, elaborate, involved descriptions of the pests, their life cycle, and behaviors (Lynch 1993, Monk and Rao 1994, Zanol et al. 1998)
- F. Social isolation (Koblenzer 1993, Trabert 1995), self-employed (Lyell 1983), abandon family to avoid infesting them (Lynch 1993, Monk and Rao 1994)
- G. Emotional trauma such as job loss, divorce/separation (Lyell 1983, Grace and Wood 1987, Webb 1993, Lynch 1993)
- H. Have seen numerous physicians, all to no avail (Driscoll et al. 1993, Lyell 1983)
- I. Mean duration of delusion was 3.0 ± 4.6 years (median, 1 year) (Trabert 1995); "Years of suffering" (Pomerantz 1959, Driscoll et al. 1993), 12-year history (Monk and Rao 1994), 40 years (Poorbaugh 1993)
- J. Complain of "itching, crawling, pinprick biting sensations" (White 1997), "formication" (Koo and Gambla 1996)
- K. Reject possibility of psychological or other explanations (Trabert 1995) "I'm not crazy." "I am not imagining this." Vehemence indicative of DP (Zanol et al. 1998). "Exceptional strength of conviction regarding infestation" (Lynch 1993) almost diagnostic for DP (Webb 1993)
- L. Express desperation, "you are my last hope" (Nutting and Beerman 1983, Lynch 1993)
- M. Delusion eventually shared by another family member (St. Aubin 1981) in up to 1/3 of cases (Koblenzer 1993)

^aCitations are illustrative of some of the published descriptions.

Description of Delusory Parasitosis

Descriptions of delusory parasitosis sufferers are remarkably consistent (Koblenzer 1993) with common attributes (Table 1). The most common symptoms include paresthesia, pruritus, (see Glossary), and a biting sensation (Hinkle 1998).

The classic delusory parasitosis case remains that of J. R. Traver (1951), a zoologist who published her personal account of 17 years of dealing with an "infestation" in her own body; the following descriptions correspond to common delusory parasitosis attributes listed in Table 1. According to Poorbaugh (1993), (A) she was 40 years old at onset of symptoms and suffered with them for another 40 years until her death at age 80. (B) She was female. (C) She used pesticides both danger-

ously and repeatedly, applied home remedies to her body, and mutilated her body by "digging out" mites with fingernails. (D) She collected material from her scalp and body and mailed samples to parasitologists for examination. (E) She provided extensive descriptions of the mites and their behavior. (H) She visited numerous physicians, including a dermatologist, an oculist, a neurologist, as well as the family physician; "little help ... was forthcoming from this source." (I) Duration of the infestation was 17 years at time of publication. (J) Sensations were described as "itching," "crawling, scratching and biting." (K) She was referred for psychological evaluation; "the patient, however, succeeded in convincing the neurologist that she had no need of his services," and she published a 25 page treatise to prove that she was not crazy. (L) "To date, no treatment employed against the mite has been completely effective." (M) The delusion also was shared by two other family members.

Traver's (1951) article provides notable documentation of the effort expended extracting and "identifying" specimens. In addition to the above characteristics common to delusory parasitosis sufferers, Traver described the pests as primarily active at night and identified animals as the likely infestation source, other commonalities (Hinkle 1998). Reflecting the often cited bias of delusory parasitosis cases toward women (Trabert 1995, White 1997), 22 (65%) of the past 34 delusory parasitosis cases I have had were female and 12 (35%) were male. Of these, three pairs involved folie a deux, the phenomenon occurring in up to one-third of cases (Koblenzer 1993), in which close associates experience the same delusion.

Although the prevalence of delusory parasitosis may be considered low by the medical profession (Driscoll et al. 1993), the pest control industry and medical entomologists encounter it all too frequently (Schrut and Waldron 1963, Kushon et

Glossary

- Delusion: a false belief that persists despite the facts.
- Dermatitis: inflammation of the skin.
- Elimite: a permethrin cream used to treat for scabies and lice.
- Erythema: abnormal redness of the skin.
- Formication: the sensation of ants crawling on the skin.
- Idiopathic: of unknown cause.
- Illusion: misinterpretation of perception of something objectively existing.
- Kwell: prescription lindane formulations used in scabies (cream) and lice (shampoo) treatment.
- Paresthesia: a sensation of pricking, tingling, or creeping on the skin.
- Pruritus: itching.
- Scarification: wound or cut marks from scratching.
- Urticaria: stinging or burning itch.

al. 1993). Of the 21 cooperative extension specialists providing estimates of their delusory parasitosis cases, the average number was 17 per year (range, 4-45), occupying 2.4% of these specialists' time (Hinkle 1998).

Many delusory parasitosis sufferers who come to entomologists already have received a prescription for Kwell (lindane) from a physician, implying that scabies had been diagnosed. However, scabies is the default diagnosis for any idiopathic dermatitis or pruritus (Pariser and Pariser 1987). Frequently, the placebo effect of such medications will effect temporary remission of the symptoms, but they almost invariably recur (St. Aubin 1981).

Typically, the cause is not any insect or other arthropod but, instead, is some physical (Blum and Katz 1990, Potter 1992), physiological, or psychological stimulus. Victims attempt to correlate what they see, or think they see, with their physical perceptions. Thus, sufferers intently examine the area experiencing the sensation, digging out blackheads, hair follicles, and other normal skin components to account for the sensation (Lynch 1993). Descriptions by some delusory parasitosis sufferers of their pests are listed in Table 2.

