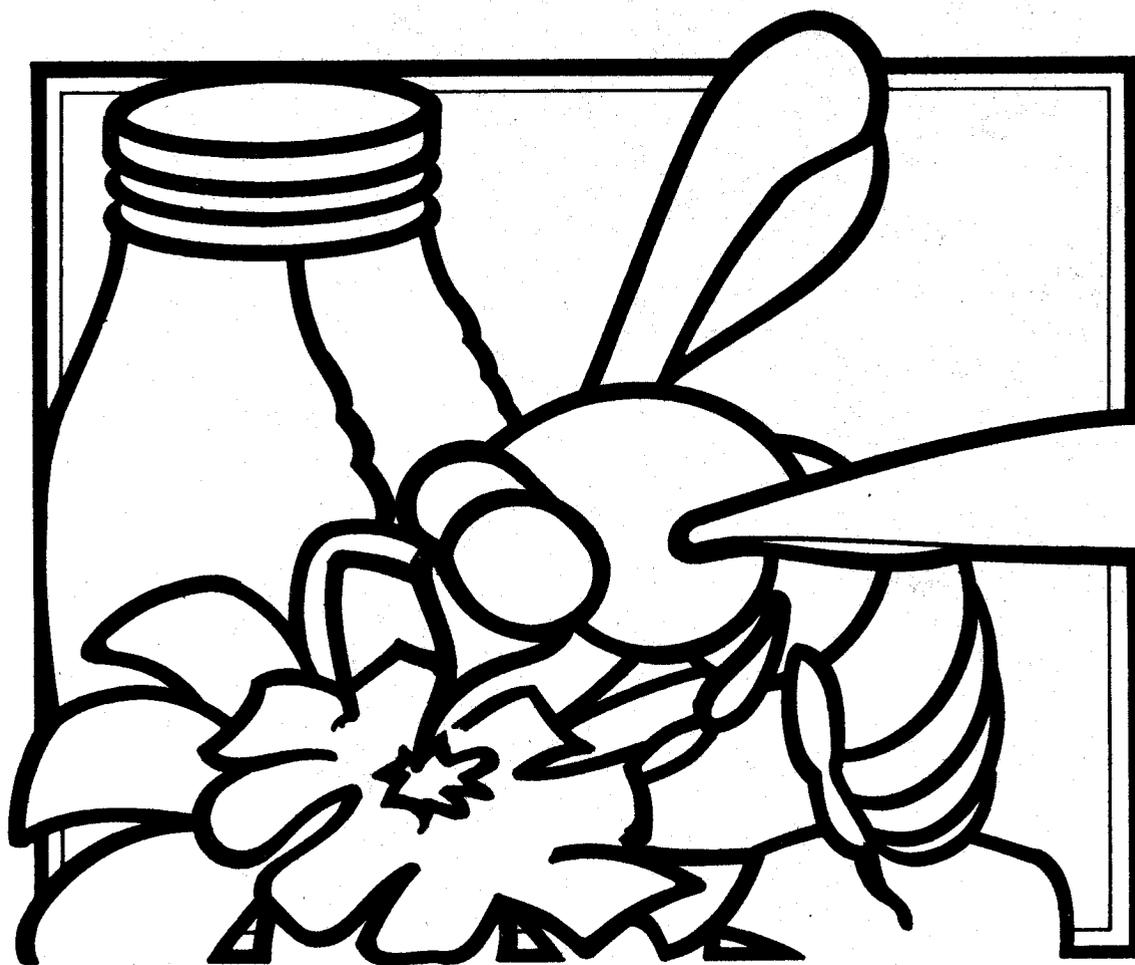


BEEKEEPING IN THE UNITED STATES



UNITED STATES
DEPARTMENT OF
AGRICULTURE

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NUMBER 335

PREPARED BY
SCIENCE AND
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ADMINISTRATION

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ABSTRACT

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In the United States about 200,000 people keep almost 5 million colonies of honey bees and produce 200 million to 250 million pounds of honey annually. Beekeepers derive income from the sale of honey, renting of colonies for crop pollination, production and sale of queen bees and packaged bees, and to a minor extent, from the sale of beeswax, pollen, bee venom, propolis, and royal jelly.

This handbook provides readers with a better understanding of beekeeping in the United States. Some topics discussed are the life history of the honey bee; bee behavior; breeding and genetics of honey bees; queens, packaged bees, and nuclei; managing colonies for high honey yield and crop pollination; diseases and pests of honey bees; and effects of pesticides on honey bee mortality. The handbook also lists beekeeping organizations and some statistics on bees and honey.

