AMERICAN FOULBROOD DISEASE

From R.M. Goodwin, J.H. Perry and H. Haine.

Part 1. The Incidence of American Foulbrood Disease in New Zealand.

American foulbrood (AFB) disease is caused by the bacterium *Bacillus larvae*. The disease was first recorded in New Zealand in 1877, 38 years after honey bees were introduced, and by 1887 had spread throughout New Zealand[1].

Accounts of the levels of AFB in the early part of this century are very sketchy. This was mainly due to the practice of managing AFB rather than destroying contaminated colonies. Colonies that had light infections were "shook swarmed". This entailed shaking the bees from infected colonies into hives that only contained foundation and was often effective at eliminating the disease. Only colonies with heavy infections were destroyed. Because of this, all the early reports only record the number of heavily infected colonies.

Some of these early attempts at management make interesting reading; Isaac Hopkins[1] wrote:

The districts in which the Ruakura State Apiary is situated were amongst the worst in the Dominion for foulbrood. The colonies I started the State Apiary with that were already on the farm were affected. By constant attention and treatment we were able to keep the disease from spreading and when we left for the Christchurch Exhibition there were six out of over 70 slightly affected with foulbrood. When we retuned in the following June we found the disease had spread through robbing to nearly every colony. Early in the following season we treated a number of the worst cases and replaced bad with clean combs. As this did not turn out so satisfactory as we hoped, I hoped to treat the whole of the colonies the next spring. The result was very satisfactory indeed, for although we still get a touch of disease in one or two colonies every season, by strict vigilance it gives us no trouble.

The first reliable report on the incident of AFB in New Zealand was in 1947. Seventy four percent of all the colonies in New Zealand were inspected and 1.7% were recorded as infected with AFB[2]. In 1950 78% of the colonies were inspected and 2.02% found to be infected[3].

It was decided after the 1950 survey that the incidence of AFB could not be reduced if shook swarming was continued. Beekeepers were instructed by the Department of Agriculture to 'destory the contents of all diseased hives, and to sterilize thoroughly any remaining hive equipment by approved methods'[3].

TABLE 1
Incidence of *B. Larvae* spores

	Hives	% Positive
Hobbyist Total	355	11.1
North Island	279	10.8
South Island	76	11.8
Commercial	1681	8.3
Feral colonies	106	6.0
Honey Total	32	25.0
North Island	22	31.8
South Island	10	10.0

There were no reliable disease data between 1950 and 1960. In 1961 only 0.23% of colonies were reported to be infected. This decline since 1950 was possible due to the move away from managing AFB, i.e., shook swarming, to destroying colonies infected with AFB disease. The percentage of colonies reported to be infected has increased by 522% from 1964 to the present (Fig. 1). The number of colonies burnt has increased even more (836%), from 446 in 1964 to 3,733 in 1991, due to the increasing number of hives.

The reasons for the increasing levels of disease that is being reported is unknown. A number of ideas have been advanced ranging from beekeepers looking harder, to the changes required in beekeeping practices to prepare hives for kiwifruit pollination. One hypothesis that has some support is that it is related to the increasing numbers of hives in New Zealand (e.g., Fig. 2). The increase in the percentage of infected colonies appears to follow closely the increase in the number of colonies in New Zealand, with a two year time delay. Whether this does reflect cause and effect is unknown.

All the information on the levels of AFB in New Zealand must be treated with caution. The figures rely heavily on the information provided by beekeepers to the Ministry of Agriculture and Fisheries. Even though it is a statutory requirement for beekeepers to inspect all colonies in New Zealand each year and report any that are diseased, not all colonies are inspected, and not all cases of disease are reported when found. The disease statistics must therefore be an underestimate of the actual disease levels. Whether they are a slight or large underestimate is unknown.

The initial aim of our research programme was to investigate the incidence of AFB in New Zealand. The first problem was to decide what actually constituted an infected colony. MAF considers a colony with one or more larvae or pupae exhibiting AFB disease symptoms to be infected with AFB. However, what about colonies that contain *Bacillus larvae* spores (the causative agent of AFB disease), but do not contain any obviously diseased larvae?

TABLE 2
Number of colonies tested for each beekeeper
and the number that tested positive.

Beekeeper	Hives	% Positive
A	400	9.3
B	422	81.8
C	200	10.0
D	200	6.5
E	200	24.5
F	200	0.5
G	200	6.0
H	281	2.8

We decided to look for colonies that contained *B. larvae* spores rather than those that contained obviously diseased larvae. To do this we tested bees and bee products for the presence of *B. larvae* spores by spreading the material to be tested on bacterial plates and looking to see how many *B. larvae* colonies grew. The test is quite sensitive and will detect spore levels which

are too low to cause infections. Therefore, the presence of *B. larvae* spores in bees, bee products or equipment doesn't necessarily mean that the colonies will show AFB symptoms. This must be remembered when the results are interpreted. The relationship between *B. larvae* spores and diseased larvae will be discussed in a later article. It is also important to remember that in looking for spores it is obviously not possible to find every one. Just because we were unable to find spores in what we were testing this may not mean that there were none, but just that there were too few to be detected. Likewise any spore loadings described are only relative estimates rather than actual numbers.

We investigated a number of hobbyist, commerical and feral colonies for the presence of *B. larvae* spores. We also investigated a number of lines of honey for spore contamination.

HOBBYIST COLONIES

We tested samples of adult bees from 355 randomly selected colonies belonging to hobbyist beekeepers taken from both the North and South Islands. Most of the hives were in city areas. A total of 11.5% of the colonies tested positive for the presence of *B. larvae* spores. The incidence in both islands was similar (Table 1).