Physical Causes

Physical causes include any external stimulus that yields a sensation of paresthesia, pruritus, urticaria, or similar irritation. Blum and Katz (1990) summarized potential physical causes that could be attributed to delusory parasitosis symptoms. These included static electricity, chemicals such as some pyrethroid insecticides, or mechanical irritants such as fiberglass filaments and paper shards. Volatile chemicals from manufactured building materials such as paneling and carpeting can produce itching and stinging sensations (Jaakkola et al. 1994). There are many non-arthropod agents capable of producing delusory parasitosis symptoms; under these circumstances an industrial hygienist can survey and make recommendations (Potter 1992).

Dry, sensitive skin is particularly susceptible to these sensations. Particles impinging on the skin as a result of static electricity may be perceived as "bites" or "stings." This is particularly true of materials with sharp projections such as paper, metal, and fiberglass fragments. Carpet fibers also may be attracted to lower portions of the body because of static electricity, and these too can feel like pinpricks. Electronic equipment generates an electrostatic charge, so office equipment and computer components can produce sufficient attraction to various materials to be irritating to susceptible individuals.

Most persons experiencing itching will rub or scratch briefly and absentmindedly without consciously noticing the sensation. Others, however, focus on the itch until it occupies all of their attention. Thus, delusory parasitosis sufferers become fixated on the perceived irritation.

Some contactants producing paresthesia are discussed by Fisher (1995) and include solvents, fabrics, and fabric finishes. Two particularly un-

Table 2. DP sufferers' descriptions of what is infesting them

1. Black and white, but change colors (Waldron 1962, St. Aubin 1981, Monk and Rao 1994)
2. Jump or fly (Waldron 1962, Monk and Rao 1994)
3. Have eight little legs and a small sucker (Gieler and Knoll 1990)
4. Half moon shape, like the end of a fingernail (Lyell 1983, Hinkle 1998)
5. Moth-like creatures (Monk and Rao 1994, Hinkle 1998)
6. Waxy looking fuzz balls (Schrut and Waldron 1963, Hinkle 1998)
7. Granules about the size of a grain of salt (Schrut and Waldron 1963, de Leon et al. 1992, Hinkle 1998)
8. Long hairs that move independently (Hinkle 1998)
9. Tiny white worm with a brown bulb on its head (Hinkle 1998)
10. Worm-like coating around the hair root, with a black bulb attached (Hinkle 1998)
11. Greenish-grey cigar shaped things (Hinkle 1998)
12. Infest inanimate objects: automobiles, furniture, clothing, rugs (Grace and Wood 1987)

usual situations are when exposure to either water (aquagenic pruritus) or air (atmokinesis) produces pruritus or paresthesia in susceptible individuals (Bernhard 1989, Bircher 1990).

Demonstration of scarification is indicative only of scratching; it proves nothing about the stimulus causing the scratching (Fig. 1). Self-excoriation is a common feature of delusory parasitosis, despite the individuals' protestations that they do not scratch (Marschall et al. 1991).

Scratching may produce papular eruptions. Any repeated skin irritation produces a friction blister. Repeated rubbing of an area often produces a bleb (small blister) which, when ruptured, yields an open sore that may become infected. Once the sore begins oozing plasma and a scab forms, hairs and cloth fibers become entrapped in the sticky fluid. These flecks are dislodged and called mites or insects because they look like they have "antennae" and "legs" (Fig. 2). Hair follicles often are pulled out; the follicle accompanied by the associated sebaceous gland looks like a worm.

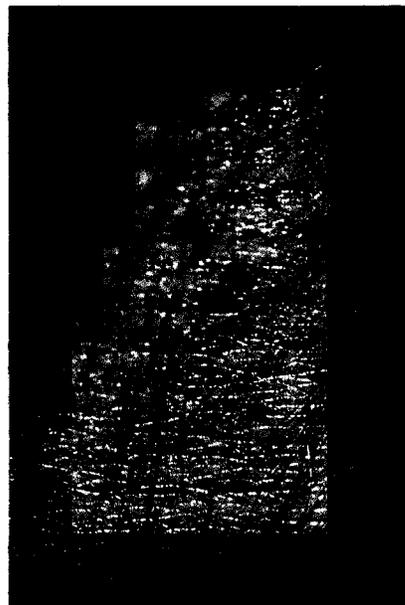


Fig. 1. Scarification indicates scratching but offers no clue as to its cause.

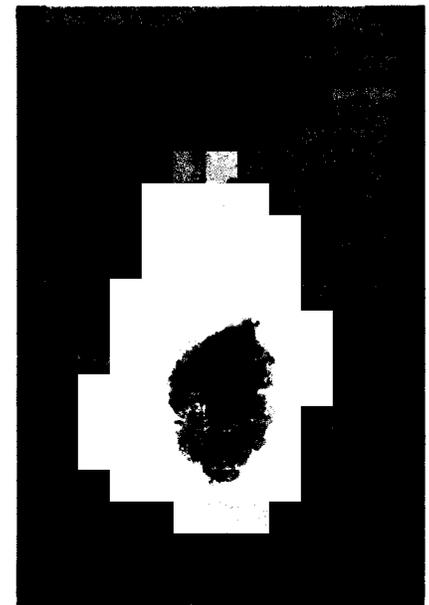


Fig. 2. A scab with entrapped hairs and fibers is said to look like a "bug."