KEYWORDS: bee venom, drones, hives, honey, honey bees, nuclei, packaged bees, pesticides, pollen, pollination, propolis, queen bees, royal jelly, swarming

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INTRODUCTION

By E. C. MARTIN¹

Beekeeping is an ancient art that has fascinated its devotees since earliest times. Honey robbed from wild colonies in trees or caves was early people's main source of sweet food. Dominance of honey as the major sweetener continued until cane and beet sugar became generally available in comparatively recent times. Honey with its unique flavors and aromas and natural origin still has wide appeal. World production was estimated at 1,446 million pounds in 1976 and more than 1,415 million pounds in 1977.

In the United States about 200,000 people keep almost 5 million colonies and produce 200 million to 250 million pounds of honey annually. Beekeepers can be classified as full-time, sideline, or hobbyist, with the number of colonies operated by individual owners varying from one to 30,000. Beekeepers derive income from the sale of honey, renting of colonies for crop pollination, production and sale of queen bees and packaged bees, and to a minor extent, from the sale of beeswax, pollen, bee venom, propolis, and royal jelly.

Problems and dangers confront the long-time survival of beekeeping as a profitable agricultural enterprise, and changing agricultural and land-use practices threaten the survival of adequate numbers of bees required to pollinate some 90 crops or more. As human population increases, houses, factories, and highways replace open fields of honey and pollen plants.

Clean cultivation of farmland and large-scale monoculture reduce the sequence of wild plants needed to provide bee food throughout the season.

Pesticides not only kill many bees, but bees also cannot be kept in areas where pesticides are used on a regular basis—such as near fruit orchards and many cottonfields. The presence of nectar and pollen plants in adequate numbers throughout the season is essential to prosperous beekeeping. In the national interest, beekeeping must survive. If it is to do so, it will need greater consideration than it now receives in land-use planning, in the revegetating of disturbed land, in large-scale weed and pest control programs, and in providing beekeeping sanctuaries on State and Federal lands.

Crop pollination is more essential to agricultural production than is generally realized. To maintain an adequate pollinating force of bees in all parts of the country, beekeeping must remain a viable, prosperous industry. Beekeeping will survive in strength adequate to our needs only if we can reverse the trend of recent years toward a deteriorating environment for bees.

The purpose of this handbook is to provide readers with a better understanding of beekeeping in the United States. It is not a beginner's book in the how-to-do-it sense, but it does provide the beginner as well as the experienced beekeeper with a good insight into the status of this small but essential industry.

Dr. E. F. Phillips, one of the early leaders of research in the U.S. Department of Agriculture, said that more had been written about bees than any living thing other than human beings. Books, bulletins, and bee journals still provide evidence that our fascination with bees and beekeeping continues unabated. Beekeepers of this generation must try to make sure that we bequeath an environment in which bees may profitably be kept by future generations.

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GLOSSARY

By E. C. MARTIN, *National Program Staff, Science and Education Administration, retired*

