

Chapter 9

WESTERN ATTITUDES TOWARD INSECTS AS FOOD: EUROPE,
THE UNITED STATES, CANADA

The early Greeks and Romans wrote about insect consumption not only in their own lands but in others as well. Herodotus, 4th Century BC Greek historian and sometimes called the "Father of History," wrote that a tribe of nomads of Central Asia called the Budini are "the only people in these parts who are vermin eaters" (cited by Burr 1939, p. 211). According to Burr, the word used by Herodotus means "louse-eaters," and Burr credits Nazaroff with the information that the Kirghiz and Kayaks are the descendents of the Scythians and their relatives the Budini of Herodotus' time. The habit of "nibbling their own personal fauna," as Burr puts it, was and still is widespread among primitive peoples. Herodotus (cited by Hope 1842, p. 129) also described how the Nasamones "hunt for locusts, which having dried in the sun, they reduce to powder and eat, mingled with milk."

In one of the earliest references to the eating of insects in Greece, Aristophanes, a foremost Greek poet of the 4th Century, quotes poulterers who sell "four-winged" fowl on the market (cited by Keller 1913, p. 455). According to Bodenheimer (1951, p. 42) these four-winged fowl were grasshoppers which apparently were cheap and consumed by the poorer classes. Young shepherds in the fields also enjoyed eating them.

While the lower-class Greeks ate locusts or grasshoppers, the upper-class Greeks apparently preferred cicadas. According to Aristotle (3rd Century BC) (cited by Holt 1885, p. 38), the most polished of the Greeks considered cicada nymphs the greatest of tid-bits. Aristotle hinted that they were not an uncommon food in Attica (Athens) and wrote (cited by Bodenheimer 1951, p. 39): "The larva of the cicada on attaining full size in the ground becomes a nymph (*tettigometra*); then it tastes best, before the husk is broken [i.e., before the last moult] . . . [Among the adults] at first the males are better to eat, but after copulation the females, which are then full of white eggs."

In the 1st Century AD a statement by the Greek philosopher, Plutarch (cited by Bodenheimer 1951, p. 40) indicates that many Greeks believed that cicadas should not be eaten: "Consider and see whether the swallow be not odious and impious . . . , because it feeds upon flesh and kills and devours the cicadas, which are sacred and musical."

Pliny the Elder, 1st Century AD Roman natural history author, mentions that cicadas are eaten in the East (vide Bodenheimer 1951, p. 39). Pliny also records (cited by Holt 1885, pp. 38-39; Burr 1939, p. 213; Bodenheimer, pp. 42) that Roman epicures of his day highly esteemed the *Cossus* grub and fattened them for the table on flour and wine. There has been much confusion about the identity of the *Cossus*, which Pliny stated feeds in oak. Bodenheimer (pp. 42-43) lists several species that have been put forward by various authors as the *Cossus* of Pliny, but credits **Mulsant (1841)** with settling the question, and concludes that almost certainly it was the larva of *Cerambyx heros* Linn.

Cowan (1865: 27) discussed the *Cossus* as follows:

The *Cossus* of the Greeks and Romans, which, at the time of the greatest luxury among the latter, was introduced at the tables of the rich, was the larva, or grub, of a large beetle that lives in the stems of trees, particularly the oak; and was, most probably, the larva of the Stag-beetle, *Lucanus cervus*. On this subject, however, entomologists differ very widely But the larva of the *Lucanus cervus*, and perhaps also the *Prionus coriarius*, which are found in the oak as well as in other trees, may each have been eaten under this name, as their difference could not be discernible either to collectors or cooks. . . . Pliny tells us that the epicures, who looked upon these *cossi* as delicacies, even fed them with meal, in order to fatten them.

Diodorus, Greek historian of the 2nd Century AD, wrote (cited by Bodenheimer 1951, p. 41) about a people in Ethiopia called the Acridophagi or locust-eaters and whom he described as small, lean and spare, and extremely black men (see under Ethiopia for details). Bodenheimer cites several other early writers on the Acridophagi who apparently relied heavily on this account by Diodorus.

Athenaeus, about 200 AD, mentions cicadas as dainties in Greek banquets, being served to stimulate the appetite (cited by Bodenheimer, p. 39). Athenaeus' opinion should possibly carry extra weight as he was a Greek grammarian and rhetorician who wrote extensively on Greek contemporary life, including cookery.

Third Century AD Roman sophist naturalist and author Aelian sounds another discordant note regarding cicadas when (cited by Bodenheimer, p. 39) he reports with discontent that he saw people selling small parcels of cicadas for food. Aelian also tells (cited by Holt 1885, p. 39; Bodenheimer, p. 43) that the King of India served as dessert for his Greek guests a dish of roasted grubs from palm trees, which Holt believes to have been the palm weevil, *Calandra palmarum*. The locals considered these grubs a great delicacy, but the Greeks did not enjoy

them.

St. Jerome, in his Treatise against Jovinian, Festus and others, mentions that wood-boring larvae are eaten as delicacies by some people while others refuse them in disgust (cited by Bodenheimer, p. 42).

According to **Bodenheimer (1951, p. 44)**, the New Age of entomology begins with the appearance in 1602 of **Aldrovandi's** "De Animalibus Insectis Libri Septem." Aldrovandi mentions various insects as food, quoting from earlier sources the consumption of locusts and cicadas. He mentions the eating of bees by the inhabitants of Cumana, the eating of fried silkworms with obvious delight by German soldiers in Italy, and from contemporary travel reports the eating of ants in parts of India and the Genusucian Islands. **Moufetus (1634;** vide Bodenheimer, p. 45) utilizes earlier sources in describing the use of locusts and their eggs in many mainly tropical or arid localities, and the consumption of cicadas by the Greeks.

De Réaumur (1737, II, 2, pp. 113-120) discussed the edibility of insects in his "Memoires pour servir a l'Histoire des Insectes" in reference to the severe damage produced in France by *Plusia gamma*. In summarizing this, Bodenheimer (1951, p. 45) says: "During that period some people who had eaten these caterpillars with salad or in soup claimed that they were poisonous. Yet, as with all other smooth caterpillars, they are actually harmless. However, the prejudice against this insect has been so great that when one of its caterpillars has been swallowed, it has been immediately held responsible for any symptoms of poisoning." De Réaumur is quoted, "One may eat as many of our vegetable caterpillars as one wishes without fearing the slightest damage, swelling or inflammation."

De Réaumur follows with a discussion of entomophagy in general (vide Bodenheimer, p. 46):

If large, smooth caterpillars were here as common as are locusts in certain regions, and especially if they were abundant in a year of famine, perhaps the peasants of France would eat them as locusts are eaten in Africa. And perhaps they would subsequently be regarded as an agreeable and wholesome dish! We know a number of wood-boring beetle grubs which appear much less palatable than smooth caterpillars, yet the ancient Romans regarded these *coffi* as a first-class delicacy. We need not even go back as far as that. Similar beetle grubs, which also live in the interior of trees in our West Indian possessions, are considered when fried as a succulent and splendid meal. And the grubs of the common *Oryctes*-beetles, which are white, plump, and fat, like those of the *Cerambyx*-grubs or *coffi*, would perhaps make an excellent entremet, if our prejudices would permit us to introduce them into our menus. One would look for these grubs in the soil, as one looks for truffles, and the number of the beetles of this injurious species in this way could be much diminished.

We could perhaps in due time overcome our repugnance at eating insects and accept them as part of our diet, and then realize that there is nothing terrible about them and that they may perhaps even offer us agreeable sensations. We have grown accustomed to eating frogs, snakes, lizards, shell-fish, oysters, etc. in the various provinces of France. Perhaps the first urge to eat them was hunger. In conclusion, while leaving the caterpillars for the time as food for the birds, we need not accuse them of poisoning. In 1735 thousands and thousands of these caterpillars have been eaten by cattle, horses, sheep, asses, etc., which suffered no harm as a result.

De Réaumur (1737, III, p. 416; vide Bodenheimer 1951, p.67) discusses the galls of ground-ivy (*Glechoma hederacea*) which are produced by *Aulax latreillei* Kieff. (= *A. glechomae* Latr.) and have been eaten as food in France. They have an agreeable taste, but Réaumur expresses doubt that they will ever be as popular as good fruit.

Brooks (1772; vide Bodenheimer 1951, p. 48), in his "On the properties and uses of insects," wrote:

The palmworms are eaten in the West-Indies by the French, after they have been roasted before the fire, when a small wooden spit has been thrust through them. When they begin to be hot, they powder them with a crust of rasped bread, mixed with salt, a little pepper and nut-meg. This powder keeps in the fat or at least sucks it up. And when they are done enough, they are served up with orange juice. They are highly esteemed by the French as excellent eating.

The first use of a Latinized name for the palmworm of the Caribbean was by Linnaeus in the later editions of his Systema Naturae. Linnaeus was well-aware that not only *Rhynchophorus palmarum* L., but also the grubs of *Macrodontia cervicornis* L. were considered great delicacies (cited by Bodenheimer 1951, p. 48). Linnaeus also mentions *Locusta cristata* L. being eaten by the Arabs (cited by Hope 1842, p. 137).

Roesel von Rosenhof (1779, Dutch ed., vol. 2, para. 37, p. 297 f.; cited by Bodenheimer 1951, pp. 46-48)

tried two recipes that he found among older reports on locust-eating. Rosenhof didn't wind up an admirer of insect dishes, but he apparently deserved an "A" for trying. He reported as follows, as summarised by Bodenheimer:

The one is to tear off the legs and the wings, and to dry them in the sun (i.e. in the weak sun and humid air of the North!), until they ferment. They are eaten and it is claimed that they make an agreeable dish. The other way is to boil the locusts in salty water and then to eat them seasoned with vinegar, salt and pepper. I have tried to prepare them in both ways. yet when they began to ferment after preparation by the first method, the smell of the fermenting insects is so bad that any desire to eat them disappears; this has also been reported by Frisch of locusts which died in the fields. The second method, however, was equally unpleasant to my palate. They then smell like shrimps, but their taste is repellent and unpalatable. When Roesel was once busy boiling locusts for one of these feeding experiments, one of his friends entered his house. This friend had always encouraged Roesel to overcome his prejudices and to taste them. Thus he asked him if he would accept an invitation to a dish of boiled locusts. He agreed but when the famous dish was set upon the table, he lost his appetite, and as did other friends, he lost all desire to taste them. Some affected to feel no repugnance, yet immediately the locusts had entered their mouths, everyone of them spit them out or vomited them, while their faces showed their fear of swallowing them. It was just as if they had taken a drug for vomiting.

Foucher d'Obsonville (1783, pp. 43 ff), in his "Philosophical Essays on the Habits of Various Strange Animals," recounts that locusts are eaten with relish by most Africans, some Asiatics and especially the Arabs. Bodenheimer (1951, p. 49) summarizes the account as follows:

On their markets they appear roasted or grilled in great quantities. When salted, they keep for some time in storage. They are used for supplying ships, where they may be served as dessert or with coffee. This food is in no way repugnant to look at or by association. It tastes like prawn, and is perhaps more delicately flavoured, especially the females when filled with eggs. Certain people assume this food to be the cause of the eye-diseases which are so common in some of these regions. d'Obsonville says he could easily imagine that excessive use would impoverish the blood and have dangerous consequences; but blindness and eye-diseases are probably caused by the salty and fiery particles transported by the winds. The Turks, Persians and Christians, who in the same regions do not eat locusts or only rarely, are subjected to the same eye-troubles, while some African peoples who eat locusts in great quantities have excellent eye-sight.

Consett (1789, p. 118; vide Bodenheimer 1951, p. 67) states that in some parts of Sweden, ants are distilled with rye to give flavor to "their inferior kinds of brandy," and ant pupae are used for the production of good gin. Consett mentions a young Swede who ate live ants with the greatest relish.

Erasmus Darwin (1800, p. 364), in his "Phytologia; or the Philosophy of Agriculture and Gardening With the Theory of Draining Morasses and With an Improved Construction of the Drill Plough," deduces that since turkeys and wild birds eat Maychafer beetles, if properly cooked they might be as good as the locusts, termites and silkworm pupae of the east. He says:

And probably the large grub, or larva of it, which the rooks pick up in following the plough, is as delicious as the grub called groogroo, and a large caterpillar, which feeds on the palm; both of which are roasted and eaten in the West Indies . . . Nevertheless all the caterpillar tribes may not be equally innocuous; as in this climate the hairy caterpillars, if laid between the fingers, where the skin is tender, I have observed to produce an itching, and leave some of the pointed bristles in the skin.