The relatively high percentage of colonies testing positive is interesting in that most of the hobbyists had only one or two hives. There is therefore little chance of the spores having found their way into the hives through cross contamination from the swapping of hive parts, as may occur in a commerical operation. This suggests that most of the spores were either produced inside the hives or were being brought in by the bees rather than being placed there by the beekeeper.

COMMERCIAL COLONIES

The survey of commercial beekeepers was not random because we were collecting the data for another reason. This point needs to be remembered when interpreting the results. We only surveyed beekeepers who had a history of having colonies infected with AFB, which would probably have produced an over-estimate. Although we sampled a large number of hives they only came from a few beekeepers which resulted in the high disease status of some of the beekeepers greatly affecting the average.

The beekeepers who supplied the hive samples were mostly from the North Island. There was a wide range in the percentage of colonies that tested positive (Table 2). If we exclude Beekeeper B whose colonies had a significant AFB problem, 8.3% of the colonies tested positive for the presence of *B. larvae* spores.

FERAL COLONIES

Bees from 106 feral colonies were tested. These were mainly collected from the Waikato; however samples were taken from as far afield as Kerikeri and Invercargill. Six percent of these tested positive.

Although feral colonies are probably a disease problem in some areas this result suggests that they may be as bad as many suppose. This is supported by the observation that a number of commercial beekeepers are able to maintain relatively disease free outfits alongside feral populations.

HONEY

Thirtytwo pots representing different lines of honey were purchased from shop shelves and tested for the presence of *B. larvae* spores. Eight of them (25%) tested positive (Table 1). All but one of the positive honey pots were packed in the North Island; however the North Island packs could have incorporated honey from the South Island.

The 25% incidence of *B. larvae* spores in honey does not of course indicate that 25% of colonies are infected or 25% of beekeepers extract infected honey. The honey from one infected super has the potential to infect a large amount of honey. Whether the concentration of spores found in the retail packs represents a potential disease risk is not known.

The incidence of *B. larvae* spores in honey does suggest that significant amounts of honey are being removed from AFB colonies, either intentionally or unintentionally, extracted and sold. If it is being done unintentionally the wet supers will have been placed back onto clean colonies.

CONCLUSIONS

It would appear from this data that *B. larvae* spores are much more common than the national disease statistics would suggest. Whether this represents the normal situation, or is a reflection of increasing disease levels is unknown. How this incidence data relates to colonies showing disease symptoms will be discussed later.

References

1 Hopkins, I. 1915: Forty two years of beekeeping in New Zealand 1874 - 1915. Some reminiscences. New Zealand Farmer stock and station Journal Dec 1915.

2 New Zealand beekeeper August 1948 P22

3 New Zealand beekeeper August 1950 P16

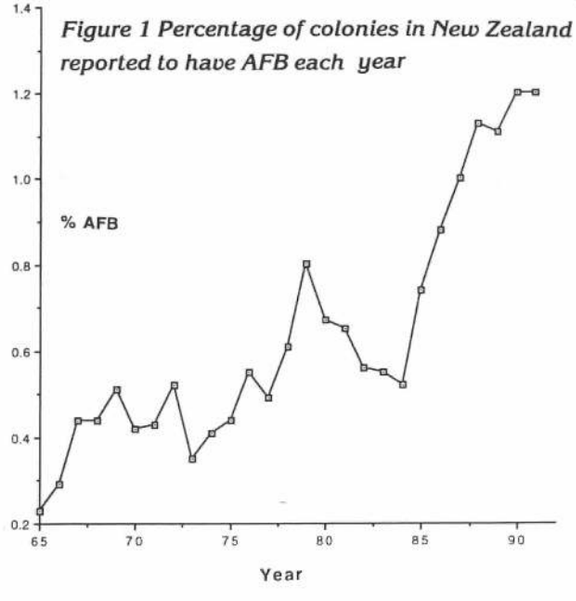

Figure 1 Percentage of colonies in New Zealand reported to have AFB each year

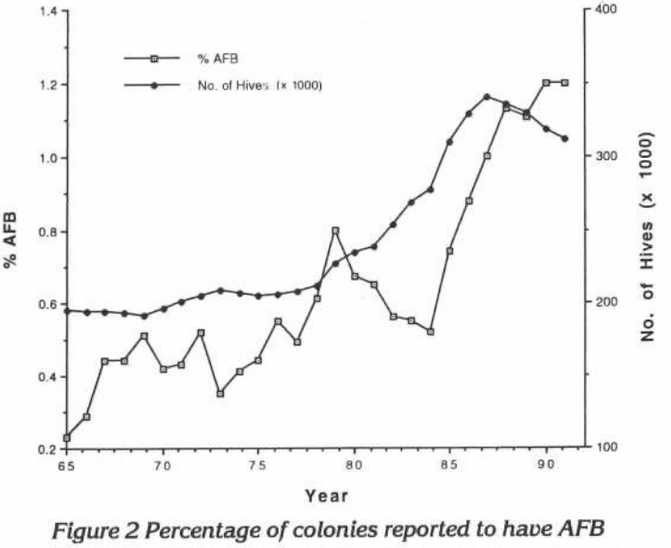

Figure 2 Percentage of colonies reported to have AFB each year and the number of colonies in New Zealand

American Foulbrood Disease Part II: Subclinical Infections

By R.M. Goodwin, J.H. Perry, & H.M. Haine
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The disease control strategy that most beekeepers in New Zealand use for their own beekeeping outfits, either knowingly or unknowingly, has been traditionally based on the following assumption;

If you inspect a colony and don't find larvae with obvious American foulbrood disease symptoms then the colony does not have American foulbrood disease.

If no disease is found, the next step is often to perform hive manipulations that could spread the disease to another colony if it was present. There are obvious problems with this scenario.