- Abdomen:** Segmented posterior part of bee containing heart, honey, stomach, intestines, reproductive organs, and sting.
- Acarapis woodi:** Scientific name of acarine mite, which infests tracheae of bees.
- Acarine disease:** Condition caused by *Acarapis woodi*.
- Alighting board:** Extended entrance of beehive on which incoming bees land.
- Allele:** One of a pair or series of alternative genes that can occur at a given point on a chromosome.
- American foulbrood (AFB):** Contagious disease of bee larvae caused by *Bacillus* larvae.
- Antennae:** Slender jointed feelers, which bear certain sense organs, on head of insects.
- Anther:** Part of plant that develops and contains pollen.
- Apiarist:** Beekeeper.
- Apiary:** Group of bee colonies kept in one location (bee yard).
- Apiculture:** The science and art of studying and using honey bees for man's benefit.
- Apis:** The genus to which the honey bee belongs.
- Apis mellifera:** Scientific name of the Western honey bee.
- Apis cerana:** Scientific name of the Eastern honey bee, the honey producer of South Asia, also called *Apis indica*.
- Apis dorsata:** Scientific name for the large honey bee of Asia which builds open air nests of single comb suspended from tree branches, rocky ledges, etc.
- Apis florea:** Scientific name for the small honey bee of Asia.
- Artificial insemination:** See instrumental insemination.
- Autopollination:** The automatic transfer of pollen from anthers to stigma within a flower as it opens.
- Bacillus larvae:** Bacterial organism causing American foulbrood.
- Balling a queen:** Clustering around unacceptable queen by worker bees to form a tight ball; usually queen dies or is killed in this way.
- Bee bread:** Pollen stored in cells of the comb.
- Bee dance:** Movement of bee on comb as means of communication; best known to indicate the direction and distance of a source of nectar or pollen.
- Bee escape:** Device to let bees pass in only one direction; usually inserted between honey supers and brood chambers, for removal of bees from honey supers.
- Bee gum:** Usually hollow log hive.
- Beehive:** Domicile prepared for colony of honey bees.
- Bee louse:** Relatively harmless insect that gets on honey bees, but larvae can damage honeycomb; scientific name is *Braula coeca*.
- Bee metamorphosis:** The transformation of the bee from egg to larva to pupa and finally to the adult stage.
- Bee moth:** See wax moth.
- Bee paralysis:** An adult bee disease of chronic and acute type caused by different viruses.
- Bee space:** A space ($\frac{1}{4}$ - to $\frac{1}{16}$ -inch) big enough to permit free passage for a bee but too small to encourage comb building. Leaving bee space between parallel beeswax combs and between the outer comb and the hive walls is the basic principle of hive construction.
- Beeswax:** Wax secreted from glands on the underside of bee abdomen; molded by bees to form honeycomb.
- Bee tree:** A hollow tree occupied by a colony of bees.
- Bee veil:** See veil.
- Bee venom:** Poison injected by bee sting.
- Bee yard:** (See Apiary).
- Bottom board:** Floor of beehive.
- Brace comb:** Section of comb built between and attached to other combs.
- Braula coeca:** See bee louse.

- Brood:** Immature or developing stages of bees; includes eggs, larvae (unsealed brood), and pupae (sealed brood).
- Brood chamber:** The area of the hive where the brood is reared; usually the lowermost hive bodies.
- Brood comb:** Wax comb from brood chamber of hive containing brood.
- Brood nest:** Area of hive where bees are densely clustered and brood is reared.
- Burr comb:** Comb built out of place, between movable frames or between the hive bodies.
- Capped brood:** Brood (either last larval stage or pupal stage) that has been capped over in its cell.
- Capped honey:** Cells full of honey, closed or capped with beeswax.
- Cappings:** Beeswax covering of cells of honey which are removed before extracting.
- Castes:** The three types of individual bees (workers, drones, and queen) that comprise the adult population of a bee colony.
- Carniolan bees:** A race of honey bees which originated in the southern part of the Austrian Alps and northern Yugoslavia.
- Caucasian bees:** A race of honey bees native to the high valleys of the Central Caucasus.
- Cell:** The six-sided compartment of a honeycomb, used to raise brood or to store honey and pollen. Worker cells approximate five to the linear inch, drone cells are larger averaging about four to the linear inch.
- Cell cup:** Initially constructed base of queen cell; also made artificially for queen rearing.
- Chilled brood:** Brood that has died because of chilling.
- Chromosomes:** The structures in a cell that carry the genes.
- Chunk honey:** A jar of honey containing both liquid (extracted) honey and a piece of comb with honey.
- Cleansing flight:** Flight bees take after days of confinement, during which they void their feces.
- Clipped queen:** Queen whose wing (or wings) has been clipped for identification purposes.
- Cluster:** Collection of bees in colony gathered into limited area.
- Colony:** Social community of several thousand worker bees, usually containing one queen, with or without drones. (See social insects.)
- Comb:** (See honeycomb).
- Comb foundation:** Thin sheet of beeswax impressed by mill to form bases of cells; some foundation also is made of plastic and metal.
- Comb honey:** Honey marketed and eaten in the comb.
- Corbicula:** See pollen basket.
- Creamed honey:** Honey made to crystallize smoothly by seeding with 10 percent crystallized honey and storing at about 57°F.
- Cross pollination:** Transfer of pollen between plants which are not of identical genetic material.
- Crystallized honey:** Honey hardened by formation of dextrose-hydrate crystals. Can be reliquefied by gentle heat.
- Cut comb honey:** Comb honey cut into appropriate sizes and packed in plastic.
- Demaree:** Method of swarm control, by which queen is separated from most of brood; devised by man of that name.
- Dextrose:** Also known as glucose; one of principal sugars of honey.
- Diastase:** Enzyme that aids in converting starch to sugar.
- Diploid:** An organism or cell with two sets of chromosomes, for example, worker and queen honey bees.
- Disappearing disease:** A condition in which colonies become weak from causes which are not readily identifiable.
- Division board:** Flat board used to separate two colonies or colony into two parts.
- Division board feeder:** A wooden or plastic trough which is placed in the hive in a frame space to feed the colony honey or sugar syrup.
- Drawn comb:** Comb having the cells built out (drawn) by honey bees from a sheet of foundation. Cells are about ½-inch deep.
- Drone comb:** Comb with about four cells to the inch and in which drones are reared.
- Drone layer:** A queen which lays only unfertilized eggs which always develop into drones. Results from improperly or nonmated queen or an older queen who has run out of sperm.
- Dwindling:** Rapid or unusual depletion of hive population, usually in the spring.
- Dysentery:** The discharge of fecal matter by adult bees within the *hive*. Commonly contributing conditions are nosema disease, excess moisture in the hive, starvation conditions, and low-quality food.

