CONNECTICUT BEEKEEPING

#2 DISEASES & PARASITES

This Publication is a Cooperative Project of the Connecticut Beekeepers Association and the State Entomologist's Office New Haven, CT. 06504

STARTING BEEKEEPING

DISEASES & PARASITES

Introduction -

This series contains two types of instruction, basic beekeeping practices to get you started (pamphlet #1), and detailed instruction on parasites and diseases pamphlet #2). The reasoning behind the strategy is as follows. We want to have a pamphlet to get the beginning beekeeper started with his or her bees, but one is expected to have no success if there is no knowledge how to control mite infestations. Tracheal mites first appeared in Connecticut in the fall of 1989. Varroa mites appeared almost exactly a year later (fall 1990). We are still learning how to best deal with the mites, and as yet, there is almost nothing published in books to help the new beekeeper learn how to control them. In fact it may be some time yet before the best methods of managing mites become apparent for Connecticut Beekeeping.

Honey bees, like house pets and farm animals, need our care to do well and produce a surplus honey crop. The relationship between human beings and honey bees goes back many thousands of years. During that time, the honey bee, unlike most domestic farm animals, has changed very little. It is superbly adapted for the task of gathering nectar to produce honey, and gathering pollen for protein to raise new bees. Often people who have no intention of becoming beekeepers will watch a colony of bees at their labors for hours. As an experienced beekeeper, you will be able to watch their labors at close hand and reap the profit of golden honey made by YOUR bees, from flowers in your neighborhood.

HONEY BEE DISEASES
AMERICAN FOULBROOD

BIOLOGY -

American foulbrood (AFB) is a disease of honey bee larvae caused by a spore forming bacterium, *Bacillus* larvae.

It is the most destructive disease of honey bees in North America. This disease has two stages of its life cycle. One form is the vegetative or rod stage, the other is a highly contagious long lived dormant or spore stage. In most cases, only larvae that are between 1 and 3 days old are susceptible to infection, and only to the spore stage. The spores are usually carried by the nurse bees and are inadvertently fed to the larvae with their food. The spores germinate within the larva into a motile rod stage and reproduce in great numbers in the hemolymph (blood) of the bee, killing it. About the same time the larva dies, the rod stage develops into a long lived (about 35 years) spore stage.

DAMAGE -

The infected larvae are usually capped over and die under this capping in a late larval or prepupal stage. The infected larva turns from a pearly white color to a dark brown and its tissues eventually become a hardened scale. Millions of spores of AFB develop within this scale. The spores are released within the colony through the attempts of the worker bees to clean these dead larvae from the cells.

The disease can rapidly spread throughout the hive, occasionally killing the hive the first season, although more often the colony dies out the following year. Eventually the disease spreads through the apiary due to drifting, robbing, and interchange of contaminated equipment, including the use of contaminated hive tools and gloves.

SYMPTOMS -

This disease can be identified by the symptoms listed below, but we recommend you send a sample of suspected brood to the Connecticut Agricultural Experiment Station (789-7236 for directions) for confirmation by an insect pathologist.

1. Scattered and irregular brood pattern.
2. Larvae appear brown rather than pearly white.
3. Capped cells become darkened and sunken rather than convex and may be punctured. (Note: this symptom can also occur in sacbrood and European Foulbrood).
4. Capped cells appear moist.
5. A protruding tongue can be seen sticking out of the dried scale.
6. The dried scale in the bottom of the cell adheres tightly.
7. A foul odor emits from the frames.
8. Decayed larva can be drawn out rope-like by inserting a toothpick or matchstick and withdrawing the mass.

TREATMENT AND CONTROL

Foulbrood is very contagious, and infected hives need to be treated with Terramycin or destroyed and burned. When the infection is light, the antibiotic Terramycin (oxytetracycline HCL) can often be used to treat AFB. Terramycin can be applied as a syrup, dust or in extender patties. A change in the law for medicated animal feeds, allow medications to be used in any feed as long as the correct dosage is being administered. In a study that used the addition of Terramycin to extender patties, sugar syrup and sugar showed all three methods were effective in cleaning up AFB. Extender patties were made by mixing 7 lbs. of table sugar, 3 lbs. of vegetable shortening with one 6.4 oz. package of TM-25, and a wax paper covered patty was kept on the top bars for 30 days. Terramycin label instructions give the directions for dust and syrup mixtures.