Firstly, most beekeepers do not usually perform complete brood checks (i.e. every brood frame in a hive is not examined for larvae exhibiting disease symptoms). The reasons for this are obvious considering the large amount of time that a complete brood check takes. It is common practice to inspect only three brood frames (often in the top super) with some beekeepers only inspecting a single frame. If there is only one diseased larvae in a hive with 12 frames of brood there is a 75% chance of it being missed if only three frames are checked. There are therefore problems in assuming that a hive is disease free based on an incomplete brood inspection. The simple solution to this problem would be to inspect every brood frame, but in most cases this is simply not practical.

However, even a complete brood inspection cannot guarantee a colony is free of American foulbrood disease. Colonies can contain American foulbrood spores but not exhibit any visual symptoms of the disease, so that even if you inspected every brood frame carefully you would not identify such a colony as having American foulbrood disease. When we conducted a survey of commercial beekeepers with Amercian foulbrood problems, we tested a large number of colonies for the presence of *Bacillus larvae* spores (Table 1). The colonies that tested positive received a complete brood check either by the beekeeper (Beekeepers C, D, E and G) or by us (Beekeepers A, B, and F). Only 26.4% of the colonies that tested positive for the presence of *B. larvae* spores contained larvae exhibiting American foulbrood symptoms. Therefore, most colonies that contained *B. larvae* spores did not exhibit visual symptoms of American foulbrood disease.

TABLE 1

Number of colonies tested, percentage (%) that tested positive and the percentage found to contain larvae exhibiting symptoms of American foulbrood disease.

Beekeeper	Hives	% Positive culture tests	% of positive hives with diseased larvae
A	400	9.3	35.1
B	422	81.8	28.9
C	200	10.0	5.0
D	200	6.5	15.3
E	200	24.5	18.3
F	200	0.5	0.0
G	200	6.0	8.3
Total	**1822**	**26.2**	**26.4**

Before the waters get too muddy we have to answer the question of what constitutes a diseased colony or larva. At this point we will ignore legal definitions or definitions of convenience and use a dictionary definition. This is important as the definition needs to assist in the control of American foulbrood disease.

The presence of B. larvae spores in the gut of larva does not necessarily mean that a larva is diseased. A larva is not diseased until the B. larvae bacteria are

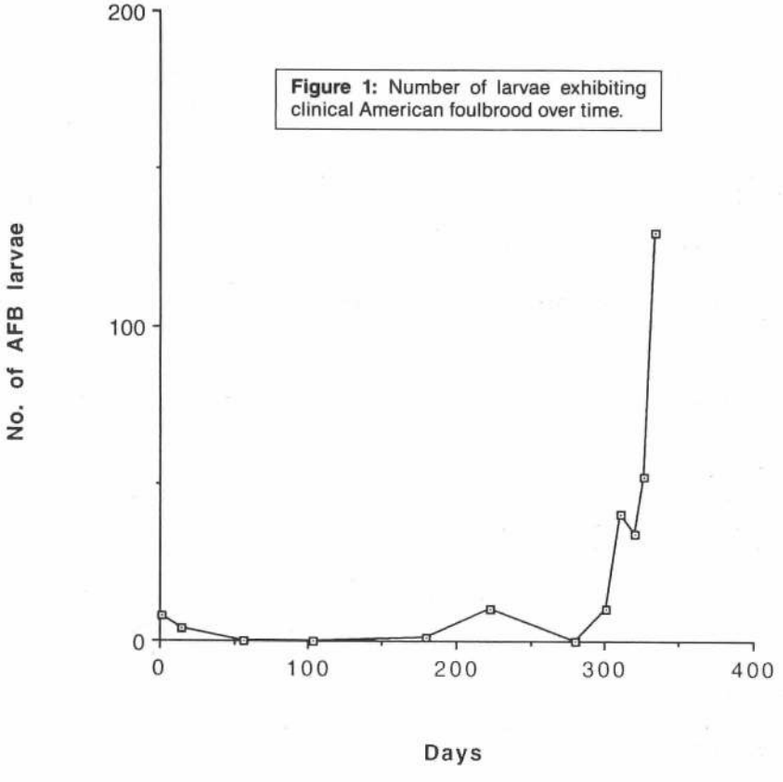

Figure 1: Number of larvae exhibiting clinical American foulbrood over time.

having adverse effects on it. Likewise the presence of spores inside a hive does not mean the colony is diseased. The colony is not diseased until it contains a diseased larva.

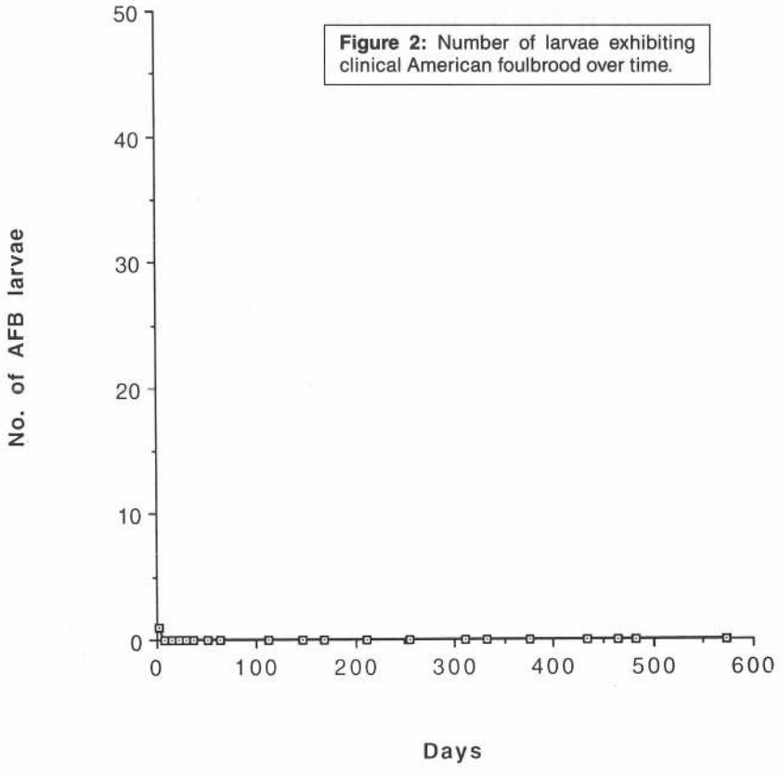

Figure 2: Number of larvae exhibiting clinical American foulbrood over time.