Immanuel Kant in his "Physical Geography" (1802; edition quoted, 1905, p. 236), devoted a paragraph to edible locusts, which is given as follows by Bodenheimer (p. 48):

Big locusts are roasted and eaten in Africa by various peoples. In Tonkin they are salted as stores for future consumption. Ludolph, who knew this, cooked the great locusts which devastated Germany in 1693 like crayfish, ate them, preserved them with vinegar and pepper and with this dish treated the Council of Frankfurt.

Illiger (1804; vide Bodenheimer 1951, p. 49) provides recipes for preserving may-bugs (*Melolontha*),

partly taken from old cookery books, and mentions a variety of insects that are eaten elsewhere: the palmworms of the West Indies, the *Cossus* and locusts known from antiquity, the inclusion of locusts among the regular provisions of the Barbary pirates, consumption of termites and locust hoppers by the Bushmen, and the eating of a large "praying mantis" on Amboina.

Westermann (1821, p. 419; vide Bodenheimer 1951, p. 66) reported cock-chafers and related species are eaten by the mountain inhabitants of Europe. The brothers Villa are credited with the information that the peasants of Lombardy eat the abdomen of *Melolontha aprilina* Duft. Similar beetles are also eaten in other provinces of Italy, and in Moldavia and Walachia both cock-chafers and *Rhizotrogus pini* Ol. are eaten (vide **Bargagli 1877, p. 6;** vide Bodenheimer, p. 66).

Kirby and Spence (1822, I, pp. 297-310) devoted a chapter to the direct benefits from insects, including their use as food by peoples in other parts of the world, mentioning palmgrubs, locusts, caterpillars, silkworm pupae, termites, bees, ants, gall-apples and honey. Many of the early authors cited above are cited by Kirby and Spence, although we have cited them as from Bodenheimer, Holt or others whose writings may be available to more readers. This work is stated by Bodenheimer to have served as a source for many later compilers. Kirby and Spence begin their discussion, saying (pp. 297-298):

Crustacea . . . are universally reckoned amongst our greatest dainties; and they who would turn with disgust from a locust or the grub of a beetle, feel no symptoms of nausea when a lobster, crab, or shrimp is set before them. The fact is, that habit has reconciled us to the eating of these last, which viewed in themselves with their threatening claws and many feet, are really more disgusting than the former. Had the habit been reversed, we should have viewed the former with appetite and the latter with abhorrence, as do the Arabs, 'who are as much astonished at our eating crabs, lobsters, and oysters, as we are at their eating locusts' [quote from Clarke's *Travels*]. That this would have been the case is clear, at least as far as regards the former position, from the practice in other parts of the world, both in ancient and modern times, to which, begging you to lay aside your English prejudices, I shall now call your attention; first observing by the way, that the insects used as food, generally speaking, live on vegetable substances, and are consequently much more select and cleanly in their diet than the swine or the duck, which form a favourite part of ours.

Cuvier, the great French naturalist, in his "Animal Kingdom" (Insecta II, p. 205), mentions an earlier report by Latreille that children in southern France are very fond of the fleshy thighs of grasshoppers. He also notes that, according to travellers' reports, grasshoppers preserved in brine and with wings removed are an item of commerce toward the coasts of Barbary.

J.J. Virey, physiologist and pharmacologist, and a member of the French Academy, appeared to vacillate on the question of entomophagy. In his "Histoire Naturelle du Genre Humain" (IX, I, p. 256; vide Bodenheimer, pp. 50-51), he writes:

Temperature regulates our diets, determining whether much meat or more vegetables are eaten. I shall not discuss locusts and other insects which are consumed by the Arabs and some Africans as good meals. At Tonkin also man and monkeys eagerly seek insects as food. Pliny and other ancient writers claim that the acridophagous peoples are weak, thin, precocious and do not live longer than 40 years (Pliny, Hist. Nat. 6: 29 and 4; Strabo 16). It is certain that the insects which are usually eaten are unwholesome and an irritant. In general, foods which have the same type of organization (i.e. mammals for man) prove the most satisfactory.

In the second edition of the same book (1824, II, pp. 319, 329), Virey mentions the cicadas of the Athenians, the *COSSUS*, and various insects eaten elsewhere, and writes, "The Moor, starving in his deserts, devours locusts or feeds on the gum of its acacias, or on some pinches of cous-cous."

The concluding paragraph of a paper by Virey, titled "Whether man may eat insects and whether he should eat them," is quoted by **J. Bequaert (1921, p. 200)**:

Man may eat insects: nothing in his anatomical organisation or his physiological functions is opposed to it. He should eat insects: in the first place, because his cousins the monkeys and his ancestors the bats, or in short the primates, eat them. In the second place, because insectivorous animals are superior to the other species of their order, both in their more perfect organisation as well as in the superiority of their intelligence.

F.W. Hope (1842) contributed a valuable paper, parts of which are incorporated elsewhere in this volume.

After citing many of the ancient records pertaining to food insect use, both in Europe and elsewhere, Hope states (p. 130):

It appears then . . . that insects live on cleanly diet, and consequently afford us more wholesome food than some of the animals that are usually served at our tables. It is not my intention here to recommend insectal food to nations living in northern climates, although I am aware that there are naturalists who have done so; the supply in summer accidentally might be abundant, but in winter certainly always must be scanty and precarious. I see no reason, however, why in the warm and well wooded regions of the world they should not be eaten, as the supply there is generally abundant. The New Hollander, or even the European settler in those parts, may derive much benefit by adopting the larvae of insects as food, for the very worms regaled on, if left to themselves, in time might multiply so as to endanger the crops of future years, entailing ruin on the grower, and perhaps famine on the settlement. In case of scarcity in our own country, and certainly in milder regions of the world where famine has been known to spread over the land, insectal food may be adopted. It is probable that want and hunger may have been the original cause of introducing to notice several of the insects which have been taken as food, although I am unable at present to adduce any particular instance to substantiate the fact. Insectal food, which I here recommend in case of necessity, will certainly not be so revolting to man as the animal gelatine of pulverised old bones, or even as insipid as sawdust bread, recommended by the French in similar emergencies.

Freeman (1858, p. 524), in "The History of Cape Cod," reported:

One of the commissioners above named related to the writer that, when on this service at West Point, the attention of the commissioners was arrested by certain inexplicable movements among the French troops encamped at some distance from the American. Perceiving that they had kindled numerous fires in the adjoining fields, and were running about in strange disorder, Maj. Osgood and himself, accompanied by Gen. Washington and other officers, mounted horses and rode to the encampment. It was found that the Frenchmen were enjoying rare sport in a campaign against the grasshoppers which were unusually numerous at that time. These insects, as soon as captured, were impaled upon a sharpened stick or fork and held for a moment over the fire and then eaten with great *gusto*. The fires were furnished with fuel of deposits from cattle in the fields, made by the excessive heat and drought of the autumn sufficiently dry and combustible.

Motschulsky (1859) summarized the various methods used, primarily in Europe, for controlling locusts. Natural control agents were also discussed, for example: "Frogs, lizards, and various birds, especially of the starling, blackbird, lark, crow, jackdaw, stork, and other species, devour them with great avidity." He notes that, "In ancient Egypt, the ibis was counted sacred, because it destroyed quantities of reptiles and injurious insects, especially locusts." Further (p. 215):

In the Neopolitan dominions, the landholders on the appearance of the locust place their chief reliance on the birds. In Asia Minor and other southern regions, the locusts make their appearance so frequently and in such vast quantities, that the birds alone cannot meet the requirements of the inhabitants. In North America, the young turkeys are trained to seek out and feed upon the larvae of grasshoppers and locusts, especially when they begin to hatch from the eggs, whereby great numbers of them are destroyed.

Domestic fowls, as geese, ducks, turkeys, and chickens, are exceedingly fond of such food. About Temeshvar, in Hungary, the locusts were once got rid of by driving into the place where they had alighted 15,000 head of swine, which in a single night and morning devoured them all.

After further discussion of the "training" of goslings, chickens and young turkeys to feed on locusts, Motschulsky adds: "The breeding of large numbers of Guinea-fowl (*Numida meleagris*), which multiply rapidly in the steppe cantons of the Caucasus, would have the effect of diminishing the swarms of locusts; since this bird is all its life constantly running to and fro, and would vigorously pursue the insects." Motschulsky's description of other, often herculean, efforts to destroy locusts, such as trampling them with herds of cattle, sheep or horses, crushing them with logs or weighted harrows, frightening them away by making noise, including the firing of cannon, use of specially designed sacks, fire, etc., etc., and their disposal by drowning, burning or burying, makes

interesting reading, and presents a sharp contrast to the harvesting of the insects as food by populations on other continents.

Cowan's (1865) "Curious Facts in the History of Insects" contains much information from original sources which has been incorporated at appropriate places in this volume. Cowan states (p. 51) that the Greeks "commended the Buprestis in food." According to Cowan (p. 65), Fabricius reported that Turkish women ate the beetle, *Blaps sulcata* (Tenebrionidae), cooked with butter, to make themselves fat. Cowan (p. 98) says "Athenaeus tells us the ancient Greeks used to eat the common Grasshopper and the Monkey-grasshopper as provocatives of the appetite," while Aristophanes said, "How can you, in God's name, like Grasshoppers. . . ." Cowan (p.127) states, "In the southern parts of France, M. Latreille informs us, the children are very fond of the fleshy thighs of Locusts." Also, regarding France, Cowan (p. 145)states: "The galls of the ground-ivy, produced by the *Cynips glecome* [Cynipidae], have been eaten as food in France; they have an agreeable taste, and to a high degree the odor of the plant which bears them. Reaumur, however, is doubtful whether they will ever rank with good fruits." Cowan (p. 145) mentions that galls of the sage (3 species of *Salvia*) are very juicy, like apples, and are gathered every year as an article of food by the inhabitants of Crete, and form a "considerable item of commerce from Scio to Constantinople, where they are regularly exposed in the market." Cowan (p. 254) states: "The Greeks, notwithstanding their veneration for the Cicada, made these insects an article of food, and accounted them delicious." And he cites (p. 255) an earlier report that Athenaeus and Aristophanes mentioned cicadas being eaten, and Aelian was angry that "an animal sacred to the Muses should be strung, sold, and greedily devoured."

Henri Miot (1870, p. 89; vide Simmonds 1885, p. 348), in the *Gazette des Campagnes*, gives the following recipe which has been adopted in certain parts of France for cockchafer grubs:

Roll the *vers blancs*, which are short and fat, in flour and bread crumbs, with a little salt and pepper, and wrap them in a stout piece of paper, well buttered inside. Place it in the hot embers and leave it to cook for twenty minutes, more or less, according to the degree of heat. On opening the envelope a very appetising odour exhales, which disposes one favourably to taste the delicacy, which will be more appreciated than snails, and will be declared one of the finest delicacies ever tasted.

Glover (1875, pp. 135-140) mentions that locusts are used as an article of food in several countries, and that they are eaten greedily by hogs, turkeys, ducks and insectivorous birds. He states that, "a large flock of turkeys will soon clear a field of these pests." Various other recommendations for destruction of locusts are described, and Glover states (p. 138):

As the migratory western grasshoppers occur in such vast numbers in certain localities and can be taken in such immense multitudes, it is possible that some enterprising individual may find out a means of making them useful to mankind and of utilizing them either as a substitute for guano or manure, or of drying them as food for fowls, hogs, &c. In Europe during the cockchafer season, a kind of oil was expressed from the bodies of the captured insects, and possibly some use may yet be made of the vast swarms of locusts or grasshoppers that now devastate our western plains and destroy the hopes of the western husbandmen. The suggestion has merely been mentioned to induce some of our chemists to make experiments in utilizing the insects, and should they succeed in making a profitable article of what has been hitherto a great injury to the farmers, they will deserve the gratitude of the whole country.