Terramycin kills only the rod stage, so spores may remain in the hive for years. It will probably be necessary to continue to treat with Terramycin in both fall and spring until the health of the colony returns and the bees can clean up any foulbrood before an

infection can again get started. **FOLLOW LABEL INSTRUCTIONS**

Occasionally, a hive has such a heavy infection it cannot be treated. Usually there are very few bees left or the bees have all died. Any live bees should be killed and the hive body disinfected (Call The Connecticut Agricultural Experiment Station 789-7236 for information). Since it is almost impossible to disinfect frames or comb, these should be removed and burned in a hole in the ground. After burning, the ashes and remnants should be thoroughly covered with soil so that bees cannot get to the residue. All dead bees should be burned. The inside of the infected hive can be disinfected by scorching thoroughly (propane torch) to kill the spores before using it again. The hive tool can be flamed or scrubbed clean with a chlorinated powdered cleanser. Gloves and bee suits should be washed in sudsy water to rid them of AFB spores. The hive can be fumigated, rather than scorched, with ethylene oxide. This method effectively kills AFB spores. Don Taylor, 57 Great Plains Road in Danbury, 744-1798 offers this service, and has recently built a new fumigation chamber.

EUROPEAN FOULBROOD

BIOLOGY -

European Foulbrood (EFB) is caused by the bacteria *Streptococcus pluton*. It differs from AFB as there is no spore form. European foulbrood does not occur as frequently as AFB nor is it usually as a destructive. The EFB bacteria occurs in a lancolate shape and occurs in chains or clusters in the gut of the larva. It can infect larvae of any age and often kills them when they are about 4 to 5 days old. Older larvae often are able to rid themselves of infection by defecation. These feces are often deposited in the cell and the comb may remain infective for several years.

DAMAGE -

Although EFB is not as common as AFB, it can cause the demise of a colony. It is more common in the spring and can occur suddenly and spread rapidly.

SYMPTOMS -

This disease can be identified by the following symptoms, but we recommend that you send a sample of suspected brood to The Connecticut Agricultural Experiment Station (789-7236 for directions) for confirmation by an insect pathologist.

1. Most larvae die before the cells are capped and appear twisted or coiled in their cells.
2. Larvae appear pale yellow rather than pearly white.
3. Dead larvae turn brown and their white tracheae become visible.
4. Dead larvae are not usually “ropy” as with AFB.
5. Brood has a sour odor somewhat like dead fish.

TREATMENT AND CONTROL -

European Foulbrood can usually be treated with Terramycin. Sometimes with heavy infestations it is necessary to requeen as well. This allows worker bees to clean dead larvae from their cells. Carefully **FOLLOW LABEL INSTRUCTIONS WHEN USING TERRAMYCIN**.

CHALK BROOD

BIOLOGY -

Chalk brood is caused by the fungus *Ascospaera apis* and only affects the honey bee brood. It rarely kills a colony. The are two forms, a vegetative or mycelium form and a resistant spore form that remains viable for years. This fungus appears to be most prevalent in the spring and usually infects larvae on the fringes of the brood area.

Larvae of about 3-4 days old are the most susceptible. It is thought that cool weather and dampness, or chilled brood, predisposes the hive to chalk brood.

DAMAGE -

Chalk brood kills the larvae which at first are covered with a white fluffy mold and later dry and shrink into mummies.

SYMPTOMS -

Look for white chalk-colored mummies in the cells, on the front entrance to the hive and on the ground in front of the hive.

Although there is no chemical treatment currently available for the control of chalk brood, it is thought preventive measures help somewhat.

1. Ventilate the hive by adding a stone or stick between the inner and outer cover.
2. Move the hive to a dry sunny location.
3. Wedge something under the back of the hive to tip if forward slightly so that rainwater will not settle on the bottom board.
4. Examine hives only on warm, non windy days to prevent the brood from being chilled.
5. Remove and destroy combs containing large numbers of mummies.

SACBROOD

BIOLOGY -

The causative organism of sacbrood disease is a virus. It is unknown how the virus is transmitted to the larvae in nature.