There are therefore three possible states:

1. *B. larvae* is present in a hive but causing no ill effects on any of the larvae (contamination).
2. *B. larvae* is adversely affecting at least one larva but the disease is not apparent to an observer (a subclinical infection).
3. *B larvae* is adversely affecting larvae and producing visible symptoms of American foulbrood disease (a clinical infection).

The presence of *B. larvae* spores in a contaminated colony, or one with a subclinical infection, can only be detected by allowing the bacteria to multiply on culture plates until the colonies are large enough to be identified. If spores are present in a hive and there is no clinical infection it will probably be for one of two reasons. The first is that the bees are not coming into contact with the spores and are not feeding them to larvae e.g. the spores may be sealed under the cappings of a frame of honey. However, more likely, the spores are being fed to larvae but not in sufficient quantities to cause the disease. *B. larvae,* like many pathogens, often needs more than one spore to be fed to a larva to cause the disease. The more spores that are fed the greater the possiblity that an infection will occur[1].

The presence of spores in a colony is, however probably indicative that either the colony is diseased, or a colony in the vicinity is diseased.

Subclinical infections occur at an individual larval level and at a whole colony level. Infected larvae do not show clinical symptoms of American foulbrood disease till they are an average of 12.5 days old. Therefore, the disease will remain subclinical for the first 12.5 days.

Many beekeepers are probably familiar with the symptoms of subclinical infections that occur on a whole colony level. Having found a colony with only a couple of diseased larvae, beekeepers are sometimes tempted to check through the colony again when they are going to destroy it. At this stage they are often unable to find any symptoms of the disease. The disappearance of the disease symptoms is probably due to the bees' hygenic behaviour. House bees will remove diseased larvae. In one trial it was demonstrated the 50% of the diseased larvae were removed before the larvae were 11 days old[2]. A colony may be diseased, but the larvae may be removed fast enough so that, when the beekeeper looks into the hive, all he sees is the empty cells where the diseased larvae used to be. Thus American foulbrood may give rise a patchy brood pattern. However inbreeding, failing queens or removal of larvae killed by other diseases such as sacbrood or chalkbrood can also give rise to a patchy brood pattern.

The presence of subclinical infections can be demonstrated dramatically if you look at the disease history of individual colonies that were kept after American foulbrood disease was first detected (Fig 1). This colony was diagnosed as having American foulbrood disease by a visual inspection. The length of time that it was diseased before the diseased was first diagnosed is unknown. As you can see it exhibited no further visual symptoms of the disease for a considerable period of time after American foulbrood disease was first diagnosed. If you had inspected this colony during that period you would have failed to recognise it as having American foulbrood disease. Adult bees from the colony tested positive for the presence of *B. larvae* spores during the period of time that it did not exhibit any clinical symptoms. Whether the colony had a subclinical infection during the time that it exhibited no clinical symptoms of the disease or was reinfected with spores stored in the hive is unknown.

Contrary to what is suggested in some quarters, colonies will not necessarily die out if they become infected with American foulbrood disease. Some colonies will recover from the disease completely (Fig 2). We will never know how many colonies become lightly infected (a couple of diseased larvae) and recover without ever being diagnosed as having American foulbrood disease.

It is possible to get an idea from the number of spores being carried by adult bees as to whether a colony is diseased or will become diseased in the near future. We have tested samples of 30 adult bees from approximately 3,000 colonies for the presence of *B. larvae* spores over the last 2 years. Where spores were present, we counted the number of bacterial colonies growing on the plates to gain an indication of the number of spores the bees were carrying. All of the colonies that tested positive and nearly 400 of those testing negative had every frame checked for diseased larvae. We then related the number of *B. Larvae* colonies growing

on the plates to the occurrence of visual disease symptoms within the colonies (Fig. 3). From this you can see that the more spores that the bees are carrying, the greater the likelihood that the colony will exibit clinical symptoms. Several of the colonies that tested negative were later diagnosed as having American foulbrood disease by further visual examinations. Whether this was due to errors in the plating or the colonies becoming infected in what was often two to three months between sampling bees and the colonies receiving a visual examination, is unknown.

Conclusions

Not only is the assumption of freedom from disease incorrect if you do not conduct a complete brood check, even a complete brood check is no guarantee of the absence of American foulbrood spores or diseased larvae. You need to consider this when you are about to take a frame of brood or honey from one colony to place in another. You may be spreading American foulbrood disease.