C.V. Riley (1876) conducted extensive studies and mounted a strong advocacy effort on the food potential of the Rocky Mountain locust, *Melanoplus spretus*. In addition, he discusses entomophagy in general, giving a number of original examples supplied by contacts in other countries (which we have discussed under the appropriate geographical area). Packard (1876, pp. 438-441) and Bodenheimer (1951, pp. 57-59) both quoted extensively from the parts of Riley's report that are duplicated below (pp. 145-147):

It had long been a desire with me to test the value of this species (*spretus*) as food, and I did not lose the opportunity to gratify that desire, which the recent locust invasion into some of the Mississippi Valley States offered. I knew well enough that the attempt would provoke to ridicule and mirth, or even disgust, the vast majority of our people, unaccustomed to anything of the sort, and associating with the word insect or 'bug' everything horrid and repulsive. Yet I was governed by weightier reasons than mere curiosity; for many a family in Kansas and Nebraska was last year [1874] brought to the brink of the grave by sheer lack of food, while the St. Louis papers reported

cases of actual death from starvation in some sections of Missouri, where the insects abounded and ate up every green thing the past Spring [1875].

Whenever the occasion presented I partook of locusts prepared in different ways, and one day, ate of no other kind of food, and must have consumed, in one form and another, the substance of several thousand half-grown locusts. Commencing the experiments with some misgivings, and fully expecting to have to overcome disagreeable flavor, I was soon most agreeably surprised to find that the insects were quite palatable, in whatever way prepared. The flavor of the raw locust is most strong and disagreeable, but that of the cooked insects is agreeable, and sufficiently mild to be easily neutralized by anything with which they may be mixed, and to admit of easy disguise, according to taste or fancy. But the great point I would make in their favor is that they need no elaborate preparation or seasoning. They require no disguise, and herein lies their value in exceptional emergencies; for when people are driven to the point of starvation by these ravenous pests, it follows that all other food is either very scarce or unobtainable. A broth, made by boiling the unfledged *Calopteni* for two hours in the proper quantity of water, and seasoned with nothing in the world but pepper and salt, is quite palatable, and can scarcely be distinguished from beef broth, though it has a slight flavor peculiar to it and not easily described. The addition of a little butter improves it, and the flavor can, of course, be modified with mint, sage, and other spices *ad libitum*. Fried or roasted in nothing but their own oil, with the addition of a little salt, and they are by no means unpleasant eating, and have quite a nutty flavor. In fact, it is a flavor, like most peculiar and not unpleasant flavors, that one can soon learn to get fond of. Prepared in this manner, ground and compressed, they would doubtless keep for a long time. Yet their consumption in large quantities in this form would not, I think, prove as wholesome as when made into soup or broth; for I found the chitinous covering and the corneous parts - especially the spines on the tibiae - dry and chippy, and somewhat irritating to the throat. This objection would not apply, with the same force, to the mature individuals, especially of the larger species, where the heads, legs and wings are carefully separated before cooking; and, in fact, some of the mature insects prepared in this way, then boiled and afterward stewed with a few vegetables, and a little butter, pepper, salt and vinegar, made an excellent fricassée.

Lest it be presumed that these opinions result from an unnatural palate, or from mere individual taste, let me add that I took pains to get the opinions of many other persons. Indeed, I shall not soon forget the experience of my first culinary effort in this line -- so fraught with fun and so forcibly illustrating the power of example in overcoming prejudice. This attempt was made at an hotel. At first it was impossible to get any assistance from the followers of the *ars coquinaria*. They could not more flatly have refused to touch, taste or handle, had it been a question of cooking vipers. Nor love nor money could induce them to do either, and in this respect the folks of the kitchen were all alike, without distinction of color. There was no other resource but to turn cook myself, and operations once commenced, the interest and aid of a brother naturalist and two intelligent ladies were soon enlisted. It was most amusing to note how, as the rather savory and pleasant odor went up from the cooking dishes, the expression of horror and disgust gradually vanished from the faces of the curious lookers-on, and how, at last, the head cook - a stout and jolly negress - took part in the operations; how, when the different dishes were neatly served upon the table and were freely partaken of with evident relish and many expressions of surprise and satisfaction by the ladies and gentlemen interested, this same cook was actually induced to try them and soon grew eloquent in their favor; how, finally, a prominent banker, as also one of the editors of the town joined in the meal. The soup soon vanished and banished silly prejudice; then cakes with batter enough to hold the locusts together, disappeared and were pronounced good; then baked locusts with or without condiments; and when the meal was completed with dessert of baked locusts and honey *a la* John the Baptist, the opinion was unanimous that that distinguished prophet no longer deserved our sympathy, and that he had not fared badly on his diet in the wilderness. Prof. H.H. Straight, at the time connected with the Warrensburg, (Mo.) Normal School, who made some experiments for me in this line, wrote: 'We boiled them rather slowly for three or four hours, seasoned the fluid with a little butter, salt and pepper, and it made an *excellent* soup, *actually*; would like to have it even in prosperous times. [Prof. and Mrs. Johonnot] pronounced it excellent.'

I sent a bushel of the scalded insects to Mr. [John] Bonnet, one of the oldest and best known caterers of St. Louis. Master of the mysteries of the cuisine, he made a soup which was really delicious, and was so pronounced by dozens of prominent St. Louisians who tried it. . . . and Mr.

Bonnet declared that this locust soup reminded him of nothing so much as craw-fish bisque, which is so highly esteemed by connoisseurs. He also declared that he would gladly have it on his bill of fare every day if he could get the insects. His method of preparation was to boil on a brisk fire, having previously seasoned them with salt, pepper and grated nutmeg, the whole being occasionally stirred. When cooked they are pounded in a mortar with bread fried brown, or a puree of rice. They are then replaced in the saucepan and thickened to a broth by placing on a warm part of the stove, but not allowed to boil. For use, the broth is passed through a strainer and a few croutons are added. I have had a small box of fried ones with me for the past two months, and they have been tasted by numerous persons, including the members of the London Entomological Society and of the Société Entomologique de France. Without exception they have been pronounced far better than was expected, and those fried in their own oil with a little salt are yet good and fresh [after several months]; others fried in butter have become slightly rancid -- a fault of the butter. . . .

Locusts will hardly come into general use for food except where they are annually abundant, and our western farmers, who occasionally suffer from them will not easily be brought to a due appreciation of them for this purpose. Prejudiced against them, fighting to overcome them, killing them in large quantities, until the stench from their decomposing bodies becomes at times most offensive - they find little that is attractive in the pests. For these reasons, as long as other food is attainable, the locust will be apt to be rejected by most persons. Yet the fact remains that they do make very good food. When freshly caught in large quantities, the mangled mass presents a not very appetizing appearance, and emits a rather strong and not overpleasant odor; but rinsed and scalded, they turn a brownish-red, look much more inviting, and give no disagreeable smell.

Also, Riley wrote regarding locusts (p. 144) that "Radoszkowski, President of the Russian Entomological Society, tells me that they are also, to this day, extensively used as food in southern Russia." Bodenheimer, p. 66, states that similar information has been repeatedly reported of the Tartars in Crimea.

Simmonds (1877, 313-344; vide Bodenheimer 1951, p. 53) discusses a number of edible insects (p. 338) including *hautle* in Mexico, insect larvae eaten in China, India and Madagascar, locusts from Algeria (where they are also used as bait for the sardine fishery), and termite oil from Gaboen, etc.

In February, 1878, The French Senator Tesselin published the following "recipes," in contesting a proposed law for the destruction of agricultural pests and the preservation of birds (vide Brygoo 1946, p. 61; vide Bodenheimer, p. 54): "Catch the may-bugs, pound them, put them through a sieve. For making a thin soup, pour water over them. For making a fat soup, pour bouillon over them. This gives a delightful dish, esteemed by the gourmets."

A.S. Packard (1878, pp. 437-443) of the U.S. Department of Agriculture spoke favorably of insects as food in what were called "Mr. Packard's Half Hours with Insects," stating (pp. 437-438):

. . . the flesh of insects is, upon the whole, repugnant to our feelings. This is certainly unreasonable, for multitudes of the locust or grasshopper of the East are eaten by Arabs and the savages in other parts of Africa. We look with repugnance upon a roasted grasshopper, but an Arab is said to have expressed his abhorrence at our eating raw oysters The writer has found by experience that grasshoppers fried in butter taste no better and no worse than shrimps.

Packard, who quoted extensively from Riley's 1876 report, discusses the results of analyses and the potential of locusts as a commercial source of formic acid. Noting the use of African locusts as bait for the sardine fishery (see under North Africa), Packard arranged for analyses of *Melanoplus spretus*, stating: "Should a demand for similar bait arise on the Atlantic or Pacific coast of the United States, large quantities of fish-bait could be prepared by Western farmers in locust years."

Provancher (1882) observed children in Quebec gathering ants from under the bark of an old stump. The ants, *Formica pensylvanica*, were for later eating. This is the species, according to Provancher, reportedly eaten "with gusto" by lumberjacks in the countryside.

Simmonds (1885, pp. 208-209, 347-375), in "The Animal Food Resources of Different Nations," provides an extensive compilation on food insect use, most of which is incorporated elsewhere in this volume. Simmonds relates (p. 348):

A few years ago at the Café Custozza, in Paris, a grand banquet was given for the special purpose of testing the *vers blanc*, or cockchafer worm. This insect, it appears, was first steeped in vinegar, which had the effect of making it disgorge the earth, etc., it had swallowed while yet free; then it

was carefully rolled up in a paste composed of flour, milk, and eggs, placed in a pan, and fried to a bright golden colour. The guests were able to take this crisp and dry worm in their fingers. It cracked between their teeth. There were some fifty persons present, and the majority had a second helping. The larvae, or grubs, generally, not only of the cockchafer, but those of the ordinary beetles, may, according to some naturalists, be eaten safely. Cats, turkeys, and different birds devour them eagerly.

Vincent Holt (1885) is extraordinarily forthright in his promotion of insects as food (this summary first appeared in *The Food Insects Newsletter* I(2): 3, 1988). The title of his little book puts the question bluntly, "Why Not Eat Insects?" Then, he summarizes the reasons for eating insects. The herbivorous insects (the only ones he recommends) are cleanfeeding compared to the lobster, crab, eel, and pig; "The lobster, a creature consumed in incredible quantities at all the highest tables in the land, is such a foul feeder that, for its sure capture, the experienced fisherman will bait his lobster-pot with putrid flesh or fish which is too far gone even to attract a crab" (p. 12). Relative to aesthetic appearance, Holt says (pp. 18-19),

As things are now, the chance caterpillar which, having escaped the careful eye of the scullery-maid, is boiled among the close folds of the cabbage, quite spoils the dinner appetite of the person who happens to receive it with his helping of vegetable, and its loathsome (?) form is carefully hidden at the side of his plate or sent straight out of the room, so that its unwonted presence may no further nauseate the diners. Yet probably these same diners have, at the commencement of the meal, hailed with inward satisfaction the presence on the board of more loathsome-looking oysters, and have actually swallowed perhaps a dozen of them raw and living as quite an appetiser for their dinner!

Frustration shows on pp. 16-17: "It may require a strong effort of will to reason ourselves out of the stupid prejudices that have stood in our way for ages; but what is the good of the advanced state of the times if we cannot thus cast aside these prejudices, just as we have caused to vanish before the ever-advancing tide of knowledge the worn-out theories of spontaneous generation and barnacle geese?" A few pages later (pp. 29-30): "Fashion is the most powerful motive in the world. Why does not some one in a high place set the common-sense fashion of adding insect dishes to our tables? The flock would not be long in following." Holt states that chemical analyses indicate that insects are nourishing and suggests (p. 15) that farmers could be aided in their battle against insect pests if the insects were collected by the poor as food (not that he suggests the poor could live entirely on insects). After calling attention to the consumption of insects by the Greeks and Romans of yore and by people in far-away lands, Holt concludes the second of his three chapters as follows (p. 47): "We pride ourselves upon our imitation of the Greeks and Romans in their arts; we treasure their dead languages: why not, then, take a useful hint from their tables? We imitate the savage nations in their use of numberless drugs, spices, and condiments: why not go a step further?"