Table 3. Some medical conditions producing delusory parasitosis symptoms

Condition	Symptoms				
	urticaria	erythema	paresthesia	pruritus	rash
AIDS ^a	X	X	X	X	-
anemia ^a	X	X	X	-	X
autoimmune disease ^a	X	-	-	X	-
carbon monoxide ^b	X	-	-	X	-
carcinoma ^a	X	X	X	-	X
cholestasis ^a	X	-	X	X	-
cirrhosis ^a	X	-	X	-	-
depression ^a	-	X	X	-	X
diabetes mellitus ^a	X	X	X	-	X
fluoride poisoning ^c	-	X	-	X	X
heavy metal toxicity ^d	-	X	X	-	X
hemochromatosis ^a	X	-	X	-	-
hepatic disease ^a	X	-	X	-	X
hyperthyroidism ^a	X	X	X	X	X
hypoglycemia ^a	X	X	-	X	X
hypothyroidism ^a	X	-	X	-	X
lupus ^f	X	-	-	X	-
lymphoma ^g	-	-	X	X	X
menopause ^h	-	X	X	-	-
multiple sclerosis ⁱ	-	X	X	-	X
neoplasia ^a	X	-	-	X	X
niacin overdose ⁱ	X	-	X	X	-
rheumatoid arthritis ^k	X	X	-	X	X
stress ^a	-	X	X	X	X
uremia ^a	-	X	X	-	-

^a Phillips 1992.

^b Levit 1995.

^c Arnow et al. 1994.

^d Kazantzis 1978.

^e Sacerdote 1987.

^f Kapadia and Haroon 1996.

^g Blum and Katz 1990.

^h Pansini et al. 1994.

ⁱ Ostermann and Westerberg 1975.

^j Lyell 1983.

^k Scherbenske et al. 1989.

Some people claim they see the "creatures" jump (Waldron 1962). This is probably caused by static electricity or magnetic charges of tiny particles (Ebeling 1978). Some people see dust and other motes floating in a shaft of sunlight and claim they are tiny flying creatures. Even the random motion of particles floating on water is perceived as deliberate movement.

Physiological Causes

Delusory parasitosis may result from physiological causes such as allergies, nutritional deficiencies, drug reactions, and other medical conditions. Allergies can include inhalant allergies, ingestant reactions, and contact dermatitis. Nutritional deficiencies or overdoses may produce both systemic and dermal reactions (Eliason et al. 1997). Drug reactions include responses to single drugs as well as multiple drug interactions.

Medical Conditions. Medical literature from the past 5 years shows more than 100 different causes of itching including infection with bacteria, fungi, viruses, nematodes, and various other pathogens

and parasites (Phillips 1992). Pruritus, paresthesia, and urticaria are common side effects of many infectious and noninfectious diseases, as well as numerous other medical conditions (Blum and Katz 1990). Those listed in Table 3 are not to be taken as explanations for all delusory parasitosis cases, merely as an indication of the range of medical conditions with manifestations that reflect typical delusory parasitosis symptoms.

Age-related neurological degenerative changes can produce phantom limblike sensations, including pruritus and urticaria, in some elderly patients (Bernhard 1992). This phenomenon may explain the disproportionate number of delusory parasitosis cases among the elderly (Trabert 1995).

Allergies are one common cause of pruritus, erythema, and urticaria. Food and skin allergies may produce these symptoms. Some common food allergies include those to milk, egg white, soybean, peanut, chocolate, wheat, food additives, mangoes, oranges, nuts, and pineapple (Kabir et al. 1993, McGowan and Gibney 1993, Levy et al. 1994).

Atopic dermatitis can be caused by skin allergies to such materials as latex, textiles, soap, detergent, fabric softeners, shampoo, lotions, insect repellents, deodorants, and any other substance that contacts the skin (Simion et al. 1995). Most contain fragrances, colorants, stabilizers, emulsifiers, preservatives, and other components that may sensitize susceptible individuals (Phillips 1992).

Numerous medical conditions have itching or other skin irritations as symptoms, emphasizing the importance of not dismissing such symptoms as "just delusory parasitosis." Prodromal sensations should be investigated medically as indicators of potentially life-threatening conditions (Pariser and Pariser 1987). Nutritional deficiencies can produce itching as can high doses of many minerals and fat-soluble vitamins (Phillips 1992, Zanol et al. 1998).

Medications. Paresthesia, erythema, urticaria, pruritus, and hives are listed as potential side effects of most prescription and over-the-counter medications (Table 4). Incidence of these symptoms may be increased by interaction of two or more of these drugs, as is particularly common in the elderly (Doucet et al. 1996). Drug-induced delusory parasitosis has been demonstrated definitively in only a few cases (Aizenberg et al. 1991). Recreational drugs such as cocaine and methamphetamine particularly are prone to produce the sensation of insects crawling on or burrowing in the skin (Siegel 1978, Elpern 1988).

The 50 most commonly prescribed drugs in the United States list at least one symptom commonly attributed to delusory parasitosis (Table 4). These include erythema (56%), paresthesia (56%), pruritus (64%), urticaria (66%), and rash (92%). Although these side effects may be rare, the fact that these data are based on more than 2 billion prescriptions indicates that these drugs are being used extensively and that an increasing proportion of patients will experience these ancillary reactions and possibly attribute them to unseen "bugs" (Fig. 3).