References

1. Woodrow, A.W. 1943: Susceptibility of honeybee larvae to individual inoculations with spores of *Bacillus larvae*. *Journal of Economic Entomology 35:* 892-895

2. Woodrow, A.W.; Holst, E.C. 1942: The mechanism of colony resistance to American Foulbrood. *Journal of Economic Entomology 35:* 327-330

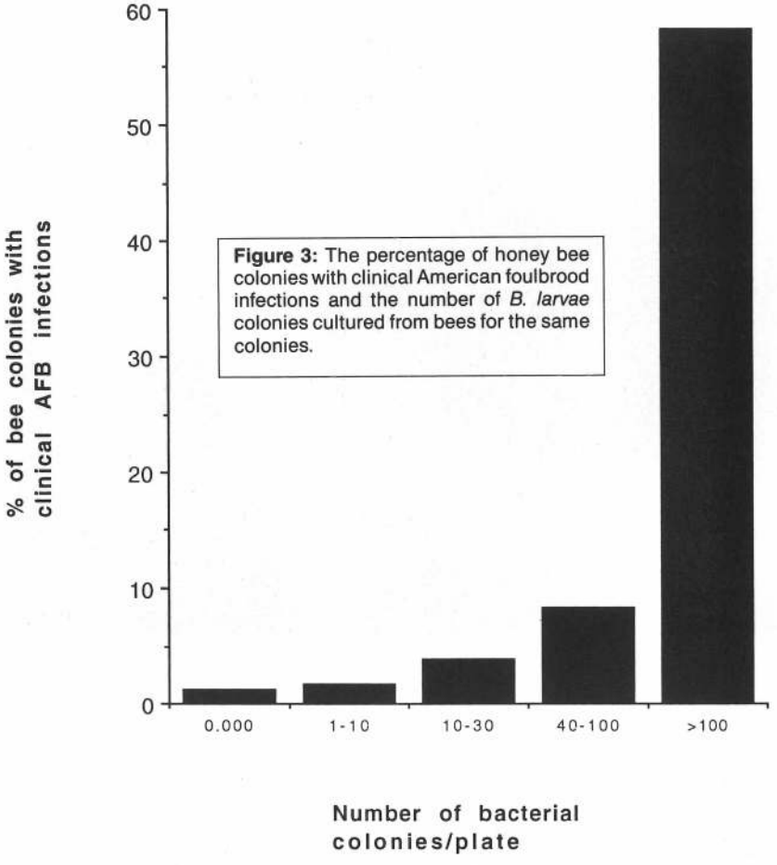

Figure 3: The percentage of honey bee colonies with clinical American foulbrood infections and the number of *B. larvae* colonies cultured from bees for the same colonies.

AMERICAN FOULBROOD DISEASE PART III: SPREAD

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To be able to control the spread of American foulbrood disease (AFB), it is important to understand how the disease spreads between colonies. A number of possible means of spread has been suggested by beekeepers. These include:

- robbing
- drift,
- transfer of brood frames,
- extracted honey supers,
- other contaminated hive parts,
- beekeeping equipment (gloves, hive tools, honey extractors etc),
- foundation,
- requeening,
- spores on flowers and the ground in front of hives,
- feeding contaminated honey and pollen.

In discussing possible sources of infection it is important to remember that although it is theoretically possible to infect a colony with a single *Bacillus larvae* spore, this probably never happens. Large numbers of spores are usually required to initiate an infection within a colony. In our studies we were able to create an infection by feeding nucleus colonies as many as 500,000 spores in sugar syrup. Infection only occurred when we increased the dose to five million spores per colony. With this in mind we can weigh up the relative importance of the suggested means by which cross infection can occur.

ROBBING

Honey bees robbing honey from an infected colony is an obvious means of spreading AFB. We were presented with a graphic case of this several years ago. A group of 80 colonies were returned from kiwifruit pollination to a dump site. Twenty of the colonies were moved to another apiary site within a couple of days. A further 20 were removed from the dump site to another apiary two weeks later. Of the remaining 40 colonies, 88% had to be destroyed over the following three months because they had contracted AFB. None of the first 20 that were removed developed the disease while 80% of the 20 colonies that were removed two weeks later had to be destroyed. At some time between the moving of the first group of hives and the second two weeks later, 85% of the colonies at the dump site developed AFB. The only reasonable explanation for this is that a large number of the colonies left on the site must have robbed an infected hive or supply of honey. The source of the infection was never found.

This example emphasises the dramatic effects that can occur with robbing. There are, however, anecodotal examples of AFB colonies being robbed without the remainder of the colonies in the apiary becoming infected. Whether this occurred because the spore levels were not high enough to create an infection or whether the robbers belonged to a neighbouring beekeeper is not known. There is no data to indicate how frequently AFB is spread by robbing.

Now to the causes of robbing. In most cases robbing is caused by the action, or inaction, of a beekeeper and not necessarily the beekeeper whose bees are doing the robbing. The beekeeper concerned may have disposed of infected material in an inappropriate manner, allowed AFB colonies to die out, or they may not have protected their hives from stock well enough so that an AFB colony gets knocked over and robbed. In some cases it may be a feral colony being robbed however we can only guess at how frequently this occurs.

DRIFT

Bees drifting between colonies is often mentioned as a major factor in the spread of AFB. Beekeepers cite examples where if one colony develops AFB the one next to it will also develop AFB, and we have seen examples of this. However, there are of course, many more examples where this does not happen, so that coincidence cannot be ruled out. It must also be remembered that the hive next to the AFB colony will usually be the next one to be worked by the beekeeper, and if hive parts are intentionally or inadvertently moved between colonies, they are mostly likely to end up in the hive next to the

one with AFB. It is therefore very difficult to be sure whether a colony developed AFB through drift or from other means.

We have been conducting trials to determine whether bees drifting from colonies with low level AFB infections are likely to spread AFB. We were particularly interested in colonies with low level infections (colonies with less than 50 larvae exhibiting clinical symptoms) because these are the type of AFB colonies that a beekeeper is most likely to miss and so leave at any apiary site.