In the final chapter, Holt mentions a number of insects in Britain that would be suitable for the table. Relative to the Orthoptera, he relates the following:

The Rev. R. Sheppard, many years ago, had some of our common large grasshoppers served up at his table, according to the recipe used by the inhabitants of Morocco in the cooking of their favorite locusts. Here it is, 'Having plucked off their heads, legs, and wings, sprinkle them with pepper and salt and chopped parsley, fry in butter, and add some vinegar.' He found them excellent. From personal experiment I can fully endorse his opinion; and there are few who would not, if they would but try this dish. . . . The above recipe is simple; but any one with a knowledge of cookery would know how to improve upon it, producing from this source such dishes, say, as 'Grasshoppers au gratin,' or 'Acridae sautes a la Maitre d'Hotel.'

From among the Coleoptera, Holt mentions in particular the grub of the stag beetle, *Lucanus cervus*, and the larva and adult of the common cockchafer, *Melolontha vulgaris*. Mentioning the pest importance of the latter, he states,

Literally tooth and nail we ought to battle with this enemy, for in both its stages it is a most dainty morsel for the table. . . . Again I endorse from personal experience. Try them as I have; they *are* delicious. Cockchafers are not only common, but of a most serviceable size and plumpness, while their grubs are, when full grown, at least two inches in length, and fat in proportion What a godsend to housekeepers to discover a new *entre* to vary the monotony of the present round! . . . Here then, mistresses, who thirst to place new and dainty dishes before your guests, what better

could you have than 'Curried Maychafers' - , if you want a more mysterious title, 'Larvae Melolonthae a la Grugru?'

L.O. Howard (1886) reported continuing work begun by Dr. Riley on the edibility of the periodical cicada:

With the aid of the Doctor's cook he had prepared a plain stew, a thick milk stew and a broil. The Cicadas were collected just as they emerged from the pupa and were thrown into cold water, in which they remained over night. They were cooked the next morning and served at breakfast-time. They imparted a distinct and not unpleasant flavor to the stews, but were not at all palatable themselves as they were reduced to nothing but bits of flabby skin. The broil lacked substance. The most palatable method of cooking is to fry in batter, when they reminded one of shrimps. They will never prove a delicacy.

M.W. de Fonvielle, Vice-President of the Societe d'Insectologie de Paris, proposed in his opening speech at the Exposition d'Insectologie in 1887 the destruction of the maybugs by "absorption," and illustrated this by swallowing some before the audience, giving signs of high satisfaction, as if he had taken some excellent chocolate lozenges (vide Brygoo 1946; vide Bodenheimer, p. 54).

Dr. Trouessart (vide Daguin 1900, p. 27; vide Bodenheimer, p. 66) saw children in France catching Orthoptera on the River Loire, pulling off their wings and cracking their hindlegs with evident pleasure.

Lugger (1897, p. 126) makes one of the few references to the use of cockroaches (Blattidae) as food (and medicine):

Few people are aware that cockroaches are of some use; they are a popular remedy for dropsy in Russia, and both cockroach tea and cockroach pills are known in the medical practice. Salted cockroaches are said to have an agreeable flavor - for those that like highly flavored sauces. These insects have also the one redeeming character - they will eat the festive bed bugs.

Caudell (1904) relates the following:

Cockroaches thrive in British Columbia as they do almost everywhere. The common species there seems to be the German roach or croton bug, *Blattella germanica*. They are in everything, even the food. On this trip I had them served to me in three different styles, alive in strawberries, a la carte with fried fish and baked in biscuit.

In a humorous descripton of "hot winds, grasshoppers and government aid" in 1874 in Oklahoma, **Callison (1914)** relates (pp. 25-26):

After the grasshoppers had eaten everything, we turned in and ate the grasshoppers. One old fellow said he used to live with the digger Indians in Idaho, and they considered a grasshopper equal to or better than oysters, crawdads, clams, chili, or chop suey. So we all learned to eat grasshoppers, and I can say from experience that they were fine; but I do not want to live long enough to eat them three times a day again. After that we had grasshoppers for about six weeks and had them cooked and served in every way that could be thought of.

Ealand (1915) devoted a section of his book, pp. 203-214, to insects as food and sometimes applies an interesting twist. He notes (p. 203) that many "North American Indian tribes were in the habit of consuming large quantities of the Rocky Mountain locust," and when "the red man was at his zenith, the Rocky Mountain locust was practically innocuous; since his subjugation, it has increased and spread to such an extent that it has come to be viewed in the light of a serious pest." In another example, Ealand (p. 204) points out that, "to the natives of Uganda, the allied crickets, *Curtilla africana* and *Acheta bimaculata*, have a double use, being kept in warm ovens, on account of their musical note, to induce sleep, and, presumably, when the pangs of hunger outweigh the discomforts of insomnia, they are used as food." Ealand notes (p. 210) that "the peasants of Lombardy are partial to the abdomens of [a beetle], *Rhizotrogus assimilis*. In Moldavia and Valachia, the beetle, *Rhizotrogus pini* forms a common article of food."

Howard (1915), lamenting that there has been very little work recently on the edibility of insects, reports results obtained at his suggestion by J.J. Davis and D.G. Tower at Lafayette, Indiana, on the eggs and larvae of *Lachnosterna*:

They find that *Lachnosterna* eggs crisply fried in butter are excellent, having a taste very much like a fine grade of bacon. The larvae, fried in butter and eaten with bread in the form of a sandwich, were not at all disagreeable, having a fresh fatty taste. They ate the heads and all, and the heads were crisp and caused no inconvenience. This line of experimentation seems to me very well worth while, and field agents having the opportunity and disposition are urged to experiment in this direction when it can be done easily and without loss of time.

Howard's last statement suggests that he was acutely aware of how taxpayers would view such research by a government agency.

Howard (1916) suggests that, with many nations facing food shortages because of war conditions, it is a propitious time to consider new and cheap food supplies. He notes that although there is an extensive literature on the historical use of insects as food, there has been little modern experimental work:

These facts point out the desirability of just such experiments, and practically all our colleges of agriculture, with their departments of home economics and of entomology, are in excellent position to do just this work. First, the edibility of the principal species abundant enough to furnish a good supply must be tested, and when the edibility of any one or more of them has been established, careful scientific work on their relative food value must be carried out. Two kinds of insects from the viewpoint of abundance and possible food value at once suggest themselves, namely, grasshoppers and the larvae of *Lachnosterna* in this country and of *Melolontha* in Europe - the so-called 'white grubs.'

Howard describes a salad and a broth prepared by Dr. C.F. Langworthy, Chief of the Office of Home Economics, USDA, from *Lachnosterna* larvae shipped from Madison, Wisconsin, by Mr. J.J. Davis and Professor J.G. Sanders. Howard describes the informal taste panel that was assembled:

The salad was eaten by Messrs. C.H. Popenoe, W.B. Wood, F.H. Chittenden, E.B. O'Leary, R.C. Althouse, W.R. Walton, C.E. Wolfe, and Herbert S. Barber of the Bureau of Entomology and Vernon Bailey of the Bureau of Biological Survey, as well as the writer. It was found very palatable, although in chewing, all of us discarded the tough chitinous skin. Dr. Chittenden discovered a disagreeable taste which none of the rest of us noticed. He tried only one, and possibly that one may have been a little spoiled. The broth was drunk by Mr. O'Leary and the writer, and we both agreed that it was not only perfectly unobjectionable but really appetizing.

Shortly afterward, Mr. Davis collected a sample of *Lachnosterna* grubs in Lafayette, Indiana, more than 100 of which were sent to Washington, and the remainder of which were made into a stew (described by Howard) which Davis and his colleagues, Messrs. Fenton and Mason, pronounced as delicious:

They prepared the grubs as they thought oyster stew was prepared, and of course ate the grubs as well as the broth. Mr. Mason thought it tasted very much like boiled crab meat and not much different from lobster. Mr. Fenton thought that it tasted much like lobster, but had not eaten crab and so was not in a position to judge whether they were more like the latter. Mr. Davis had never eaten either fresh crab or lobster, but thought that they had a decided seafood taste. All thought it 'agreeable' and 'were sorry when it was all gone.'

From the grubs sent to Washington, a stew (described by Howard) was made in Dr. Langworthy's laboratory which was found to be "very appetising." It was eaten by Messrs. E.B. O'Leary, C.E. Wolfe, C.H. Popenoe, Joseph Jacobs, A.B. Duckett, C.H.T. Townsend, C.S. Menaugh, W.R. Walton, W.B. Wood, and by Howard. Howard states that analyses and digestibility experiments were planned to determine their food value (*Lachnosterna* is now considered a synonym of the genus *Phyllophaga*). In concluding, Howard states that he is "sure that the prejudice against insects as food is perfectly unreasonable." In a footnote to this article, Howard mentions that, "Miss Colcord, the Librarian of the Bureau of Entomology of the United States Department of Agriculture, is preparing a complete bibliography of this subject [insects as food] for publication in the near future." So far as known, however, the bibliography was never published.

A.N. Caudell (1916), upon his retirement from the presidency of the Entomological Society of Washington, delivered an interesting paper titled, "An Economic Consideration of Orthoptera Directly Affecting Man." He discusses both the good and bad aspects of these insects insofar as they affect humans physically and psychologically. He provides some new references to insects as food (noted elsewhere in this volume), but, in

addition, some of his other material is of the kind needed to help upgrade the status of insects in the public mind. For example, on page 91: "The songs of insects have been enjoyed and applauded by man since the dawn of history and among our musical insects the Orthoptera are dominant. So musical are the notes of some of our orthopterous songsters that it is difficult to express their melody. The rhythmic beat of the tree-cricket has been termed by Burroughs as a 'slumberous breathing,' while Hawthorne describes it an 'audible stillness' and declares that 'if moonlight could be heard it would sound like that'" (McNeill 1889; vide Caudell 1916).

F. Netolitzky's paper (1920), "Beetles as food and medicine," is important because of the wide range of original papers consulted. Netolitzky states that entomophagy is more than a mere curiosity. Bodenheimer summarizes as follows:

Primitive man could neglect no source of food. Through insect-eating he discovered certain stimulations and side-effects which ensured for a number of insects their place in popular medicine. The weak stimuli of many other insects were attractive, and they became a favourite food or delicacy, including even lice. Yet the consumption of large and fat beetle grubs in the tropics is not based on their taste, but on their protein and fat contents. People with a predominantly vegetable diet are in great need of proteins and fats, of which insects are an important source, especially before the stages of agriculture and husbandry have been reached. The extensive list of beetles used as food or medicine [provided by Netolitzky] is valuable for the exactness of the determination of the species.

J. Bequaert (1921) refers to the recent wartime suggestion by Howard (1916) that the food value of insects should be ascertained, then states: "Favorable as the results may have proved, one can well imagine the storm of protest that would have resulted had the adoption of such a program by the general public been advocated. Yet to many it is surprising and can be attributed only to prejudice, that civilized man of today shows such a decided aversion to including any six-legged creatures in his diet." Then Bequaert ranges widely discussing the past and, at that time, present uses of insects as food in other cultures.

J.H. Fabre (1922, V, pp. 262 ff.; 1924, X, pp. 102 ff.), the French entomologist, believed in testing for himself the famous Greco-Roman insect dishes. Bodenheimer (1951, pp. 62-63) described two such occasions as follows:

One hot July morning the larvae of *Cicada plebeja* emerged from the soil for the nymphal moult. Fabre with all his family started to collect them. After two hours of intensive search four cicadas were found. Following the advice of Aristotle that they are best before their skin bursts for the moult, they were killed by being submerged in water. These were fried in oil with a pinch of salt and a little onion. The dish was found enjoyable but tasted less like grasshoppers than like shrimps. Its consistency, however, was so thin and to chew it was so much like parchment that Fabre resolved not to accept any of the other dishes recommended by Aristotle.

The village club, consisting of Julian, the teacher, Guigue, the blind man, and J.H. Fabre decided one day to try the taste of the larvae of *Cerambyx heros*, which they quite properly took for the *cossus* of Pliny. They grilled the grubs over a fire, seasoning them with salt and let them turn to a golden colour. The club approved the dish unanimously, its taste recalling that of roasted almonds and vanilla. They admired the refinement of the old Roman gourmets. Only the skin had to be discarded. Yet Pliny had also recommended fattening the *cossi* in flour. Against his own expectation Fabre found that the larvae, although not getting fatter, did at least remain in excellent condition for a long period.