- Escape board:** Board with one or more bee escapes on it to permit bees to pass one way.
- European foulbrood:** Brood disease of bees caused by *Streptococcus pluton* and possibly associated organisms.
- Extracted honey:** Honey removed from the comb by centrifugal motion (in a special machine called an extractor) and marketed in the liquid form.
- Extractor:** Machine that rotates honeycombs at sufficient speed to remove honey from them.
- Field bees:** Those bees in the hive who are mature enough to fly from the hive on foraging missions; also termed forager bees.
- Food chamber:** Hive body containing honey provided particularly for overwintering bees.
- Foundation:** (See Comb foundation).
- Frame:** Rectangular, wooden honeycomb supports, suspended by top bars within hive bodies.
- Fructose:** (See Levulose).
- Full sisters:** Queen or worker bees produced by a single queen and sired by different drones that are related to each other as brothers (used in bee breeding).
- Fumagillin:** Antibiotic given bees to control nosema disease.
- Galleria mellonella:** Scientific name of greater wax moth, whose larvae destroy honeycomb.
- Gamete:** A male or a female reproductive cell (egg or sperm).
- Gene:** A unit of inheritance located at a specific location in a chromosome.
- Gene pool:** The genetic base available to bee breeders for stock improvement.
- Germplasm:** All the hereditary material that can potentially contribute to the production of new individuals.
- Giant bee:** (See *Apis dorsata*).
- Glucose:** (See Dextrose).
- Grafting:** The transfer of young larvae from worker cells to queen cups.
- Granulated honey:** (See crystallized honey).
- Half sisters:** Queen or worker bees produced by a single queen and sired by drones that are not related to each other.
- Haploid:** An organism or cell with one set of chromosomes; for example, drone bee.
- Hemizygous:** The condition in which only one allele of a pair is present. Drones are hemizygous at all loci.
- Heterosis:** Hybrid vigor.
- Heterozygous:** An organism with unlike members of any given pair or series of alleles (bee genetics).
- Hive:** Man-constructed home for bees.
- Hive tool:** Metal tool for prying supers or frames apart.
- Hoffman frame:** Self-spacing wooden frame of type customarily used in Langstroth hives.
- Homozygous:** An organism with identical members of any given pair or series of alleles.
- Honey:** Sweet, viscous fluid elaborated by bees from nectar obtained from plant nectaries, chiefly floral.
- Honey bee:** Genus *Apis*, family Apidae, order Hymenoptera.
- Honeycomb:** Comb built by honey bees with hexagonal back-to-back cells on median midrib.
- Honeydew:** Sweet secretion from aphids and scale insects.
- Honey extractor:** (See Extractor).
- Honey flow:** Period when bees are collecting nectar from plants in plentiful amounts.
- Honey house:** Building in which honey is extracted and handled.
- Honey pump:** Pump for transferring liquid honey, usually from the extractor to storage tanks.
- Honey stomach:** (Honey sac) An enlargement of the posterior end of the oesophagus in the bee abdomen. It is the sac in which the bee carries nectar from flower to hive.
- Honey sump:** Temporary honey-holding area with baffles usually placed between the extractor and the honey pump; tends to hold back sizable pieces of wax and comb.
- Hybrid:** Offspring from two unrelated (usually inbred) lines.
- Hymenoptera:** Order to which all bees belong, as well as ants, wasps, and certain parasitic insects.
- Inbred:** A homozygous organism usually produced by inbreeding.
- Inbreeding:** Matings among related individuals.
- Inner cover:** A cover used under the standard telescoping cover on a bee hive.
- Instrumental insemination:** The act of depositing semen into the oviducts of a queen by the use of a manmade instrument.
- Introducing cage:** Small wood and wire cage used to ship queens and also sometimes to release them into the colony.