We set up 24 pairs of colonies, each pair consisting of one hive with a light AFB infection and one uninfected colony. The colonies in each pair were facing the same way and positioned as close together as possible to maximise the level of drift. When we measured the level of drift between the colonies we estimated that the equivalent of 50% of the bees swapped colonies over a 20-day period. This may of course have been due to a smaller number of bees moving backwards and forwards between hives rather than a total of 50% of the bees swapping colonies.

We know that most bees in an AFB infected colony carry *B. larvae* spores, even those colonies with low level infections. We have tested individual bees from different parts of infected hives. The bees left on frames after the frames are shaken are on average the youngest bees, while those found on the frames before shaking are the next oldest. Bees in the honey supers are older still while foraging bees are likely to be the oldest. Bees found on the brood frames are more likely to be dealing with infected larvae and are therefore more likely to be contaminated with spores. We found that the percentage of bees carrying enough spores to be detected depends on where they there are taken from (Fig. 1). This also affects the total number of spores carried (Fig. 2).

In the experiment, no equipment was swapped between hives and all the equipment used to inspect the colonies was sterilised after each hive was managed. The pairs of colonies were together for a total time of seven years (an average of 103 days for each pair). Only two of the non infected control colonies developed AFB. They both developed AFB at the same time as 12 hives in two apiaries close by that were involved in another experiment also developed AFB so it is not possible to rule out robbing. As only 8% of the control colonies developed AFB it is possible to conclude that bees drifting from colonies with light AFB infections are not a major factor in the spread of AFB. Whether the same can be said for drift from colonies with heavy infections is unknown.

TRANSFERRING BROODFRAMES

Transferring a frame of brood from an AFB infected hive to a clean colony has to be a very effective way of spreading AFB. To put this into context, a colony may need to be fed five million *B. larvae* spores to become infected. However, one diseased larvae can contain 2,500 million spores or 500 times the number required to initiate an infection. Nevertheless, placing a diseased larvae into a hive is probably still no guarantee that the colony will develop AFB.

WET HONEY SUPERS

Honey supers are probably the pieces of equipment that are most frequently swapped between hives. The colonies that they come from are often not checked thoroughly when the honey is removed, and in some outfits not checked at all. We are currently conducting a trial to determine the importance of wet honey supers in the spread of AFB. We collected 20 supers of honey from colonies with light AFB infections. Most of the supers came from colonies with less than five larvae exhibiting clinical AFB symptoms. These are the type of infections you would be likely to miss if you were only checking three brood frames in a colony. The honey was extracted, all of which tested positive for the presence of *Bacillus larvae* spores, and the supers placed back onto AFB-free colonies in the spring. The colonies were split between two sites and situated with a further 20 AFB free colonies.

There were no obvious symptoms of robbing when we placed the supers on the colonies. However, when we tested bees from the hives two days later all

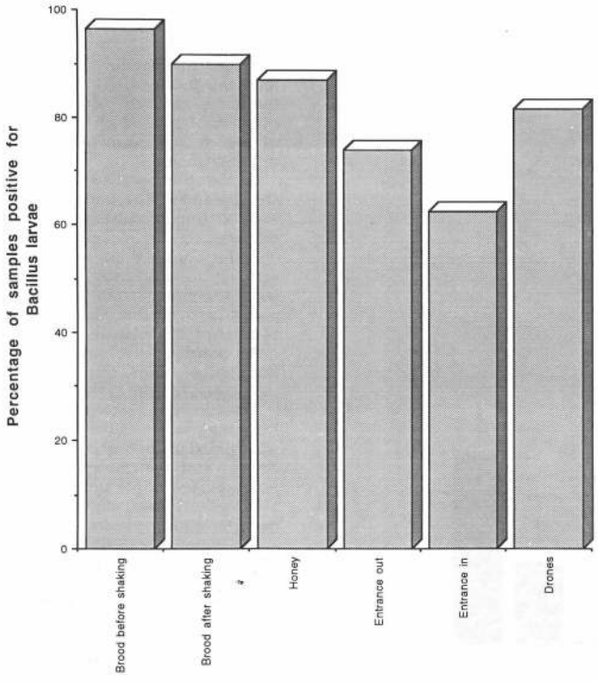
INFORMATION REGARDING LIFE MEMBERSHIP

Both the Executive Secretary and the Librarian have been asked several times for information regarding NBA members who have received Life Membership of our Association for services rendered to the beekeeping industry. Records seem to be sadly incomplete and probably incorrect. We would like to put this matter right and ask readers for their cooperation. Please peruse the following list to see if certain names are missing which should have been recorded, or if present information is not correct. We need the name, address at time when the Life Membership was bestowed, still alive, or passed on and the year in which this L.M. was received. This only concerns Life Membership of the Association not Branch Life Membership.

Please pass on your info to the Librarian, NBA Technical Library, C/ Post Shop, Milton. Your help with completing this "ROLL OF HONOUR" will be much appreciated.

J.R. Barber, Pio Pio.
A.R. Bates, Matamata.
S.F. Bartrum, Herbert.
D.A. Barrow, Tauranga.
W.B. Bray, Leeston.
H. Cloake, Timaru.
T. Chisnall, Nelson.
A.F. Chapman, Leeston.
P. Berry, Havelock North.
A.H. Davies, Whangarei.
R. Davidson Sr., Timaru.
C.E. Dawson, Timaru.
James Forster,
Ivor Forster, Oamaru.
J.W. Fraser, Ryall Bush.
N. Glass, Gore.
R.V. Glasson, Blackball.
J. Glynn, Balfour.
M.G. Gordon, Hastings.
A.M.W. Greig, Tauranga.
L.K. Griffin,
G. Gumbrell, Geraldine.
W.T. Herron, Waikaka.
I.W. Haines, Kaitaia.
D.G. Hamilton, Waimati.
Sir Edmund Hillary,
A.A. Lennie, Invercargill.
J.D. Lorimer, Hamilton.
J. McFadzien, Havelock North.
T. Palmer-Jones, Wellington
T.E. Pearson, Fairfield.
T.H. Pearson, Auckland.
H.R. Penny, Hawera.
T. Penrose Sr., Christchurch.
J. Rentoul,
L.F. Robins,
E.W. Sage, Ohaupo.
R. Stewart, Heriot.
W. Watson,
T.S. Wheeler, Otorohanga.
E.D. Williams,
W.W. Nelson,
C.R. Patterson,
K. Ecroyd, Wanaka.
H. Belin, Auckland.
M.J. Heineman, Milburn.
I. Berry, Havelock North.
I. Dickinson, Milton.
C. Rope, Auckland.
T. Gavin, Whangarei.