After mentioning the protozoa and other diverse fauna and flora in the intestines of termites, and that termites are eaten cooked, uncooked or alive by native populations in some tropical countries, **Snyder** (1927) remarks (p. 339), "Think of the teeming intestinal fauna and flora, the nematodes, filaria, fungi and moulds!" In contrast to the dour outlook of Snyder, **Verrill** (1937) notes that "many races or nations eat and enjoy certain articles which others consider wholly unfit for human consumption" (p. 183), then lauds a number of insect foods (we've discussed in earlier chapters) which are used in various countries of the Western Hemisphere (pp. 185-186, 278-279).

C.H. Curran (1939), Associate Curator of Insects at the American Museum of Natural History, opens by relating that:

One evening while dining at the home of an entomological friend the talk got around to the eating of insects. To prove my argument that all food was liable to contain insects I picked up a piece of

lettuce from the salad. With no waste of time I picked off two or three plant lice and displayed them before my host and hostess. My host grinned weakly but my hostess was embarrassed beyond all reason. She protested that she had washed the lettuce personally and had really seen no insects on it. I was the only one present who ate the salad.

Curran mentions a number of foods and the kinds of insects that are almost assuredly to be infesting them as unwanted contaminants. In many cases it is almost impossible to detect the potentially offending insects. After a brief discussion of the intentional use of insects as food in other countries, Curran closes with the following:

During the past few years there have been a number of people who have suggested that we should eat insects. They were probably seeking notoriety or being facetious. Some of them have gone so far as to publish menus. There is no 'should' or 'should not' about the advisability of people eating insects. If they wish to do so there is no reason why they should not, since there are hundreds of different kinds that are perfectly edible. However, it is absurd to urge upon a people blessed with a super-abundance of good, delectable food, the advantage of eating something which is likely to prove less agreeable to the palate than the things to which we are now accustomed.

As we have seen, in making this statement Curran himself was not squeamish about eating insects.

Weston Price (1939), pp. 147, 184, 186, 283) mentions insects as among the traditional foods of cultures in Africa and Australia and decries the reduced access to, and use of these foods. He states (p. 186):

While the Aborigines are credited with being the oldest race on the face of the earth today, they are dying out with great rapidity wherever they have changed their native nutrition to that of the modern white civilization. For them this is not a matter of choice, but rather of necessity, since in a large part of Australia the few that are left are crowded into reservations where they have little or no access to native foods and are compelled to live on the foods provided for them by our white civilization. They demonstrate in a tragic way the inadequacy of the white man's dietary programs.

Malcolm Burr (1939), pp. 208-225), "sometime Vice-President" of the Royal Entomological Society of London, discusses insects as food and medicine, citing examples that we have noted under the appropriate geographical region in this volume. Burr says:

It is a curious thing that civilised man does not draw upon the insect world for food. Probably the real objection is that they are so small that it is difficult to catch enough to make a substantial meal, or even an appetiser. Many insects are beautiful, aromatic, pungent, or oily, and there is no logical reason why men, who do not mind drinking animals' milk, should draw back at the notion of eating an insect.

Burr, like others before him, notes that when it comes to arthropods there seems to be some saving grace in marine association.

S.W. Frost (1942), in his book, "General Entomology" (pp. 62-64), briefly discusses insects as food, using sources cited before, and also insects in music and art. **J.R. de la Torre-Bueno (1944)** similarly discusses examples of food use with which we are now familiar, as does **C.T. Brues (1946)** in the "Insect Dietary" (pp. 417-422). In **Curran's (1951)** "Insects in Your Life," pages 205-224 are a reprint of his 1939 article in "Natural History" while pages 271-285 include a few additional remarks about insects as food, primarily in Mexico. **Gaul (1953)**, pp. 14-15), in "The Wonderful World of Insects," also gives the usual examples of insects eaten by primitive cultures abroad and by American Indians and notes that, "We 'civilised' people are inclined to say 'ugh!' when thinking of eating insects." But, according to Gaul, cockroach abdomens were formerly used on prescription by the entire U.S. medical profession.

Road Dahl (1945 [1983, pp. 212-236]) builds an eerie tale around royal jelly, the material that is fed to bee larvae that are destined to become queens.

E. Brygoo (1946), in a thesis "Les Insectes comestibles," furnishes many original sources of insects as food, distinguishing between the gathering of every available food, as by the primitive food gatherers, and the selective gathering of certain insects which are an appreciated food (vide Bodenheimer 1951, p. 65). Brygoo also discusses the nutritive value of insects in the human diet.

In a short section on "Insects as Food" (pp. 109-110), **Jensen (1953)** mentions insects as a "food of minor importance," but then cites several examples of their use in other countries and data on the nutritive value of

locusts, concluding, "Perhaps the economists of the future, if hard-pressed to maintain an ever increasing population, may well turn their attention to the utilization of certain kinds of insects as human food."

Lucy Clausen (1954) of Columbia University and the American Museum of Natural History, and the author of "Insect Fact and Folklore," makes numerous brief references to insects as food in different countries as follows: caterpillars (pp. 17-19), beetles (pp. 32-33, 43-44), grasshoppers (pp. 58-59), crickets (p. 63), dipterous larvae (p. 82), honey (pp. 96-102), bee larvae (pp. 101-102), ants (pp. 111-112), cicadas (p.129), aquatic Hemiptera (p. 139), dragonflies (p. 143), and termites (p. 151). Relative to modern-day use in the United States, Clausen mentions (p. 18) that people in the United States are eating fried "*gusanos*" (skipper butterfly larvae from Mexico) with relish. "Close to the Mexican border, '*gusanos*' are served as thirst-producers at cocktail parties. In recent years Mexico has been canning and exporting '*gusanos*' and they may now be purchased in the better delicatessen and department stores of our larger cities. They are advertised as 'delicious delicacies, especially with cocktails.'" She mentions (p. 58) that in one of the handbooks published by our armed forces during World War II cooked grasshoppers were recommended as food in case of emergency. It was emphasized that they should be cooked in order to destroy any parasites they might harbor although there is no evidence that any grasshopper parasites can be harmful to humans.

Parker (1954, p. 8) mentions the use of grasshoppers as fish bait, saying that only angleworms are more widely used in trout fishing. When plentiful, they are eaten in great numbers by game birds and unconfined poultry. While grasshoppers have never caught the public's fancy as food in the United States, they were eaten by the North American Indians and are used by people in many other lands. The author notes the efforts of C.V. Riley in behalf of gaining public interest in grasshoppers as food.

In his book on how to survive in the woods, **Angier (1956, pp. 20-21)** quotes George Leopard Herter, of Herter's Inc., sporting goods manufacturer, importer and exporter: "Insects are wonderful food, being mostly fat, and far more strengthening than either fish or meat. It does not take many insects to keep you fit. Do not be squeamish about eating insects If the weather is too cold for flying insects, kick open some rotten logs or look under stones and get some grubs. They keep bears fat and healthy and will do the same for you." Herter mentions several insects such as grasshoppers, cicadas, termites and crickets, also that a most nutritious flour is made from eggs of aquatic insects in Mexico, and that dragonflies, which are a delicacy in Japan, have a "delicious, delicate taste."

Merle (1958) states that canned *gusanos de maguey* (agave worms) are sold in France, "not only at the common vendor's shop, but also, for example, in a gourmet shop at 'la Place de la Madeleine' in Paris."

Shotwell (1958, pp. 5-6), in discussing the grasshopper problem in Missouri, mentions that they are used as food in many parts of the world and quotes from some of Riley's work aimed at generating interest in their use in the United States.

D.M. DeLong (1960) discusses the beneficial aspects of insects including their use as food, stating: "Indirectly, insects are of great importance to the food supply of man the world over as they supply the basic or initial food materials that are transformed into the bodies of food animals, especially birds and fishes, whose flesh later finds its way to our tables. These insects are as much a part of the food chain for fish and fowl as corn is a part of the food chain for bacon, ham, or beef we eat. While the value and acceptability of the bodies of insects as food for man might be questioned, there are many instances where they have been or are being used. Our close neighbors, the people of Mexico utilize several types of insects as food. The larval stage of a large hesperid skipper which lives in the maguey or century plant may be purchased alive in the markets in lots of ten or twelve, tied in a small sack made from the thin membrane of the maguey plant, or they may be purchased in cans placed in groceries or food stores by commercial canning companies. At one of the regular meetings of the Columbus [Ohio] Entomological Society in 1941 these larvae were served as refreshments and some seventy-four of seventy-five persons partook of them upon this occasion." DeLong makes brief reference to several other food species.

Marston Bates (1960), the zoologist, discusses a number of insects used as food in other countries and provides some personal anecdotes:

[p. 43] In our household, I am left in charge of one department -- the things to eat with drinks. In the store where I do most of the buying, there is a wonderful assortment of temptations: fish eggs of many kinds other than the authentic but impossibly expensive caviar; fish themselves of many species, prepared in many ways; a wide range of cheeses and sausages, of crispy fried things, of olives and nuts and minced clams and smoked oysters. Lately several kinds of insects have appeared on the shelves -- canned ants and silkworm pupae from Japan, maguey worms from Mexico, fried grasshoppers -- the can doesn't say where they are from. Insects are an important element in human diet in many parts of the world, but they have long been taboo in European civilisations. It is possible that they will get back into the Western diet by way of the cocktail hour.

[p. 51] The maguey worms have been canned for the local market in Mexico for some time, and now they are being imported into the United States by the stores that specialize in fancy foods. The canned worms are best if eaten hot; they have a pleasant, nutty flavor, which blends as well with a martini as with mescal, the potent drink that the Mexicans distill from the fermented pulque. In my home we have been trying these worms on cocktail guests. As yet we haven't found anyone who disliked them, although our guests have shown considerable variation in the degree of their enthusiasm. The worms at least provide a topic of conversation.

From these experiments of ours with guests, I get the idea that while Americans may be prejudiced, they are far from being proud of their prejudices. . . . [p. 50] I used to live in a small town in the interior of South America where, at the right season, bags of the toasted sexual forms of the leaf-cutting ants were sold at the movie theater. They had the same quality, and served the same function as popcorn. The Japanese now export canned fried ants to this country, but these canned ants seem to me quite tasteless, lacking the crisp, toasted quality that I remember from South American experience.

Catherine Philip (1960) reports an interview with Professor Brian Hocking relative to research on bees in Canada and quotes him, "We have about 50 more years of steaks and then perhaps we'll have to explore other sources of animal protein." The bee brood was found to have the protein content of beefsteak, 10 times the vitamin D equivalent of cod liver oil, twice the amount of vitamin A as egg yolk and 1/10 that of cod liver oil. Philip mentions various flavors attributed to the brood, such as "nutty," etc., but, "Hocking says they taste like bees." The light flaky texture would make it an ideal fish food and the adult bees might make an excellent animal food.

Reitter (1961), in his book about beetles, devotes a section to "Beetles in Myths, Folk-lore and Folk Medicine" (pp. 48-55), in which are included a few examples of their use as non-medicinal food.

Remy Chauvin (1967), in "The World of an Insect," published originally in French, includes some discussion of insects as food.

Howard Ensign Evans (1968, p. 204), in his "Life on a Little-Known Planet," quotes from Riley's accounts of his efforts to interest Americans in western locusts as food, and then provides an interesting summary of locust harvesters that were invented (for control, not food harvest) and of laws and politics relating to locust control in the late 1870's. For example, as described by Evans:

At Riley's urging, the states of Missouri and Minnesota enacted laws awarding bounties for the collection of locust eggs and hatchlings. In Missouri, a bounty of five dollars, half paid by the state and half by the county, was awarded for each bushel of eggs collected during the fall or winter. Hatchlings collected in March were valued at one dollar a bushel, the slightly larger hoppers in April at fifty cents, the still larger ones in May at only twenty-five cents a bushel. The locusts had to be presented to the county clerk, who then issued a certificate to be presented to the county treasurer. The office of county clerk was not an enviable one! It is said that on a few occasions grasshopper eggs were actually passed as currency.