Table 4. Fifty most commonly prescribed U.S. drugs and some side effects^a

Brand Name	Generic Name	Drug Type	Erythema	Paresthesia	Pruritus	Rash	Urticaria
Trimox, Augmentin	Amoxicillin	antibiotic	X		X	X	X
Premarin, Prempro	Estrogens	estrogen	X			X	
Synthroid, Levoxyl	Levothyroxine	thyroid				X	X
Bancap, Lorcet	Hydrocodone/APAP	analgesic			X	X	
Prozac	Fluoxetine	antidepressant	X	X	X	X	X
Lanoxin	Digoxin	cardiovascular				X	
Prilosec	Omeprazole	ulcer	X	X	X	X	X
Vasotec	Enalapril	hypertension	X	X	X	X	X
Zithromax	Azithromycin	antibiotic				X	
Norvasc	Amlodipine	angina	X	X	X	X	X
Zoloft	Sertraline	antidepressant	X	X	X	X	X
Claritin	Loratadine	antihistamine	X	X	X	X	X
Coumadin	Warfarin	thrombolytic		X		X	X
Zocor	Simvastatin	cardiovascular	X	X	X		X
Furosemide, Lasix	Furosemide	hypertension	X	X	X	X	X
Paxil	Paroxetine	antidepressant	X	X	X	X	X
Albuterol, Ventolin	Albuterol	bronchodilator	X			X	X
Zantac	Ranitidine	ulcer	X			X	
Zestril, Prinivil	Lisinopril	hypertension	X	X	X	X	X
Procardia, Adalat	Nifedipine	hypertension		X	X	X	X
Cardizem	Diltiazem	hypertension	X	X	X	X	X
Biaxin	Clarithromycin	antibiotic				X	X
Bactrim	Trimeth/Sulfameth	antibiotic	X		X	X	X
Keflex	Cephalexin	antibiotic	X		X	X	X
Tylenol with Codeine	Acetaminophen/Codeine	analgesic			X		
Glucophage	Metformin	diabetes				X	
Cipro	Ciprofloxacin	antibiotic	X	X	X	X	X
Darvocet, Darvon	Propoxyphene N/APAP	analgesic				X	
Veetids	Penicillin VK	antibiotic					X
Pravachol	Pravastatin	cardiovascular	X	X	X	X	X
Dyazide	Triamterene/HCTZ	cardiovascular				X	
Ultram	Tramadol	analgesic		X	X	X	X
Motrin, Advil	Ibuprofen	analgesic	X	X	X	X	X
Hytrin	Terazosin	cardiovascular		X	X	X	
Ambien	Zolpidem	sedative		X		X	X
Accupril	Quinapril	hypertension			X	X	
Relafen	Nabumetone	analgesic	X	X	X	X	X
Elavil	Amitriptyline	antidepressant		X		X	X
Claritin	Loratidine	antihistamine	X	X	X	X	X
Humulin	Insulin-NPH	diabetes				X	
Dilantin	Phenytoin	anticonvulsant	X			X	
Pepcid	Famotidine	ulcer		X	X	X	X
Glucotrol	Glipizide	diabetes	X	X	X	X	X
Lotensin	Benazepril	hypertension		X	X	X	
Cardura	Doxazosin	hypertension		X	X	X	
Mevacor	Lovastatin	cardiovascular	X	X	X	X	X
Cefzil	Cefprozil	antibiotic	X		X	X	X
Xanax	Alprazolam	sedative		X	X	X	
Prednisone, Panasol	Prednisone	antiarthritic	X				X
Tenormin, Atenolol	Atenolol	hypertension	X			X	

^aSandow 1998, based on more than two billion 1997 U.S. prescriptions.

Drugs disproportionately prescribed for the elderly such as those for heart conditions, glaucoma, osteoporosis, impotence, and arthritis particularly may be predisposed to cause these side effects (May and Terpenning 1991). These drugs include insulin, estrogen, arthritis medications, hypertension drugs, beta blockers, MAO inhibitors, and antidepressants.

Several factors contribute to the predisposition of elderly people to experience adverse drug ef-

fects: the elderly take multiple medications simultaneously (prescription and over-the-counter), frequently receive prescriptions from more than one doctor, more frequently are confused by instructions or forget how often they have medicated themselves, and drug pharmacokinetics vary by patient age. Persons over 65 years old represent only 12% of the population but receive more than 30% of all prescription drugs (Jones 1997). Older adults average three prescription medications per day, 15

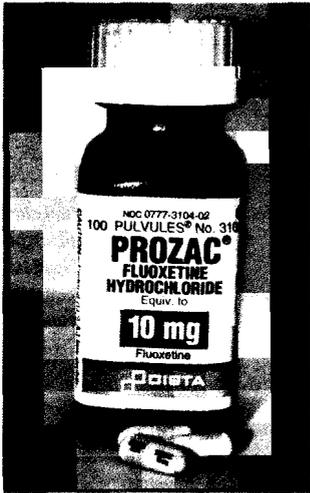


Fig. 3. Side effects of Prozac®, the fifth most commonly prescribed medication, include all five symptoms commonly attributed to delusory parasitosis—erythema, paresthesia, pruritus, rash, and urticaria.

different prescriptions per year, and consume 70% of all over-the-counter drugs. Approximately 25% of their hospital admissions are a result of incorrect prescription drug usage. One in five Americans over the age of 60 regularly takes pain medication and one in four who does so experiences side effects caused by the medication; one in ten is hospitalized as a result (Chrischilles et al. 1992).