Larvae that are two days old are most susceptible to this disease. The virus multiplies in the body tissues of the larvae and fluid accumulates between the body of a diseased larvae and its outer skin. The larvae resemble a liquid filled sac from where the name sacbrood was derived. The workers usually detect infected larvae and quickly remove them.

DAMAGE -

Infected larvae die shortly after they have been sealed in their cells. The virus multiplies in each larva so that each contains enough virus (1 milligram) to infect every larva in over 1000 colonies of honey bees. Although adult bees do not show outward symptoms of the disease, they are suspected of acting as a reservoir and most likely continue to infect the larvae. Sacbrood is usually not as destructive as foulbrood and rarely kills an entire colony. It often spontaneously subsides in summer.

SYMPTOMS -

1. Scattered sunken caps on sealed brood are often punctured or half uncapped. (also AFB).
2. Swollen dead larvae under the caps.
3. Infected larvae are initially yellow, then turn brown with black heads.
4. Larvae appear “canoe like” in the cell, head and end pointing upwards.
5. Dead larvae do not “rope out” as in AFB.
6. Scale does not adhere to the cell wall but is easily removed.

CONTROL -

There are no chemotherapeutic agents available for the control of sacbrood. Symptoms often subside in the summer. In heavy cases, requeening or feeding sugar syrup will help a colony recover.

NOSEMA

BIOLOGY -

Nosema disease is caused by a single-celled protozoan. It is a serious problem for adult honeybees, often infecting the queen who is often replaced by supersedure.

There are two growth forms of the protozoan. One stage is an actively growing cell stage that reproduces in the midgut and a resistant spore stage that can remain viable over a long period of time. The infection occurs when spores are ingested by the adult bee. These spores are passed out of the bee through defecation.

DAMAGE -

Honey bees that are heavily infected are unable to process food and have a shortened life span. A heavy infection greatly reduces the adult population and results in a poor spring build-up and queen supersedence.

SYMPTOMS -

Actual confirmation of *Nosema* needs to be done by microscopic examination at 400 x for the presence of Nosema spores. Call the Connecticut Agricultural Experiment Station at 789-7236 for mailing directions. Some symptoms are listed below, but diseased bees may not exhibit any obvious manifestations.

1. Crawling bees in front of the hive with unhinged wings (K-wing) This also occurs with tracheal mites.
2. Bees have distended abdomens.(also occurs with pesticide poisoning and bee paralysis).
3. Remove the tip of the abdomen of a bee by slowly pulling with tweezers. The normal midgut is tan with distinct rings, an infected one is swollen and milky.

CONTROL -

Fumagillin (Fumidil-B) is an antibiotic that effectively controls *Nosema*. It is administered in a sugar syrup mixture often prophylactically in the spring and fall.

FOLLOW LABEL DIRECTIONS.

PARASITES - VARROA JACOBSONI

VARROA MITE BIOLOGY

The Varroa mite, *Varroa jacobsoni*, is an external parasite of the honey bee. The female mite is reddish brown and can be seen with the naked eye as it is about the size of a pinhead. The female mite is the stage most readily seen as it feeds on adult honey bees as well as brood. The adult males and nymphal stages are much smaller and yellowish to grayish white. They are rarely seen because they remain inside the sealed brood. Mated female mites feed on the hemolymph (blood) of the adult honey bee by piercing its outer membrane. It is thought this protein meal is necessary for egg production. She then enters a cell containing a bee in the late larval stage shortly before it is sealed. The mite prefers drone brood rather than worker brood. After capping, she lays 2 to 6 eggs at varying intervals. The developing mites feed on the developing bee within the capped cell. Female mites take 8 to 10 days to develop; male mites develop within 6 to 7 days. Since the *Varroa* only reproduces in capped brood cells it requires precise timing to complete its life cycle. The male mite mates with its sister mites and then dies in the cell. The fully developed, mated females leave the cell attached to the emerging bee. The female mites seek a blood meal before entering a cell about to be capped. With higher levels of mite infestation in the hive, many female mites may enter a cell just before it is capped. The adult female mite lives about 2 months in summer and about 5-8 months in the winter.

Mite Damage -

A high degree of deformity and premature death of the honey bees can occur as a result of mite parasitism. Deformed wings and legs, shortened abdomens, shortened life spans, and lower body weights are common occurrences with heavy infestations. Worker bees seem to sustain greater damage than drones.