According to Evans:

The Kansas legislature, in 1877, passed quite a different law, one that has become something of a classic in legal history. This is the so-called 'grasshopper army' Act, which was apparently never enforced, although still on the books until 1923. This law required every able-bodied male between the ages of twelve and sixty-five to assemble for the purpose of fighting locusts, under the supervision of the road overseers, whenever so ordered by the town officials. Persons over eighteen could avoid duty by paying a dollar a day to the overseer, but anyone not paying or serving in the 'grasshopper army' could be fined three dollars a day.

Brothwell and Brothwell (1969, pp. 67-72) briefly discuss a number of insects used as food (discussed in this volume under the appropriate geographic regions).

Pirie (1969, pp. 161-175) offers advice on how to overcome obstacles in gaining acceptance of new foods, thus his topic is pertinent to any efforts that would be made to gain acceptance of insects in the Western world. One of the points made that seems particularly appropriate in the case of insects is that an "introduction should proceed from the privileged towards the underprivileged rather than *vice versa*. A stigma, however acquired, is not easily rubbed off. It follows from this that a novelty should never be used at first in orphanages,

prisons, or refugee camps."

Marcel Leclercq (1969), pp. 125-127), in "Entomological Parasitology," notes that world nutritional sources are becoming inadequate to meet the burgeoning world population and states that, "It could seem surprising to state that entomophagy should have at all times constituted a vast chapter in medical natural history." He refers briefly to various insects used as food in different regions, examples that we have noted previously.

In a chapter titled, "Recipes we Shall Never Use," in his book, "Exotic Food," **Rupert Croft-Cooke (1969)**, p. 150) mentions locusts: "These have been eaten immemorially and are said to taste rather like prawns which are, after all, a sort of maritime locust. Wild honey is the traditional and Biblical garnish but they are better fried, after the head is removed, in butter in which a chopped clove of garlic has been browned." Locusts are included with "better-known improbabilities" such as albatross, bulrush shoots, camel, iguana, llama and parrot pie. Then, there are "lesser-known improbabilities" such as agouti, crocodile, porcupine, tiger and zebu.

As compilers and editors of "The Explorers Cookbook," **Douglas and Douglas (1971)** offer "an international potpourri of recipes and tales from world adventurers." Included in this potpourri are several insects. As compiled from one club member (p. 34), raw witchetty grubs in Australia "have a flavor reminiscent of soft almonds and are eaten by being grasped firmly by the head . . . and then bitten off. The cooked ones are rolled in the hot ashes and sand until they 'pop.' These taste like crisp chicken fat. . Very nutritious and a major source of vitamin C." Another recipe is for "Periodical Canapes" which can be prepared every 17 years when the periodical cicada emerges. Instructions are as follows (p. 102):

Go to the woodland in the evening when the cicadas are emerging from the soil and climbing the tree trunks. Pick them from the bark just after they have shed their hard larval skins. At this stage they are white, soft-bodied, and have beautiful red eyes. When you have a hundred or so, take them home and fry them in deep fat until crisp. A clove of garlic will help. Remove from fat, drain on paper toweling, salt and serve. They are best accompanied with chilled vodka or Geneva gin.

Other recipes to be found in Douglas and Douglas include "fried Katanga termites" from Zaire which go "wonderfully well with ice cold tequila" (pp. 108-109); "matiti bugs" which are dug up in cattle kraals in Botswana, roasted, and are delicious with a taste "much like shrimp" (p. 129); "migratory locust Arabiene" which sells for 70¢ a pound, the same price as for camel meat (p. 153); "Cherokee yellowjack soup" made from the grubs (p. 210); and "locust cakes" in Africa, which are "very nutritious and tasty" (page unnumbered). G.W.B. Witten, who describes the preparation of the latter, says, "The first time I ate locust cakes I had a two-day hunger to flavor them with, but I have eaten them many times since and enjoyed them."

James Trager (1972), in the preface of "The Food Book," states: "The world of foods is changing faster than most of us suspect. . . . Why don't we eat some of the perfectly edible things most of us never think of eating? . . . While most of the world is forced to live on monotonously limited diets, the scope of our own diets is limited by stale habit and familiarity." Trager discusses insects under the heading, "Mmm, grasshoppers" (pp. 336-339) and begins by saying: "Western society abhors the idea of eating insects (though we do not hesitate to eat honey, an insect-manufactured food) and regards insect eating almost as an unnatural act. Arabs, and other Africans and Asians who do eat insects, for their part can scarcely believe Westerners would eat shellfish which, like insects, are invertebrate arthropods. (Put a lobster beside a grasshopper and note the similarity of construction.)" Trager continues: "We eat lobsters, crabs and shrimp, but how about land crabs? They are a great delicacy at Las Croabas, in Puerto Rico, but in Florida, where land crabs abound, nobody will touch them. North Americans will evidently eat arthropods, but only if they come out of the water."

Trager briefly discusses the usual examples of insect use as food around the world, then says:

But the only insects in American supermarkets, at least the only kinds offered for sale, are fried grasshoppers, Japanese ants, bees and silkworm pupae, and Mexican maguey worms (the larva of a butterfly, *Aegiale hesperialis*). All are sold in cans, ostensibly as cocktail snacks but basically for their entertainment value. Americans' propensity for 'impulse purchases' is prodigious.

Food habits can change though; Trager mentions (pp. 331, 333-334) that, "Until the American diplomat Townsend Harris went to Japan in 1856, no Japanese ever ate beef. . . . Today Japan is America's biggest export customer for meat, though the Japanese are famous for their own Kobe beef . . ." The enormous shift that is needed in Western attitudes about insects, however, is indicated by the following episode related by Trager (p. 338):

During the Nigerian-Biafran war, when thousands of Biafrans were dying of starvation, a London

group in the summer of 1968 appealed for funds to aid the hungry Biafrans. Their full-page advertisement in the *Manchester Guardian* showed a large winged insect and carried the ironic headline, 'Fresh food is now flying in to Biafra.'

Good nourishing stuff it is, too [said the copy].

Sausage-flies are full of protein.

So Biafran mothers feed them to their children. It's the only way to keep them alive.

And if they can't stomach sausage-flies, there are always rats and lizards.

But sausage-flies are the easiest meat. At night they flock to any bright light they see.

Which is more than can be said of relief planes.

"It was an effective ad for a just cause, but its strength lay in the shock with which its readers must have regarded eating insects. African readers would not have been so shocked."

Reay Tannahill (1973), in "Food in History," mentions a number of familiar examples of the uses of insects as food (pp. 48, 244, 252) and states:

The destructive nature of early American hunting and seafoodgathering may be partly explained by prehistoric man's inbred taste for flesh food. But fortunately, even with meat, fish and seafood in short supply, there were insects he could fall back on. An analysis of digestive remains from a prehistoric site in Mexico suggests that early man there was not averse to a meal of grasshoppers, ants or termites. Indeed, there is no good reason why he should have been. Several insects were considered delicacies in classical times in Europe, and a number are still eaten with pleasure in China, Africa and Australia today.

Regarding the arrival of Columbus in the Caribbean, Tannahill says:

One thing they learned was that the people ate many foods which appeared revolting to Europeans, among them 'large fat spiders, white worms that breed in rotten wood, and other decayed objects.' The peoples of tropical America had, in fact, a long tradition of eating the plump insects which abounded in those latitudes, and the agave worm (*meocuilin*) was a delicacy greatly favored at the Aztec court and still relished in Mexico in the twentieth century.

J.K. Loosli (1974), animal nutritionist at Cornell University, authored an article on "New Sources of Protein for Human and Animal Feeding" which is different from most such articles in that he at least mentions insects -- although barely. Discussed are efforts to develop mixtures of vegetable protein foods to extend or replace milk; increases in crop production resulting from the Green Revolution; new protein sources including fish and fish protein concentrate; soybean protein including soyflour, soymilk, and isolated soybean protein; amino acid fortification of foods; single-cell protein including dried brewers yeast, bacteria, algae and something called chlorella in Taiwan; animals as sources of protein including cattle, goats and other conventional forms of livestock, and a variety of game animals such as buffalo, zebras and antelope. Even giraffes, elephants, rhinoceros and hippopotamus are mentioned as utilizing leaves and small branches not used by conventional livestock (this would have been a good place to mention with some emphasis African caterpillars and quite a number of other edible insects). Loosli's coverage of insects is found in this excerpt:

Food habits differ widely in various areas of the world. In addition to the items listed in US food composition tables, the FAO (1968) table for use in Africa includes the following as foods of animal origin which are accepted by some groups: animal organs, ants (flying), ass, baboon, bat, beetles, blood, bushpig, camel, cane rats, caterpillars, chimpanzee, cranes, crickets, crocodile, dog, donkey, elephant, flies (lake), frog, gorilla, grasshoppers, hippopotamus, horse, iguana, lemur, locust, mouse, pigeon, porcupine, rat, rhinoceros, snakes, sparrows, termites, turtle, wildcat.

In 1974, almost ninety years after publication of Holt's book, a newspaper reporter, Bud Gordon, interviewed Eric Classey, owner of the London publishing company that had just issued its third reprinting of Holt's book (1967, 1969, 1973). "We've already printed three editions - about 6,000 copies - of the book and orders are still coming in," said Classey. He continued, "Eating tastes are becoming more adventurous every day and some people are actually trying the recipes. But the main reason for the book's success is all the talk about the world's food supplies running out. People seem to want this book on their shelves just in case worst comes to worst and eating becomes a matter of survival rather than pleasure." The reporter, Gordon, listed a few of Holt's recipes, then rendered his conclusion, "Ugh!"

In his book, "Butterflies in My Stomach," **Ronald Taylor (1975)** discusses a number of aspects pertaining

to the food potential of insects. In the first chapter examples are given showing that there is no logic in the matter of food prejudices and preferences of different peoples. It is stated that: "There is nothing inherently wrong, of course, with a preference for a diet of 'meat and potatoes,' but it is sad when we regard such a diet as somehow 'superior' or even preferable to the diets of other peoples. The world contains many nutritious, tasty foods that Western peoples -- because of our prejudices -- have never eaten." It is noted in the second chapter that insects function both directly and indirectly in the human diet, indirectly through pollination of food crops, production of honey, and as food for animals whose flesh is found on our tables, and, directly, when eaten either intentionally or unintentionally. Several examples are given of the ways in which insects or insect parts slip into the Western diet despite the best efforts of government and the food industry. Taylor says, "It is my belief that many of the 'Maximum Permissible Levels of Insect Infestation or Damage' prescribed by the Food and Drug Administration are set as low as they are not necessarily because more insects would represent a hazard to human health but because they would be noticed by a public sensitized against insects in any shape or form." Taylor notes the environmental cost of this over-sensitivity in the expanded use of pesticides. The world protein crisis, the reasons for it, and approaches that are being taken to try to alleviate it are discussed in the third chapter, and the potential of insects as one of the viable approaches in the fourth chapter. Insects are nutritious, have a high food conversion efficiency, have a high reproductive capacity, and they are mass-producible. Several recycling systems are hypothesized, one, for example, being the use of termites for recycling the millions of tons of paper and other wood-derived wastes that are burned or buried daily. Problems of marketing are discussed. The fifth chapter is devoted to methods of obtaining and preparing insects, the sixth chapter to the use of insects in wilderness survival, and the seventh chapter to the medicinal role of insects. Part II of the book is a summary of the insects that are used as food somewhere in the world. There are a number of appendices and a bibliography of approximately 150 titles.

Dr. Taylor's book is a useful introduction to this vast subject for both the scientist and layperson, although the frequent lack of text citations detracts somewhat from its value for the former. As stated by the author, however, it was intended for the general reader rather than the specialist.