Herbal remedies and nutritional supplements may produce untoward side effects including pruritus and urticaria (Huxtable 1990, Cetaruk and Aaron 1994). Additionally, they may interfere with or potentiate prescription and over-the-counter medications, resulting in unanticipated effects.

Although this is by no means an exhaustive review of medication side effects, it does show that symptoms experienced by delusory parasitosis sufferers may have valid physiological causes, either in medical conditions or in the drugs prescribed for their treatment. Psychologists and dermatologists have noted that organic causes must be excluded before a diagnosis of psychogenic pruritus can be made (Freyne and Wrigley 1994, Gupta 1995).

Because of the numerous potential physiological causes of pruritus, urticaria, and paresthesia, it is understandable that physicians often do not attempt to treat underlying causes but, instead, prescribe palliatives or advise the patient to pursue entomological possibilities (which fits with the patient's inclinations, anyway). In these days of managed care, physicians have neither the time nor incentive to do a thorough medical workup or attempt to determine causation of obscure and non-life-threatening symptoms.

In teenagers and young adults, recreational drug use may be a more likely explanation for delusory parasitosis symptoms (Zanol et al. 1998). Drugs such as cocaine and methamphetamine particularly are noted for producing "formication," or the sensation of ants crawling in or on the skin (Ellinwood 1969, Siegel 1978, Elpern 1988, Marschall et al. 1991). Cocaine use is admitted by 19% of all 18-25 year olds and 26% of all 26-34 year olds; hallucinogens such as methamphetamines have been used by 12% of 18-25 year olds and 16% of 26-34 year olds (SAMHSA 1996). Ekbohm's (1938) syndrome caused by drug use was featured in an episode of "The X Files" (Hinkle 1998), thus assuming its place in popular culture.

Psychological Causes

Scratching is a common primate displacement activity in response to tension, anxiety, and stress

(Schino et al. 1996). There are strong socio-psychological implications of self-grooming, reflecting group status, individual self-image, and psychological well-being. Touching, scratching, and rubbing are viewed as forms of self-assurance, consolation, and validation of the psyche (Schino et al. 1991, Troisi et al. 1991). This dynamic is displayed in meetings, in one-on-one confrontations between individuals, and in other human interactions.

Symptoms of anxiety, stress, tension, depression, and tiredness can manifest themselves as itching and tingling (Gieler and Knoll 1990, Gupta et al. 1994, Gupta 1995, Woodruff et al. 1997). Although it is generally recognized that stress can induce headaches, high blood pressure, acne, heart attacks, and ulcers, delusory parasitosis sufferers are reluctant to acknowledge that their dermatologic symptoms could be related to stress or depression.

Social isolation is one predisposing feature of delusory parasitosis. Some delusory parasitosis cases involve lonely people who need interactions with other humans (May and Terpenning 1991). Elderly people who live alone, seldom get out, seldom have visitors, or feel they have no purpose in life are prone to fixating on themselves and their health (Bernhard 1992, Freyne and Wrigley 1994). For many of these people, the illness itself is an important security factor (Laihinen 1991), allowing them to seek attention and evoke sympathy.

Bell's Syndrome (the Power of Suggestion). Often, the fact that several people are experiencing the same sensation is used to demonstrate that it is not psychological. Scratching behavior is an atavistic primate response with high psychological contagiousness (de Leon et al. 1992). Thus, situations in which more than one person is complaining of the symptoms are not necessarily evidence that there is a common cause behind the symptoms.

Entomologists who deal with delusory parasitosis cases will attest to this. Despite finding no arthropod in any samples provided, there is a strong urge to take a shower following these examinations. Consciously, one realizes that there is no infestation, but subconsciously one often feels the "creepy-crawlies" after looking through the victim's scurf. In fact, the author, while reading through the delusory parasitosis literature in preparing this article, found herself absentmindedly scratching; before the manuscript was completed, her arms and legs bore distinct scarification.

Responses of the Entomologist or Pest Control Operator

It always should be determined whether, in fact, an arthropod is involved (Table 5). Monitoring may include using cellophane tape to entrap the culprit while it is attacking the skin, glueboards to survey the environment, or a hand-operated vacuum cleaner to sample the area in which attacks are occurring (Potter 1992). Typical culprits include thrips brought in on flowers, bird or rodent mites from nests in the building, or cryptic pests

Table 5. Some web sites dealing with delusory parasitosis

Cultural entomology	http://www.insects.org/ced2/insects_psych.html
Factsheet	http://www.ianr.unl.edu/ianr/lanco/enviro/pest/factsheets/009-95.htm
Imaginary infestations	http://www.medscape.com/SCP/IIM/1998/v15.n03/m4174.godd/m4174.godd.html
National Geographic	http://www.nationalgeographic.com/media/ngm/9812/fngm/index.html

such as bed bugs or fleas (Webb 1993). If a causative agent is identified, the source can be eliminated and the problem solved. Otherwise, no pesticidal applications should be made (Potter 1992).