- Invertase:** Enzyme produced by bees that speeds inversion of sucrose to glucose and fructose.
- Italian bees:** A race or variety of honey bee which originated in Italy and has become widely dispersed and cross-bred with other races.
- Jumbo hive:** Hive 2½ inches deeper than standard Langstroth hive.
- Langstroth:** A minister from Pennsylvania who patented the first hive incorporating bee space thus providing for removable frames. The modern hive frequently is termed the Langstroth hive and is a simplified version of similar dimensions as patented by Langstroth.
- Langstroth frame:** 9¼- by 17¾-inch standard U.S. frame.
- Larva:** Stage in life of bee between egg and pupa; "grub" stage.
- Laying worker:** Worker bees which lay non-fertilized eggs producing only drones. They occur in hopelessly queenless colonies.
- Levulose:** Noncrystallizing sugar of honey which darkens readily if honey is overheated.
- Line breeding:** Mating of selected members of successive generations among themselves in an effort to maintain or fix desirable characteristics.
- Locus:** A fixed position on a chromosome occupied by a given gene or one of its alleles.
- Mandibles:** Jaws of insects.
- Mating flight:** The flight of a virgin queen during which time she mates with one or more drones high in the air away from the apiary. Queens usually mate with 6 to 10 drones on two or more mating flights.
- Mead:** A wine made with honey. If spices or herbs are added, the wine usually is termed metheglin.
- Metamorphosis:** Changes of insect from egg to adult.
- Migratory beekeeping:** Movement of apiaries from one area to another to take advantage of honey flows from different crops.
- Mite:** See *Acarapis woodi* and *Varroa jacobsoni*.
- Mutation:** A term used to describe both a sudden change in the alleles or chromosomes of an organism and the changed form itself as it persists.
- Nectar:** A sweet secretion of flowers of various plants, some of which secrete enough to provide excess for the bees to store as honey.
- Nectaries:** Special cells on plants from which nectar exudes.
- Nosema disease:** Disease of bees caused by protozoan spore-forming parasite, *Nosema apis*.
- Nucleus (Nuke):** A small colony of bees resulting from a colony division. Also, a queen-mating hive used by queen breeders.
- Nurse bees:** Three-to 10-day-old adult bees that feed the larvae and perform other tasks in the hive.
- Observation hive:** Hive with glass sides so bees can be observed.
- Ocellus (ocelli):** Simple eye(s) of bees.
- Package bees:** A quantity of bees (2 to 5 lb) with or without a queen shipped in a wire and wood cage to start or boost colonies.
- Paralysis:** (See bee paralysis).
- Parthenogenesis:** Production of offspring from a virgin female.
- Pheromones:** Chemicals secreted by animals to convey information or to affect behavior of other animals of the same species. (See queen substance.)
- Pistil:** The combined stigma, style, and ovary of a flower.
- Play flight:** Short orientation flight taken by young bees, usually by large numbers at one time and during warm part of day.
- Pollen:** Male reproductive cells of flowers collected and used by bees as food for rearing their young. It is the protein part of the diet. Frequently called bee bread when stored in cells in the colony.
- Pollen basket:** Area on hindleg of bee adapted for carrying pellets of pollen.
- Pollen cake:** Cake of sugar, water, and pollen or pollen substitute, for bee feed.
- Pollen substitute:** Mixture of water, sugar, and other material, such as soy flour, brewer's yeast, etc., used for bee feed.
- Pollen supplement:** Pollen substitute added to natural pollen in a pollen cake.
- Pollen trap:** Device which forces bees entering hive to walk through a 5-mesh screen, removing pollen pellets from their legs into a collecting tray.
- Pollination:** The transfer of pollen from the anthers of a flower to the stigma of that or another flower.
- Pollinator:** The agent which transfers pollen; e.g., a bee.
- Pollinizer:** The plant source of pollen used for pollination; e.g., pollinizer varieties of apples and pears must be planted in order to produce