"Entertaining with Insects. Or: The Original Guide to Insect Cookery" by **Ronald Taylor and Barbara Carter (1976)** is an attractive booklet with 85 recipes that incorporate insects as part of hors d'oeuvres, savories, soups, salads, vegetable dishes, entrees, desserts and candies, breads and pastries or butters. They carry such enticing names as cricket crisps, cricket rumaki, sauteed bacon-pepper bees, chirping stuffed avocados, cricket pot pie, jumping melon salad, mealworm chow mein, chocolate chirpies, honey bee granola bars and jumping jubilee (prepared over flaming brandy). The recipes center around the mealworm (a beetle larva, *Tenebrio molitor*), and the cricket (*Acheta domestica*), both of which are commercially available, and the honey bee (*Apis mellifera*) which can be obtained from your nearest beekeeper friend. Some of the tastiest insects were excluded because they were not commercially available although they can be home-grown. (One of these, the larva of the greater wax moth, *Galleria mellonella*, is now commercially available.) Commercial sources are given for mealworms, crickets and praying mantises, as well as instructions for home-rearing of mealworms, crickets, bees, and wax moth larvae among others. Also given are instructions for cleaning and preparing the insects. The last 10 pages of the book are given over to earthworm cookery.

The insect is unrecognizable as such in most of the recipes, and your guests would be unaware of their presence if not told, the authors say. "This of course, is not to advocate 'tricking' your guests. Rather, it simply emphasizes that objections to eating insects have little or nothing to do with their taste or food value. If there is a problem, it arises from what we bring to the insect rather than what the insect brings to us." A section called "Basics" describes various ways of treating the insects before their application in the recipes. These basic preparations include "basic" cooked insects, dry roasted insects, basic insect flour, pastry, insect broth, insect marinade, garlic butter fried insects, and candied insects, as well as sauteed mushrooms and garlic butter which contain no insects.

Taylor and Carter not only offer 85 recipes, but they have created complete menus for practically every gastronomic occasion, to wit: the cocktail party for 30 and the more intimate party for six; the Bloody Mary brunch and the champagne brunch; the formal lunch and the California lunch; the French dinner and a hearty dinner; the late evening supper (for after the theater); and for more kinds of national celebratory occasions than we knew existed, i.e., the Chinese New Year, a Mardi Gras party; Birthday of Rome; Florentine Cricket Festival -- a picnic; Indian Independence Day; and the Japanese Moon-Viewing Festival.

If insects do not soon gain a foothold in American cuisine, it will not be for lack of exciting recipes from which to choose. Taylor and Carter say of their Insect Quiche: "This recipe suggests a whole new dimension in quiche cooking. We're up front about the insects; they're not camouflaged." Of their Melanzane Italiano, they say: "We recently served this dish at a small dinner party. All went well even after one lady asked for the recipe." Of their Szechwan Supreme: "A spicy Oriental dish we named after one of the largest provinces in China. A guest recently called it 'supremely good.'" Of their Siu Mai: "A friend of ours describes our Siu Mai as 'bundles of gustatory excitement.'" Of their Cricket Pot Pie: "Don't be surprised if this dish is picked up by the

manufacturers of frozen foods." Finally, of their Egg Foo Yung (see the recipe at the end of this summary of Taylor and Carter), they say: "Disguised among the bean sprouts, you will find our addition of mealworms. This is an excellent dish to serve to those who would like to try insects but feel they 'just couldn't.' The bean sprouts and mealworms both crunch and are indistinguishable. We regard this creation as our *pièce de résistance*."

Of the greater wax moth larva, Taylor and Carter say (p. 135),

"If only they were commercially available, we would probably have centered most of our recipes around them. They are our favorite insect. They are thin-skinned, tender, and succulent. They would appear to lend themselves to commercial exploitation as snack items. When dropped into hot vegetable oil, the larvae immediately swell, elongate and then burst. The resulting product looks nothing like an insect, but rather like popcorn. Anyone who enjoys the flavor of potato chips, corn puffs, or the like would delight in the taste of fried wax moth larvae. We can imagine them fried as above, salted, packaged in cellophane, and displayed in the supermarket alongside the other snack items.

"Entertaining With Insects" is a totally delightful little book, stylishly illustrated (by John Gregory Tweed) with scenes of happy people of obvious intelligence, class, charm and substance. None show the slightest hint of mental strain, even though we know what they have been up to. As the authors say in their introduction, *Bon Appetite!*

Recipe for **Egg Foo Yung**, from Taylor and Carter (1976, pp. 80-81; an example of recipes presented):

2 tablespoons vegetable oil
 1 medium green pepper, chopped
 1 medium onion, chopped
 ½ cup cooked mealworms, chopped (see Basic Cooked Insects in *Basics*)
 1 cup bean sprouts
 1 can (8-ounce) water chestnuts, drained and thinly sliced
 3 tablespoons soy sauce
 5 eggs
 Hot Soy Sauce (see below)

Barbara Ford (1978), pp. 250-258), in a chapter called "Eating the Unthinkable" in her book "Future Food," summarises several accounts from the popular press and interviews with several people who are into insect-eating, mentioning termites, bees, grasshoppers, and crickets, among a few others. **Dewey M. Caron (1978)** reminds that one-third of the American diet comes from plants requiring or benefitting from insect pollination and that honeybees are responsible for 90% of the planned pollination. Caron notes that most of the students in his apiculture class at the University of Maryland find bee brood to be better than they expected.

Ruth Adams (date?, pp. 169-175), in a chapter titled "Let's Eat the Bugs!," is an outspoken advocate of doing just that. She notes the ravaging of our forests in the northeastern United States by the gypsy moth, and says:

Our early ancestors and many groups of primitive people alive today regarded insects as very good food, delicacies, you might say. Why shouldn't we? Why should we continue to devastate our land with poisons, year after year, in order to destroy what is surely one of our best sources of protein - in a protein-hungry world! Surely anyone who has ever eaten a snail, an oyster, or a dab of caviar has no excuse for feeling squeamish or queasy over a fine fat grub.

Adams provides numerous examples of insect-eating from around the world. As a sampler: "Restaurant keepers in China in the days of Marco Polo served silkworms made into pies, which were much like their shrimp pies. Grasshoppers were eaten by poor Chinese peasants, although they were called 'brushwood shrimp' as a euphemism, much as a Chinese peasant, sitting down to a meal of fried rat, called it 'household deer.'" Another: "So important are caterpillars to the Bantu people in Africa that, when they migrate from the bush into town, it has been found necessary to ship in caterpillars, cook and package them, and sell them in food stores. They provide protein, as all food of animal origin does, plus B vitamins in abundance, and many minerals. It's safe to say, if the Bantu town-dwellers are faced with eating the refined, processed, carbohydrate-rich foods which are so inexpensive and easily available in markets, the caterpillars may well be the single most nutritious item in their meals." And for ingenuity, referring to Mormon crickets: "Indians in Northern Nevada hunted crickets in

somewhat the same way. They dug trenches 30 feet long, joined at the ends, facing uphill and covered with stiff grass. Then swinging fans of grass, they drove the crickets toward the trenches. As the insects crawled into the grass for cover, the Indians set fire to the grass - and presto - roast crickets for dinner!"

Adams notes that experts "all over the world are working feverishly with brewer's yeast, powdered milk, soybeans, fishmeal, leaf protein, petroleum products and dozens of other relatively inexpensive foods and non-foods, trying to concoct some highly-concentrated nutrients which will be acceptable to people who appear to be the ones who will go hungry or starve before the rest of us do - primarily the people in the undeveloped countries. . . . If African pygmies can devise ingenious ways to capture practically all the termites in a given hill, and Nevada Indians had methods for luring enough crickets to roast and eat for many days, surely the engineers of our modern technological world can contrive ways of capturing the insect pests that devastate so much of the earth." And finally: "And surely American food technology, which gave us the Space Bar, the candy bar, the muffin mix and Seven-Up, can invent ways to make this highly nutritious insect windfall palatable to almost anyone anywhere."

Klausnitzer (1981) discussed "Edible and curative beetles," citing a number of examples from around the world (pp. 71-73). He states:

In every age, insects have played a greater or smaller part in providing food for human beings. Analysis shows that insect protein has a composition which is of great value to man. The same is true of insect fat. . . . It is generally accepted that in primitive societies, insects were a valuable item of diet. . . . Even today in many parts of the world, insects are prized as a valuable food. A completely illogical, purely emotionally based aversion to the idea of eating insects is in essence to be found only among Europeans, although Linné in his *Systema naturae* remarks (translation): 'Roast larvae are considered a delicacy.'

Regarding insects as Western fare, Klausnitzer mentions:

In the best French restaurants, even toward the end of the last century it was still possible to eat Cockchafer Bouillon. The raw material used was generally the abdomens, although other opinion specified the thorax. Cockchafer Bouillon was said to strengthen the nerves. In an old cookery book, the recipe can be found for Cockchafer soup which is recommended in a special diet for anaemia. 'Take 1 pound of cockchafers, remove the wing cases and legs, fry bodies in 2 ounces of butter until crisp, add chicken stock and boil; add a small quantity of sliced calf's liver and serve with chopped chives and croûtons.'

Kent Martin (1988) describes a lunch in which Whitney Cranshaw, extension entomologist at Colorado State University, and several students tried grasshoppers. They were prepared in two ways (after removing wings and legs), either roasted and salted or dipped in tempura batter and soy sauce. Results: "Overall, the roasted males of both species proved tastiest, everyone concurred. Then again, no one volunteered to take home the leftovers, and Cranshaw hasn't had requests to repeat the trial. So the group's unanimous conclusion stands: For the near future, at least, controlling grasshoppers by eating them isn't likely to catch on in the States." Cranshaw, personally, has tried cabbage loopers (while a graduate student at the University of Minnesota working on pest problems for commercial canned-pea growers) and compares their flavor and texture to shrimp. "People pay \$7.99 a pound for lobster and shrimp, and you don't even want to know what those crustaceans eat off the ocean floor," he says. "These insects just get to the peas a little before we do, but we wouldn't dare eat them. Ironically, I think they taste a lot better than canned peas in the first place."

In a brief discussion of insects as a source of nutrients (pp. 214-215), **Peters (1988)** points out that all major vertebrate groups have representatives that consume insects on a regular basis and at least one representative that lives exclusively on insects and other arthropods. For example, partially insectivorous Pisces include trout, sunfish; Amphibia include salamanders, frogs; Reptilia include gecko, garter snake; Aves include robins, thrushes, shrikes, creepers, sparrows, starlings; and Mammalia include moles, skunks, shrews, bears, foxes, rodents and primates. Brief tabular data on protein, fat, ash and calorie content are presented as a basis for saying that, compared to beef and dried salt-fish, insects are the richer source of nutrients, overall. Peters states:

The point to be made is not that we should all start eating insects, just because other peoples consume them, but they do constitute an acceptably nourishing material. The food industry has made great progress in increasing the palatability of many nutrients. A food technology sophisticated enough to make spiny dogfish flesh into such appetizing and acceptable foods as 'hot dogs,' 'corn curls,' 'shrimp roll,' and shrimp should be able to meet the challenge offered by

insect proteins without difficulty.

Pemberton (1988) reported finding the Thai giant waterbug, *Lethocerus indicus* (Hemiptera), for sale in a Thai food shop in Berkeley, California. The bugs, imported from Thailand and known as "mangda" in Thai, had been preserved by boiling in salt water. They were priced at \$1.50 each, and, according to the shop owner, are popular with Thai and Laotian customers who use them to make bug-paste condiments. The bug-paste, called "nam prik mangda," is usually prepared by combining and mashing a whole bug with salt, sugar, garlic, shallots, fish sauce, lime juice and hot Thai capsicum peppers in a mortar and pestle. "Nam prik mangda" is commonly used as a vegetable dip and as a topping for cooked rice.

Pemberton found a commercial preparation of the bug-paste in a San Francisco Thai market, and clear alcohol extracts of the bug, called "Mangdana essence," in Southeast Asian markets in Berkeley, Oakland and San Francisco. A few drops of "mangdana essence" is used as a substitute for a whole bug in the preparation of "nam prik mangda." These commercial products, made in Thailand, were priced between 79 cents and \$1.20, and are considered to be inferior in taste to home-made "nam prik mangda" made from whole bugs. The product labels made no mention of the bug, and Pemberton speculates that the manufacturers were concerned that openly marketed insect foods might be culturally offensive in the United States. Pemberton was unable to find *L. indicus* in California's Chinese markets as reported by R.L. Usinger in 1956, but suspects that it is still used by some California Chinese. The author concludes, saying, "The presence of *L. indicus* and its products in California markets is indicative of the great diversity of Asian food entering America."