the samples tested positive even those from the colonies that did not receive AFB supers. The colonies were given a complete brood check every month. The first clinical AFB symptoms were recorded two months after the supers were put on and further clinical symptoms up to five months afterwards. The colonies are being followed to determine if any more develop AFB. It is interesting to note that some of the colonies did not develop clinical AFB symptoms for a considerable time (five months) after the wet supers were added. The effects of contaminated supers placed on hives in the spring may therefore not become fully evident till the following spring. Four (20%) of the control colonies have developed AFB to date and eight (40%) of the colonies given infected honey supers. Extracted honey supers are therefore a important factor in the spread of AFB.



OTHER HIVE PARTS

The importance of other hive parts, such as empty supers, floor boards, hive mats, division boards, and lids, in the spread of AFB is unknown. They are likely to carry less spores than brood and honey frames and so are probably less important in the spread of AFB.

BEEKEEPING EQUIPMENT

Unless you use your hive tool or the fingers of your gloves to determine if a larvae will rope then they will not generally be carrying large numbers of spores and therefore will not be a major factor in the spread of AFB. Your extractor is also unlikely to be a major factor. Infected honey may be transferred between frames during the extracting process however the amount will be insignificant compared to the amount contained on a wet AFB super. However, you should still take precautions to ensure that gloves, hive tools and extractors are not a factor at all.

FOUNDATION

At least some of the wax that is melted down for foundation must come from AFB-infected colonies. In trials conducted last year we demonstrated that cappings honey and wax from AFB hives carry many more spores than the remainder of the honey. However most of the spores will be removed by the initial melting and the later processing. Although we have

tested eight lines of foundation to date, we have yet to find any *B. larvae* spores.

QUEENS

It is theoretically possible for queens to transmit AFB. Of the eight queens we have tested from AFB colonies, two tested positive for *B. larvae* spores. It is unlikely that they would carry enough spores to create an infection.

FLOWERS AND SOIL

Bees picking up chalkbrood spores from flowers has been suggested to be a means of spread of chalkbrood. However, it must be remembered, that compared with *B. larvae,* relatively few chalkbrood spores need to be carried back to a hive to create an infection. Except where bee-collected pollen is artificially added to flowers to effect pollination, bees are unlikely to pick up enough spores picked up from the soil in front of a hive to cause a problem. One study that looked for *B. larvae* spores in the soil in the front of AFB hives was unable to find any[1].

HONEY AND POLLEN FEEDING

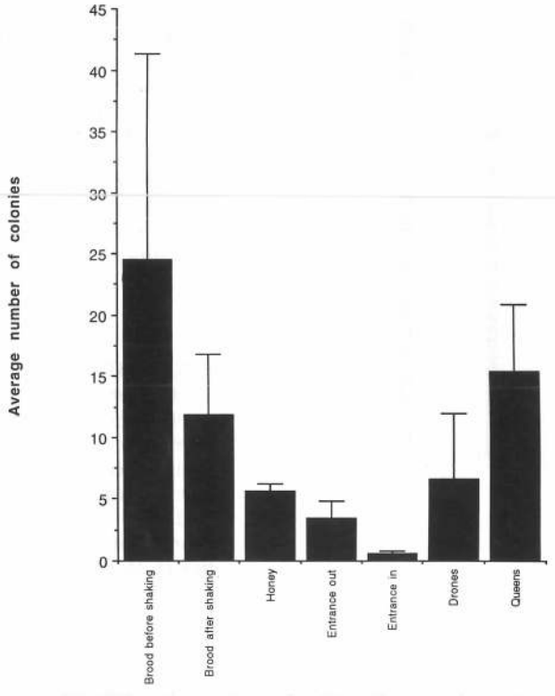
Both honey, and pollen taken from pollen traps, can contain high levels of *B. larvae* spores. If fed to a colony, both honey and pollen taken from an AFB colony could be a major source of infections.

SUMMARY

The four most important ways in which AFB probably spreads are:

- swapping brood
- robbing
- extracted honey supers
- feeding honey and pollen.

Of lesser importance will be drift and contaminated hive parts and very much in last place other beekeeping equipment (gloves, hive tools and extractors), queens, foundation and flowers.



Even though some factors are more important than others in the spread of AFB it is important to endeavour to minimise the risks involved with very beekeeping operation.

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1 Gochaur T.A. 1981: The distribtion of *Bacillus larvae* spores in the environs of colonies infected with American Foulbrood disease. *American Bee Journal 121:* 332 - 335.

Fig. 1 The percentage of bees taken from different places in AFB infected colonies that tested positive for the presence of *B. larvae* spores.

Fig. 2 The average number of B. larvae colonies cultured from bees taken from different places in AFB infected colonies.

Dealing with disaster

THE KEY TO SUCCESSFULLY MANAGING A CRISIS IS BEING PREPARED FOR IT.

A crisis management plan can protect your reputation and save you millions!