Monitoring and careful investigation of the situation may indicate that, although no arthropod is involved, there are physical causes such as insulation being blown through air-handling systems or nylon fragments from newly installed carpet (Blum and Katz 1990, Potter 1992). Frequently, such modifications as improved sanitation, installation of antistatic devices, and increased humidity will reduce complaints.

If no entomological cause can be identified, the individual should be referred to a physician and encouraged to pursue the possibility of one of the previously mentioned medical conditions serving as the basis of the symptomatology (Kushon et al. 1993). Meanwhile, the sufferer should be advised to discontinue using self-prescribed treatments. These materials, applied topically, are not good for the skin and may aggravate the problem. In particular, pesticidal shampoos and lotions should not be used more than stated specifically on the label; these are potent compounds that will increase skin sensitivity when overused.

Responsible pest control firms have policies against treating for pests until a culprit has been identified. This is legally and ethically appropriate (St. Aubin 1981). Customers, however, frequently do not understand, expecting that the pest control operator will "just spray something." Pressure to comply may be extreme. By applying pesticides, the pest control operator is validating the customer's perception that there is a pest present. Unwarranted pesticidal applications increase the building's pesticide load. Pesticide exposure can increase symptom manifestations, both as psychological responses and as physiological reactions to the formulation. For instance, the alpha-cyano pyrethroids are known to produce cutaneous paresthesia (Pauluhn 1996), and some organophosphates produce dermatological manifestations following sustained exposure (Misra et al. 1985). So, insecticide treatments made in delusory parasitosis cases may exacerbate the situation.

Conclusion

Although arthropod activity can cause irritation to humans, similar sensations can be produced by many other conditions. When there is no arthropod involvement, the condition is termed "delusory parasitosis" and is no longer within the scope of entomological expertise but appropriately devolves to health-care professionals. The entomologist's function is to determine whether insects or mites are involved and, if so, to identify and make recommendations for their suppression (Waldron 1972). Unfortunately, it typically is impossible to convince the individual that there are no "bugs" present, and recommendations to visit a health care professional virtually always are rebuffed (Lynch 1993).

Entomologists should have the courage of their

convictions. Once it has been determined that there are no arthropods involved in the case, this should be conveyed to the individual tactfully but firmly. The letter may be worded to make the point that, "Although examination of the specimens you provided yielded no evidence of arthropod involvement, the symptoms you are experiencing are real and deserve further investigation." The objective is to persuade the sufferer to go to a physician where, it is hoped, he or she may receive appropriate health care (Lynch 1993, Hinkle 1998). As Elliott (1944) observed over half a century ago, investigating delusory parasitosis is "an intriguing field for useful research, an opportunity for teamwork on the part of the pest control operator, the medical entomologist, the dermatologist, and the psychiatrist." 

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References Cited

- Aizenberg, D., B. Schwartz, and Z. Zemishlany. 1991. Delusional parasitosis associated with phenelzine. *Br. J. Psychol.* 159: 716-717.
- Arnow, P. M., L. A. Bland, S. Garcia-Houchins, S. Fridkin, and S. K. Fellner. 1994. An outbreak of fatal fluoride intoxication in a long-term hemodialysis unit. *Ann. Intern. Med.* 121: 339-344.
- Bernhard, J. D. 1989. Nonrashes: atmokinesis: pruritus provoked by contact with air. *Cutis* 44: 143.
- Bernhard, J. D. 1992. Phantom itch, pseudophantom itch, and senile pruritus. *Int. J. Dermatol.* 31: 856-857.
- Bircher, A. J. 1990. Water-induced itching. *Dermatologica* 181: 83-87.
- Blum, S. J., and H. L. Katz. 1990. Itches, illusions and phobias, pp. 1003-1034. In K. Story [ed.], *Handbook of pest control*, 7th ed. Franzak & Foster, Cleveland, OH.
- Cetaruk, E. W., and C. K. Aaron. 1994. Hazards of nonprescription medications. *Emerg. Med. Clin. North Am.* 12: 483-510.
- Chrischilles, E. A., D. J. Foley, R. B. Wallace, J. H. Lemke, T. P. Semla, J. T. Hanlon, R. J. Glynn, A. M. Ostfeld, and J. M. Gurałnik. 1992. Use of medications by persons 65 and over: data from the established populations for epidemiologic studies of the elderly. *J. Gerontol.* 47: 137-144.
- de Leon, J., R. E. Antelo, and G. Simpson. 1992. Delusion of parasitosis or chronic tactile hallucinosis: hypothesis about their brain physiopathology. *Compr. Psychiatry* 33: 25-33.
- Doucet, J., P. Chassagne, C. Trivalle, I. Landrin, M. D. Pauty, N. Kadri, J. F. Menard, and E. Bercoff. 1996.