The Food Insects Newsletter began publication in 1988 with two issues. Since 1989, there have been three issues per year, in March, July and November, with 8 or 10 pages per issue in the early years and 12 pages in subsequent issues. For the first six years, the Newsletter was free, circulation increased to nearly 3,000 with recipients in 82 countries. The founding editor was this author (DeFoliart); in November 1995, he was succeeded in the editorship by Dr. Florence V. Dunkel. The Newsletter publishes feature articles, shorter articles and notes, summaries of technical papers, letters, recipes and other items on every aspect of entomophagy. It serves as a valuable forum and source of information for both scientists and laypersons, students, writers and the mass media.

With regard to insects imported as food to the United States, as most American consumers do not think of insects as food, **Brickey and Gorham (1989)**, Food and Drug Administration, explain that, ". . .insects fall under FDA's definition of food if that is the proposed usage by the importer." More broadly, they state that:

The fact that a food product consists largely or entirely of insects intentionally processed and packaged for use as human food does not automatically bar it from commercial distribution to the American consumer. Usually, all that FDA requires under the law is that the food, whether imported or manufactured domestically, must be clean and wholesome (i.e., free from filth, pathogens and toxins), must have been manufactured, packaged, stored and transported under sanitary conditions, and must be properly labeled in English.

"Fried cow or fried locust -- What's the diff?" is the title of a short article in the newsletter published by the Department of Entomology at the University of Minnesota (**Anon. 1989**). Entomology students, apparently refusing to be overcome by cultural bias, provide recipes for fried locusts and grasshopper fritters.

Following a 1988 reprinting by the British Museum (Natural History) of Vincent Holt's 1885 book, "Why Not Eat Insects," **R.L. Vane-Wright**, of the Museum, reviews the subject (**1991**) and concludes, "Why not eat insects indeed!" He states:

To many people the idea of eating insects evokes only feelings of disgust. . . . But what does biology tell us? A wide range of vertebrates are insect eaters. The common ancestor of primates is thought to have been an insectivore. Most monkeys and apes eat insects -- including the chimpanzee, our closest living relative. In contrast, many humans restrict their choice of meat to a few vertebrates, molluscs and crustaceans."

Noting that western European cultures, and nations derived from them, are the only ones which do not use insects as food, Vane-Wright says, "Food habits are not conditioned by nutritional tables, calorie counts or balanced diets. What we eat is conditioned by religion, by tradition, by fashion -- in a word, by culture." Once established, food preferences are highly resistant to change. Mentioning a number of insects consumed in Africa, Asia and the Western Hemisphere, including the famous mopani worm, *Gonimbrasia belina*, in Africa, Vane-Wright asks: "Could such insects become acceptable to western palates? Perhaps. My three-year old daughter finds fried mopani worms irresistible; her food preferences have yet to become fixed."

Unpredictability of supply is a major problem with wild insects for feeding urban societies, even though

many insects are locally or periodically abundant. Advanced culture techniques will be needed if city dwellers are to be reliably fed on a large scale. Vane-Wright notes that, "the very fact that eating insects belongs to the hunter-gatherer stage of human evolution may be a major factor in their rejection by western people; we may unconsciously reject entomophagy as primitive." Relative to safety, the author notes that unicolorous larvae are generally thought to be the most suitable, hairy or spiny insects may irritate, and brightly colored species may be poisonous. Cooking is always desirable because some insects carry parasites.

Vane-Wright asks whether, despite insects being a wholesome source of protein, fats and other nutrients, there is any compelling economic reason for using them as food. His answer: "Well, there may be. Raising conventional protein animals, such as cattle, is having a major effect on the surface of the planet -- large areas of forest burned to make way for ranching, with all the problems that this short-term economic solution brings -- including greenhouse gases released by cattle effluent." Also, stimulating the idea that insects are desirable food could promote additional concern for the conservation of biodiversity, as well as reducing pesticide pollution and returning grazing land to forest.

Vane-Wright concludes: "Insects have an undeservedly bad reputation. A handful of noxious species has meant that, too often, they are all seen as enemies. In their most infinite variety, insects could yet be our salvation. Is it not time for economic entomologists to develop a more positive view of their value?"

In Europe, **Comby's (1990) *Delicieux Insectes*** sold so well that German and Italian translations of the original French edition have been published.

Schmidt and Buchmann (1992) point out that honeybee brood (larvae/pupae) is not only relished as food in many indigenous cultures, but has proven nutritional value in the feeding of non-human animals, particularly songbirds. In the form of drone powder, brood has proven valuable in rearing certain insectivorous predators used in biological control programs. There are other modern products of the hive: honey, beeswax, pollen, propolis, royal jelly and venom (for treatment of severe sting allergies). These products, when added to their immense importance as pollinators, make honeybees an excellent example of a multiple-product food insect that increases economic and environmental efficiency (see DeFoliart 1997, pp. 120-122).

In a report by the World Conservation Monitoring Centre, **Smith (1992, pp. 361-364)** presents four tables with data relevant to the use of edible insects: Selected insects used as a human food resource (showing scientific names [63 species or genera], life stage normally consumed, and area(s) where eaten); Countries with honey production at or in excess of 10,000 tons in 1989; Nutritional values of selected vertebrate and invertebrate products (proximate analyses of 8 vertebrate and 19 insect species), and; Efficiency of food conversion for selected animals (6 vertebrates and 29 insects). From the tabular data, the author notes that, nutritionally, insects compare well with other animal products, and that efficiency of food conversion to biomass is also favorable.

Other points made by Smith include: "Some species are dried and sold to quite a large market and are important in the local economy"; "The seasonal abundance of certain species makes them especially important at times of year when other food resources may be lacking"; "Despite the widespread use of insects and other invertebrates for food, they represent an under-exploited resource"; and, "Many species which are agricultural pests are also used as a food resource in some part of their range, or have the potential to be utilized." The sources of insect data cited are among those familiar to students of the subject, but the report is significant because it is another demonstration that organizations such as the WCMC are increasingly recognizing the global importance and potential of edible insects. The WCMC is a joint-venture between partners who developed the World Conservation Strategy: The World Conservation Union, United Nations Environmental Programme, and World Wide Fund for Nature (World Wildlife Fund). Its mission is to support conservation and sustainable development through providing information on the world's biological diversity.

DeFoliart (1992) states:

During the past few years there has been a new upsurge of interest in insects as food. One factor that may be responsible is an increasing awareness in the western world that insects are traditional and nutritionally important foods for many non-European cultures . . . Other factors may be increased pride in ethnic roots and traditions, increased concern about environment and overuse of pesticides, and better communication among scientists who are interested in the subject. Edible insects may be closer now than ever before to acceptance in the western world as a resource that should be considered in trying to meet the world's present and future food needs.

The author treats the subject under four major headings: Traditional use and economic importance in non-European cultures; Nutritional value; Relevance to environmentally compatible pest management and sustainable agriculture; and Economic implications for industrialized countries. Subheadings under Nutritional

value are Protein, Fat, Vitamins and minerals, Fibre, and Potential hazards.

In a sequel to their book, *Future Stuff*, published in 1989, **Abrams and Bernstein (1993)**, pp. 281-282 predict that edible insect products will arrive in stores or become otherwise available nationwide in the U.S. by 1995, and they set the odds at 50:50 that this will happen by 2001. The authors start by saying: "It's time Westerners got wise. Most of the rest of the world knows how delicious and nutritious insects can be. In Africa, Asia, Latin America, and the Western Pacific insects are valuable and traditional food sources. So what gives with Europeans and North Americans?" Abrams and Bernstein then go on to note that insects are high in protein, unsaturated fatty acids, vitamins such as riboflavin and thiamine, and minerals such as iron and zinc (the latter important for vegetarians). They note that the flavors of insects are varied and good. Food conversion efficiency of many insects is high, and therefore, their environmental compatibility, and insect harvest bolsters rural economies. Furthermore, the edible insects are clean feeders, unlike shrimps, crabs and lobsters. It is noted that the main obstacle to commercialization is the need for methods of mass production.

Relative to use of the mud nests of wasps (mud-daubers, potter or mason wasps), in medical infusions, **Starr (1993)** mentions that "Dirt Dauber Blues" is one of two songs about stinging insects mentioned in a recent book on the blues by Paul and Beth Garon ("Woman with Guitar: Memphis Minnie's Blues," 1992). The first verse lyrics go like this:

Everybody worrying me, want to know why I'm so crazy about dirt dauber tea.
Everybody worrying me, want to know why I'm so crazy about dirt dauber tea.
Because when I was young, they built their nest on me."

According to Starr, Garon and Garon cite several uses in southern folk medicine for mud-dauber nests and a tea prepared from them. Starr says the species must be *Sceliphron caementarium* or the organ-pipe mud dauber, *Trypoxylon politum* (Sphecidae), both of which are common in the southern U.S. According to Starr: "Minnie's remark that they built their nest on her may be taken almost literally. If Minnie was bed-ridden in an unscreened house in the summertime, a mud dauber may well have taken to making a nest right on her bedpost or headboard. Lying immobile, she would have seen the wasp come and go many times, gradually building up the nest." Starr provides further interesting analysis about the song, the mud dauber's unthreatening buzz, and the easy familiarity between rural southerners and their wasps.

In an article titled "Every 17 Years, Like Clockwork" in the Old Farmer's 1995 Almanac, **Deborah Papier (1994)**, pp. 46-48, 50 reports that "Sometime in the spring of 1995, residents of Pennsylvania, Maryland, Virginia, West Virginia, and North Carolina will begin hearing an incredible and constant racket the likes of which they will not have heard since 1978." The article gives a good summary of periodical cicada biology. It notes that there are approximately 15 broods of *Magicicada*, each with a 17- or 13-year cycle, and that each year, somewhere, a brood is making its rare appearance. "In 1995 its showtime for Brood I, a 17-year cicada that has staked out a portion of the mid-Atlantic region," says the author, who points out that only the males make music, and a single cicada can make itself heard a quarter of a mile away. "A chorus of the insects can produce a din that will register at 100 decibals - the equivalent of a jackhammer." The cicada is discussed as a taste treat in a sidebox, under the heading "Bet you can't eat just one" (p. 50):

Just the right size for popping into your mouth, with a satisfying crunch and a flavor that has been compared to a cross between a potato and an avocado, cicadas would seem to be the perfect snack food. The Native Americans were quite fond of the crispy critters, but the settlers could never be persuaded to munch along, and few people today appreciate this rare taste treat. Cicadas are easily prepared: Just dip in batter until golden brown. Serve with cocktail sauce.

The final annual meeting of the USDA's Grasshopper Integrated Pest Management (GHIPM) Project, held in Boise, Idaho, opened with a grasshopper social featuring laboratory-reared 'hoppers supplied by the Rangeland Insect Laboratory, an Agricultural Research Service facility in Bozeman, Montana (**Sampson 1994**). The head chef at the hotel in Boise prepared stir-fry grasshoppers, grasshoppers tempura, and chocolate-covered grasshoppers. According to Sampson, most of those attending the meeting sampled the entomological cuisine, "but some diehards said they would rather 'treat than eat' the 'hoppers." Preparing grasshoppers to tempt the palate was credited with helping to draw attention to the grasshopper problem, especially from local and regional media, and a television station in Albuquerque, New Mexico, even aired a short film feature about cooking and eating grasshoppers as a result of covering the meeting. The GHIPM Project involved 8 Federal agencies, 10 universities, and a number of State departments of agriculture, private industry and public interest groups in a 9-year effort to improve and refine grasshopper management techniques. The GHIPM Project staff in Boise will continue to implement technology transfer in the western rangeland states and close out the project, according to Sampson, "perhaps feasting on a final meal of 'hoppers before saying goodbye." This would seem, in the opinion

of this writer, a most appropriate way to end a government project on grasshopper pest management.

The **Insectarium de Montreal (1994)** published a free leaflet (available in English or French) on how to rear and prepare your own mealworms (*Tenebrio molitor* [Tenebrionidae]). Following some general discussion on the global use of insects and their quality as food, the 4-page leaflet is arranged under the following headings: How to raise mealworms, subdivided into sections on equipment, preparation and maintenance; When can you begin eating the larvae from your "farm"?; Preparing your insects for use; Start your ovens. Recipes are provided for mealworm cookies and Mealworm canapes. A similar leaflet on crickets was published subsequently.

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