Research has revealed that bees fed upon by 1 to 5 mites in the cell showed no visible damage. However, when 6 or more mites fed, the emerging bees showed a high degree of deformity or died within the cell. It is for this reason that during the first few years of infestation when the number of mites per cell is low, the prevalence of deformity is low and often overlooked by the beekeeper. The peak number of *Varroa* mites in the hive occurs in the fall.

In addition to loss of hemolymph, the puncture wounds caused by the sucking mites, subject the bees to possible invasion by bacteria and viruses. Microorganisms that are harmless in a healthy hive can become pathogenic in the feeding wounds of weakened bees. Lab and field studies indicate acute paralysis virus is the primary cause of bee mortality in hives infested with *Varroa* mite in Russia, Germany and Great Britain, yet it occurs commonly in healthy bee hives without incidence.

MITE SURVEY TECHNIQUES

The type of survey that can be conducted may depend on temperature, time of year, brood availability and whether or not honey supers are on the hive or a honey flow is occurring. The following methods may be used as an attempt to determine whether or not a hive may be infested with *Varroa*. (Low infestations are extremely difficult to detect).

Brood Examination -

Since drone brood is preferred by the *Varroa* mite over worker brood, the most reliable method is to remove the drone pupae and examine it for mites. This can be done by 1. inserting a capping scratcher into the cells and lifting out the pupae and caps, 2. scratching off the cap with a forceps and lifting out the pupa for examination, 3. slicing off the caps with a knife and rapping the frame upon a clean white surface (such as the hive top) to dislodge the pupae and by, 4. checking all of the removed pupae and the bottom of the cells. The *Varroa* can easily be seen against the white background of the pupae once removed from the cell.

Apistan Strips and Detection Boards -

Apistan Anti-*Varroa* Mite Strips are now registered in Connecticut by the Zoecon Corporation for use by the general public. These strips are composed of food grade plastic impregnated with 10% fluvalinate. Follow directions on the label for placement and allow them to remain for seven days as a survey tool in conjunction with detector boards.

Detector boards can be made by cutting white paper or cardboard to fit the bottom board of the hive. This can be sprayed with a cooking oil such as PAM, a vegetable oil, or petroleum jelly to trap any mites that fall or they will crawl up again. Above this should be a cover of screening to keep the bees from sticking to the board and from carrying the mites out with the debris. The screen should have holes large enough to allow the mites to fall through (holes greater than 2mm), but small enough to keep the bees off. We find that 8 mesh screen works fine. It is best to tape or staple this screen to a frame to raise it about ¼ inch above the sticky board. The attachment of a heavy string or ribbon will facilitate removal from the bottom board. This detector board can be used any time of year as there is always some mite mortality, but **Apistan strips can only be used when the honey supers are off.** If you use detector boards without the fluvalinate strips, it is best to check them weekly. A great deal of debris builds up very quickly in some hives making it difficult to locate mites. Debris can be brushed into 98% isopropyl alcohol if you can locate a source of this strength. The debris will ultimately sink and the mites will float. One or two inch grid lines initially drawn on the white sticky board aides in examination of the board. You will need one sticky board and screen for each hive to avoid spreading the disease and mites from hive to hive. Diseases such as foulbrood have resistant spores and are difficult to destroy. We autoclave our detector boards here at the station. For those beekeepers with many hives in several locations, you might want to start with 5 to 10 % of these hives in each yard.

Fall or early spring, before honey flow, is a good time to use these strips as a survey tool. If mites are found, the strips are already in place for treatment. These strips contain pesticides, **be sure to wear gloves, make sure honey supers are off, and follow the label directions carefully.**

Ether Roll -

An ether roll is a quick way to determine whether a hive has *Varroa* mites or if there is a high infestation level. It can be done during summer months or during honey flow when you can't add chemicals to the hive. However, the percentage of infestation detected with the ether roll is not as accurate as with fluvalinate strips. In a study done by the Nebraska Department of Agriculture, only 1 of 12 colonies was found to be infested with mites using the ether roll method, whereas 8 of 12 hives showed infestation with a fluvalinate strip survey.

1. Brush 300 to 500 bees from combs containing brood into a large glass jar.
2. Spray the bees in the jar with an ether-based starter fluid (used to start cars in cold weather) for a couple of seconds. Ether is explosive and requires extreme caution if used.
3. Close the jar immediately, and gently roll the bees while holding the jar horizontally. After about ½ minute, examine the sides of the glass jar for mites.