- a crop. Bees must carry the pollen from one variety to another.
- Proboscis:** Mouth parts of bee for sucking up nectar, honey, or water.
- Propolis:** A glue or resin collected from trees or other plants by bees; used to close holes and cover surfaces in the hive. Also called bee glue.
- Pupa:** Stage in life of developing bee after larva and before maturity.
- Queen:** Sexually developed female bee. The mother of all bees in the colony.
- Queen cell:** Cell in which queen develops.
- Queen cup:** The beginnings of a queen cell in which the queen may lay a fertile egg to start the rearing of another queen.
- Queen excluder:** Device usually made of wood and wire, with opening 0.163 inch, to permit worker bees to pass through but excludes queens and drones. Used to restrict the queen to certain parts of the hive.
- Queen substance:** Pheromone material secreted from glands in the queen bee and transmitted throughout the colony by workers. It makes the workers aware of the presence of a queen.
- Race:** Populations of bees, originally geographically isolated and somewhat adapted to specific regional conditions.
- Ripening:** Process whereby bees evaporate moisture from nectar and convert its sucrose to dextrose (glucose) and levulose (fructose), thus changing nectar into honey.
- Rendering wax:** Melting old combs and wax cappings and removing refuse to partially refine the beeswax. May be put through a wax press as part of the process.
- Requeen:** To replace a queen in a hive. Usually to replace an old queen with a young one.
- Robbing:** Bees steal honey from other hives. A common problem when nectar is not available in the field.
- Royal jelly:** Glandular secretion of young worker bees used to feed the queen and young brood.
- Sacbrood:** A fairly common virus disease of larvae, usually nonfatal to the colony.
- Scout bees:** Worker bees searching for nectar or other needs, including suitable location for a swarm to nest.
- Sealed brood:** Brood in pupal stage with cells sealed.
- Self-pollination:** The transfer of pollen from the anther to the stigma of the same flower or to flowers of the same plant or other plants of identical genetic material such as apple varieties, clones of wild blueberries, etc. (See autopollination).
- Septicemia:** Usually minor disease of adult bees caused by *Pseudomonas apiseptica*.
- Skrep:** A beehive, usually of straw and dome-shaped, that lacks movable frames.
- Slumgum:** A dark residue, consisting of brood cocoons and pollen, which is left after wax is rendered by the beekeeper.
- Smoker:** Device used to blow smoke on bees to reduce stinging.
- Social insects:** Insects which live in a family society, with parents and offspring sharing a common dwelling place and exhibiting some degree of mutual cooperation; e.g., honey bees, ants, termites.
- Solar wax melter:** Glass-covered box in which wax combs are melted by sun's rays and wax is recovered in cake form.
- Spermatheca:** Small saclike organ in queen in which sperms are stored.
- Spermatozoa:** Male reproductive cells.
- Spiracles:** External openings of tracheae through which bees breathe.
- Stamen:** Male part of flower on which pollen-producing anthers are borne.
- Sting:** Modified ovipositor of female Hymenoptera developed into organ of defense.
- Sucrose:** Cane sugar; main solid ingredient of nectar before inversion into other sugars.
- Super:** Any hive body placed above the brood chamber for the storing of surplus honey.
- Supersedure:** The replacement of a weak or old queen in a colony by a daughter queen—a natural occurrence.
- Supersisters:** Queens or worker bees produced by a single queen and sired by identical sperm from a single drone (subfamily).
- Surplus honey:** A term generally used to indicate an excess amount of honey above that amount needed by the bees to survive the winter. This surplus is usually removed by the beekeeper.
- Swarm:** Natural division of colony of bees.
- Tarsus:** Fifth segment of bee leg.
- Thorax:** Middle part of bee.
- Tracheae:** Breathing tubes of insects.
- Tumuli:** Nest mounds (wild bees).
- Uncapping knife:** Knife used to remove honey cell caps so honey can be extracted.
- Unite:** Combine one colony with another.

Unsealed brood: Brood in egg and larval stages only.

Virgin queen: Unmated queen.

Wax glands: Glands on underside of bee abdomen from which wax is secreted after bee has been gorged with food.

Wax moth: Lepidopterous insect whose larvae destroy wax combs.

Wild bees: Any insects that provision their nests with pollen, but do not store surplus edible honey.

Winter cluster: Closely packed colony of bees in winter.

Wired foundation: Foundation with strengthening wires embedded in it.

Wired frames: Frames with wires holding sheets of foundation in place.

Worker bee: Sexually undeveloped female bee.

Worker comb: Honeycomb with about 25 cells per square inch.

Worker egg: Fertilized bee egg.