- Drug-drug interactions related to hospital admissions in older adults: a prospective study of 1000 patients. *J. Am. Geriatr. Soc.* 44: 944-948.
- Driscoll, M. S., M. J. Rothe, J. M. Grant-Kels, and M. S. Hale. 1993. Delusional parasitosis: a dermatologic, psychiatric, and pharmacologic approach. *J. Am. Acad. Dermatol.* 29: 1023-1033.
- Ebeling, W. 1978. *Urban entomology*. University of California, Division of Agricultural Science, Berkeley.
- Ekbom, K. A. 1938. Der praesenile Dermazozoenwahn. *Acta Psychiatrica Neurol.* 13: 227-259.
- Eliason, B. C., J. Kruger, D. Mark, and D. N. Rasmann. 1997. Dietary supplement users: demographics, product use, and medical system interaction. *J. Am. Board Family Practice* 10: 265-271.
- Ellinwood, E. H. Jr. 1969. Amphetamine psychosis: a multi-dimensional process. *Sem. Psychiatry* 1: 208-226.
- Elliott, G. R. 1944. Entomophobia. *Soap Sanit. Chem.* 20: 105.
- Elpern, D. 1988. Cocaine abuse and delusions of parasitosis. *Cutis* 42: 273-274.
- Fisher, A. A. 1995. Contactants that produce pruritus and paresthesia with invisible reactions (nonrash). *Cutis* 55: 269.
- Freyne, A., and M. Wrigley. 1994. Delusional infestation in an elderly population. *Irish Med. J.* 87: 86-88.
- Gieler, U., and M. Knoll. 1990. Delusional parasitosis as 'folie a trois.' *Dermatologica* 181: 122-125.
- Goddard, J. 1995. Analysis of 11 cases of delusions of parasitosis reported to the Mississippi Department of Health. *South. Med. J.* 88: 837-839.
- Grace, J. K., and D. L. Wood. 1987. Delusory cleptoparasitosis: delusions of arthropod infestation in the home. *Pan-Pac. Entomol.* 63: 1-4.
- Gupta, M. A. 1995. Evaluation and treatment of "psychogenic" pruritus and self-excoriation. *J. Am. Acad. Dermatol.* 32: 532-533.
- Gupta, M. A., A. K. Gupta, and N. J. Schork. 1994. Depression modulates pruritus: a study of pruritus in psoriasis, atopic dermatitis, and chronic idiopathic urticaria. *Psychosomat. Med.* 56: 36-40.
- Hinkle, N. C. 1998. The role of extension specialists in dealing with delusory parasitosis. *Proc. Natl. Conf. Urban Entomol.* 1998: 84-94.
- Huxtable, R. J. 1990. The harmful potential of herbal and other plant products. *Drug Safety* 5: 126-136.
- Jaakkola, J. J., P. Tuomaala, and O. Seppanen. 1994. Textile wall materials and sick building syndrome. *Arch. Environ. Health* 49: 175-181.
- Jones, B. A. 1997. Decreasing polypharmacy in clients most at risk. *AACN Clin. Issues* 8: 627-634.
- Kabir, I., P. Speelman, and A. Islam. 1993. Systemic allergic reaction and diarrhoea after pineapple ingestion. *Tropical and Geographical Med.* 45: 77-79.
- Kapadia, N., and T. S. Haroon. 1996. Cutaneous manifestations of systemic lupus erythematosus: study from Lahore, Pakistan. *Int. J. Dermatol.* 35: 408-409.
- Kazantzis, G. 1978. The role of hypersensitivity and the immune response in influencing susceptibility to metal toxicity. *Environ. Health Perspect.* 25: 111-118.
- Koblentz, C. S. 1993. The clinical presentation, diagnosis and treatment of delusions of parasitosis—a dermatologic perspective. *Bull. Soc. Vector Ecol.* 18: 6-10.
- Koo, J., and C. Gambla. 1996. Delusions of parasitosis and other forms of monosymptomatic hypochondriacal psychosis. General discussion and case illustrations. *Dermatol. Clin.* 14: 429-438.
- Kushon, D. J., J. W. Helz, J. M. Williams, K.M.K. Lau, L. Pinto, and F.E. St. Aubin. 1993. Delusions of parasitosis: a survey of entomologists from a psychiatric perspective. *Bull. Soc. Vector Ecol.* 18: 11-15.
- Laihinen, A. 1991. Assessment of psychiatric and psychosocial factors disposing to chronic outcome of dermatoses. *Acta Dermato-Venerol. Suppl.* 156: 46-48.
- Levit, F. 1995. Skin discomfort as a presenting sign of carbon monoxide poisoning. *J. Am. Acad. Dermatol.* 32: 671.
- Levy, Y., B. Kornbroth, I. Ofer, B. Z. Garty, and Y. L. Danon. 1994. Food allergy in infants and children: clinical evaluation and management. *Isr. J. Med. Sci.* 30: 873-879.
- Lyell, A. 1983. Delusions of parasitosis. *Sem. Dermatol.* 2: 189-195.
- Lynch, P. J. 1993. Delusions of parasitosis. *Sem. Dermatol.* 12: 39-45.
- Marschall, M. A., R. F. Dolezal, M. Cohen, and S. F. Marschall. 1991. Chronic wounds and delusions of parasitosis in the drug abuser. *Plast. Reconstr. Surg.* 88: 328-330.
- May, W. W., and M. S. Terpenning. 1991. Delusional parasitosis in geriatric patients. *Psychosomatics* 32: 88-94.
- McGowan, M., and M. J. Gibney. 1993. Calcium intakes in individuals on diets for the management of cows' milk allergy: a case control study. *Eur. J. Clin. Nutr.* 47: 609-616.
- Misra, U. K., D. Nag, V. Bhushan, and P. K. Ray. 1985. Clinical and biochemical changes in chronically exposed organophosphate workers. *Toxicol. Letters* 24: 187-193.
- Monk, B. E., and Y. J. Rao. 1994. Delusions of parasitosis with fatal outcome. *Clin. Exp. Dermatol.* 19: 341-342.
- Nutting, W. B., and H. Beerman. 1983. Demodicosis and symbiophobia: status, terminology, and treatments. *Int. J. Dermatol.* 22: 13-17.
- Ostermann, P. O., and C. E. Westerberg. 1975. Paroxysmal attacks in multiple sclerosis. *Brain* 98: 189-202.
- Pansini, F., P. Albertazzi, G. Bonaccorsi, M. Calisesi, C. Campobasso, L. Zanotti, B. Bagni, and G. Mollica. 1994. The menopausal transition: a dynamic approach to the pathogenesis of neurovegetative complaints. *Eur. J. Obstet. Gynecol. Reprod. Biol.* 57: 103-109.
- Pariser, R. J., and D. M. Pariser. 1987. Primary care physicians' errors in handling cutaneous disorders. *J. Am. Acad. Dermatol.* 17: 239-245.
- Pauluhn, J. 1996. Risk assessment of pyrethroids following indoor use. *Toxicol. Lett.* 88: 339-348.
- Phillips, W. G. 1992. Pruritus. What to do when the itching won't stop. *Postgrad. Med.* 92: 34-36, 39-40, 43-46, 53, 56.
- Pomerantz, C. 1959. Arthropods and psychic disturbances. *Bull. Entomol. Soc. Am.* 5: 65-67.
- Poorbaugh, J. H. 1993. Cryptic arthropod infestations: separating fact from fiction. *Bull. Soc. Vector Ecol.* 18: 3-5.
- Potter, M. 1992. Management strategies for mystery bugs. *Pest Control Technol.* 4: 44-46, 50, 52.
- Sacerdote, A. 1987. Urticaria as a sign of hypoglycemia. *Diabetes Care* 10: 257.
- SAMHSA. 1996. National household survey on drug abuse (<http://www.samhsa.gov/oas/nhsda/nhsdafsl.htm>).
- Sandow, N. 1998. The top 200 prescriptions. *Am. Drug-gist* (<http://www.rxlist.com/top200.htm>)