4. If no mites are found, you can discard the bees and rinse the jar with 70% rubbing alcohol and pour it through a light-colored paper towel or cloth.

5. This debris can then be examined for mites. Although they can be seen with the naked eye, a magnifying glass will aide in identification.

Tobacco Smoke -

In some European countries, tobacco smoke has been used as a survey tool in conjunction with detection boards. Tobacco (Nicotiana tabacum) contains 1% nicotin. Although 90% of the nicotin is destroyed by burning, a stabile salt is formed with the base nicotin in the acid honey. Further research is being carried out to determine what undesirable residues might occur in wax and honey.

CONTROL

Despite years of regulations, effort of beekeepers, regulators, researchers, and the use of 147 different fumigants, acaricides, and insecticides, *Varroa* has not been eradicated but has spread to 5 continents.

Although we are having success combating the initial 5 *Varroa* mite infestations in Connecticut, this mite, like the tracheal mite, may eventually be found throughout the state. There may come a time when beekeepers may have to learn to live with an economic threshold of mites.

The Apistan Anti-*Varroa* Mite Strips are the only registered materials we have in the United States at this time for the control of Varroa mites. The Zoecon company recommends a treatment of 42 days during the fall or spring when brood is reduced or is not present. Placement directions are given on the label and are very important because the bees must come in contact with the strips as there is little or no vaporization.

Flour dusting can be used as a non-chemical method of control of Varroa mites. A study by Shah and Shah in the January 1988 issue of the American Bee Journal discusses control using the dusting of 10-15 grams of flour at weekly intervals. This study needs confirmation.

Many products are being tested in Europe and the United States to control mites. Some of these methods such as synthetic comb, heat treatments, chemical lures all offer hope until resistant bees can be developed. We will report on new methods as scientific data for control become available.

If you find mites in your hive, please call the CT. Agricultural Experiment Station. **All beekeepers in a 3 mile radius will then need to be surveyed by us.**

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PARASITES - ACARAPIS WOODI

TRACHEAL MITE BIOLOGY

The tracheal mite is an internal parasite of the honey bee. The entire life cycle of the mite takes place in the respiratory system (tracheae) of the bee. The female mite lays 6 to 9 eggs in the large tracheae of the adult bee. The eggs hatch in 4 days and all 4 stages, i.e., egg, larvae, pharate adult and adults may be present in either the right or left tracheae of infested honey bees. The male mite develops from egg to adult in 10 days; the female development takes 12 days. The adult female mites are oval, pearly white with a length of 150 microns and a width of 80 microns. A 15-20 power hand lens or microscope is needed for identification. The larval, nymphal and adult stages all have mouthparts that pierce the membrane of the trachea allowing them to feed on the hemolymph (blood) of the bee. As many as 100 mites in all stages of development have been found in one trachea. The male mites mate with any female in the trachea and die there. The mated females migrate out of the tracheae of the host bee to its hair tips and transfer to young adult bees of less than 4 days old. The mated female enters the trachea of the young bee via the spiracle and lays eggs, starting the life cycle over again. The population of mites reaches its peak in the winter and is lowest in the summer.

Mite Damage -

The mites clog the tracheal tubes of the honey bee reducing the oxygen uptake. Often there is not enough oxygen available to fuel flight muscles. Some of the symptoms of a tracheal mite infestation are crawling bees near the front entrance of the hive and K-wing in which 2 wings on one side of the bee separate. Other symptoms include small clusters, split clusters, acute dysentery, or dying winter bees, even when there is plenty of stored honey. Infested colonies that do survive the winter are slow to build up in the spring.

Mite Survey Techniques -

One method of determining whether bees have tracheal mites is through live dissection. Chill approximately 100 bees until they are motionless, but not dead. After removal from the freezer, store the bees on ice as they quickly revive. Set up a 15-20 power stationary hand lens or microscope and a strong light to enable you to see any mites as you dissect the bees. With one hand, hold the bee with a fine tweezer between the first and second pair of legs (feet up) under the hand lens. With a second tweezer gently pull off the bee's head and first pair of legs. Next remove the cervical collar located where the base of the head was attached. You should immediately be able to see both the left and right large tracheal tubes. Look for darkened spots that are caused by fungal or microbial activity in feeding wounds. Mites should be visible within a few moments if the tracheae are darkened. Clear, pearly tracheae are probably not infested.

If you don't have the equipment or the inclination to examine your bees, you can send them to us (Connecticut Agricultural Experiment Station). Sweep about 100 bees into 70% rubbing alcohol (91% works faster) to kill the bees and preserve them. Seal and label the container and mail them to us. We are also willing to teach you the dissection and examination procedures.

CONTROL

Menthol is the only legally registered material in the United States for the control of tracheal mites at this time. It is a food product that is 99.99994% pure. Menthol exists in a crystalline form at lower temperatures, begins to evaporate at temperatures above 65 °F, and melts to a liquid at temperatures of 102-105 °F. The evaporation rate of menthol is best at temperatures between 80 °F and 85 °F. These vapors are heavier than air and flow downward.

Placement of the menthol is important for control. **REMOVE ALL HONEY SUPERS BEFORE TREATMENT AND CAREFULLY FOLLOW LABEL INSTRUCTIONS.** For a hive containing not more than two hive bodies, use a 50 gram (1.8 ounces or about a rounded 1/3 measuring cup) packet of menthol. This is usually purchased in a coffee filter type bag. Place this packet on the top bars above the brood nest. In hot weather put a piece of foil under the packet to prevent liquid menthol from running down into the hive and killing the brood. Temperatures in the hive are much higher than outside temperatures. Brood is raised at 93 °F to 95 °F.,

which allows good evaporation of menthol, although outside temperatures may be cooler.

Menthol Packet installed on Top Bars of upper Brood Chamber

The packet of menthol should be in place for on a minimum of 15 days. If cooler temperatures or high infestation rates of mites necessitate a longer treatment period, it is best to check it frequently as it quickly becomes propolized. The underside is the first to be coated. Use an entrance reducer when outside temperatures are below 85 °F. When temperatures are above 85 °F the label and experts say to put the menthol on the bottom board or vapors will cause the bees to leave the hive. Our studies showed, in all cases where we put the menthol on the bottom board in higher temperatures, the mites were not killed and we had to retreat the hives. If you are concerned about your bees leaving the hive, perhaps it is best to wait for slightly cooler temperatures before treating.

The best time to treat is in the spring or early fall. Temperatures should remain above 60 °F for a minimum of 15 days. Menthol should be removed 1 month before the beginning of the surplus honey flow to prevent contamination of marketable honey. In the fall, supers can be removed in late August, leaving the goldenrod honeyflow to the bees as overwintering supplies, yet leaving enough days with temperatures high enough to get good control. Effective control of mites can be achieved by treating overwintering hives with menthol even in cooler climates. Replace packets in overwintering hives with fresh packets as needed to maintain menthol in the hive.

Vegetable Oil -

Recent studies confirm that vegetable oil can be used to control tracheal mites. Extender patties have been used by many beekeep-

ers as a method to apply terramycin to their hives to prevent foulbrood. These patties are traditionally made with 3 lbs. of powdered sugar, 3 lbs. of vegetable shortening and one 6.4 oz. TM 10 packet of terramycin. All the materials are mixed together and formed into 20 patties 4" to 5" about ¼ inch thick. Some beekeepers found that hives with extender patties remained free from tracheal mites. A recent study confirmed that extender patties made from 1 part canola oil to 3.5 parts of sugar had 40% fewer mites than untreated hives. It is suspected that the vegetable oil hydrocarbons mask the cuticular hydrocarbons on the surface of the bee. Caged studies show that the use of vegetable oil completely prevented infestation of mites in bees less than 24 hours old.

Amitraz -

The Nor-Am Corporation is still attempting to register Miticur, the trade name of a product base of Amitraz. Many studies have confirmed that the product is effective in control of tracheal mites. Nor-Am expects to market it in 10% impregnated strips and as an aerosol. The EPA label will allow usage during honey flow and during non honey flow. The registration will allow 0.1 ppm in honey residue and 7 ppm in wax. The strips need to remain in the hive for 6 weeks to control mites, but can remain there until the next handling. The cost is estimated to be about $2.00 per strip and the formulation will be of at pure product containing no carriers of xylene, benzenes or petroleum distillates.

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