- Scherbenske, J. M., P. M. Benson, G. P. Lupton, and C. P. Samlaska. 1989. Rheumatoid neutrophilic dermatitis. *Arch. Dermatol.* 125: 1105-1108.
- Schino, G., A. Troisi, G. Perretta, and V. Monaco. 1991. Measuring anxiety in nonhuman primates: effect of lorazepam on macaque scratching. *Pharmacol. Biochem. Behav.* 38: 889-891.
- Schino, G., G. Perretta, A. M. Taglioni, V. Monaco, and A. Troisi. 1996. Primate displacement activities as an ethnopharmacological model of anxiety. *Anxiety* 2: 186-191.
- Schrut, A. H., and W. G. Waldron. 1963. Psychiatric and entomological aspects of delusory parasitosis: entomophobia, acarophobia, dermatophobia. *J. Am. Med. Assoc.* 186: 429-430.
- Siegel, R. K. 1978. Cocaine hallucinations. *Am. J. Psychiatry* 135: 309-314.
- Simion, F. A., L. D. Rhein, B. M. Morrison Jr., D. D. Scala, D. M. Salko, A. M. Kligman, and G. L. Grove. 1995. Self-perceived sensory responses to soap and synthetic detergent bars correlate with clinical signs of irritation. *J. Am. Acad. Dermatol.* 32: 205-211.
- St. Aubin, F. E. 1981. Ectoparasites: real or delusory? How to recognize and cope with either. *Pest Control Tech.* 9: 1-26.
- Trabert, W. 1995. 100 years of delusional parasitosis. *Psychopathology* 28: 238-246.
- Traver, J. R. 1951. Unusual scalp dermatitis in humans caused by the mite, *Dermatophagoides* (Acarine, Epi-dermoptidae). *Proc. Entomol. Soc. Wash.* 53: 1-25.
- Troisi, A., G. Schino, M. D'Antoni, N. Pandolfi, F. Aureli, and F. R. D'Amato. 1991. Scratching as a behavioral index of anxiety in macaque mothers. *Behav. Neural Biol.* 56: 307-313.
- Waldron, W. G. 1962. The role of the entomologist in delusory parasitosis (Entomophobia). *Bull. Entomol. Soc. Am.* 8: 81-83.
- Waldron, W. G. 1972. The entomologist and illusions of parasitosis. *Calif. Med.* 117: 76-78.
- Webb, J. P. 1993. Case histories of individuals with delusions of parasitosis in southern California and a proposed protocol for initiating effective medical assistance. *Bull. Soc. Vector Ecol.* 18: 16-25.
- White, D. J. 1997. Treatment of delusional parasitoses. *J. Am. Med. Assoc.* 278: 1319.
- Woodruff, P. W., E. M. Higgins, A. W. duVivier, and S. Wessely. 1997. Psychiatric illness in patients referred to a dermatology-psychiatry clinic. *Gen. Hosp. Psychiatry* 19: 29-35.
- Zanol, K., J. Slaughter, and R. Hall. 1998. An approach to the treatment of psychogenic parasitosis. *Int. J. Dermatol.* 37: 56-63.



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