It's not a case of whether you'll have a crisis or not - every organisation does sooner or later - it's how you handle it that makes the difference.

The reputation of a company and its brands is a fragile thing. Public opinion is highly fickle and can switch from warm support to cold rejection overnight.

A badly managed crisis can often be the trigger for such a drastic swing in attitude. There have been numerous examples, both in New Zealand and overseas, of crises which have led to the devastation of brands and even, in extreme cases, entire organisations.

On the other hand, a well managed crisis can be shrugged off with a minimum of disruption and can even be turned to advantage if the circumstances allow it.

Perhaps one of the best-documented crises and certainly one of the most capably handled occurred when the manufacturers of Tylenol, the leading pain killer in the United States, became the victim of a deliberate poisoning campaign.

As word of the sabotage became public knowledge, sales of Tylenol plumeted and threatened to destroy the brand altogether.

The company reacted by withdrawing Tylenol from the market and re-packaging it in the first widespread use of "tamper-proof" packaging. This action, and the communication process that accompanied it, not only saved the brand from annihilation but actually improved its market share over the following years.

In addition to resolving the crisis as quickly and efficiently as possible, preserving and re-building public confidence is one of the principal objectives of any crisis management plan. From a marketing perspective this is also the most important aspect of planning.

The first step to be taken in planning is therefore to assess the potential crises that may befall the organisation. These may range from relatively minor occurrences, such as equipment failure, to more serious possibilities, such as loss of life arising from negligence or product contamination.

The next step in the plan is to determine executive responsibilities during the crisis. Usually, a crisis management team will be nominated, each with clearly defined responsibilities to be undertaken.

At this stage of planning, the various components of the crisis strategy are prepared by the personnel responsible. Developing systems for product withdrawal, testing and reintroduction are all part of this aspect of the plan.

From an image perspective, having a media strategy is essential. This will entail having a spokesperson appointed for the organisation and a clearly defined policy for informing the media of developments if the crisis is of sufficient scale to warrant public attention.

The plan will also include a strategy for rebuilding the brand or company image in the event of certain types of crisis. Preparation of this aspect of the crisis will ensure that there is no delay in beginning the recovery process and returning to normal trading.

It is an unfortunate truism that most organisations do not see the need for crisis management planning until they actually have a crisis. Regrettably, once the crisis is upon them they realise that it's too late to plan and the best they can do is react.

There have been enough highly visible instances of crises afflicting New Zealand organisations in recent times to convince even the most sceptical that planning should be an essential part of any organisation's routine activity.

American Foulbrood Disease. Part IV. Control.

by Mark Goodwin

In order to manage colonies to reduce American foulbrood (AFB) disease levels it is important to understand one basic concept. This is that most AFB infections of colonies are due to beekeeping practices. If your disease levels are remaining stable you are probably infecting clean colonies at the same rate that you are finding and destroying diseased colonies. You can alter the disease situation of your hives for better or worse by either modifying the number of effectiveness of your disease inspections or changing management practices which may either increase or decrease the rate of spread of the disease. For example a change in any of the following may affect disease levels.

Disease inspections

* The percentage of brood frames inspected
* The location in the hive of the frames inspected
* The frequency of inspections
* Whether the bees are shaken off first
* Ability of the inspector to identify disease larvae
* The timing of inspections.

1. Hive Management

* Amount of brood shifted between hives
* Exchange of wet or dry supers between hives.
* Frequency of robbing and drift
* Use of feed honey
* Speed with which diseased hives are destroyed
* The methods used to sterilise equipment.

The preceding lists are of course not complete but provide an idea of the complexity of the issue. The importance of each increase with the overall disease incidence. For instance increasing your disease incidence five fold from 0.5% to 2.5% might be painful however increasing it from 5% to 25% might be disastrous.

The list also demonstrates that there are a large number of factors that can be worked on to reduce disease levels. The choice of which are selected probably depends on the importance placed on reducing disease levels.

There are a number of possible options for inspection programmes and hive management.

INSPECTIONS

The first step is to ensure that you and your staff can recognise a larva with American foulbrood disease.

The first basic rule in inspecting colonies is that you cannot inspect brood frames for disease unless you shake the bees off first. The second rule is that the more brood frames you check the more likely it is that you will identify an American foulbrood infected colony. Although they take a lot of time, complete brood inspections are a very valuable tool.

Obviously the more frequently you inspect colonies the greater the probability that you will identify any diseased colonies that are present. However there are certain times when failure to identify a disease colony may prove to be particularly expensive. Such as when you are removing something from a hive that may be placed in or on another hive. e.g. brood, honey supers, bees or empty supers. It is best to target your inspections for these times. If your hives have a disease problem probably the best advice that you will get is to do a complete brood check before you remove anything from any hive, especially when you are removing honey supers. It may be a pain in the neck when you are trying to take honey off however it might save a lot of work burning hives later on.

One solution to the problem of trying to inspect at the same time as you remove honey is to number all your hives. This can be done quickly and cheaply with a felt pen. The number would only have to last a few weeks. When you remove your honey supers don't inspect for disease but write the number of the hive on every box as it is removed. Then come back and do a complete brood check before you extract the honey. Any boxes from infected colonies can then be removed as it turns up at the uncapper.

This said there are of course the legal requirements. This are to inspect, or have inspected, your colonies between the 1st of August and the 30th of November each year and to report any AFB found forthwith, along with sending in a statement of inspection including the yearly hive totals by the 7th of December. I am always surprised by the number of beekeepers I hear of that are in contravention of the act and do not report disease forthwith. If you read the act you will see that the notification must be in writing.

2. Culture tests

Colonies can have AFB disease without exhibiting any clinical symptoms[2]. It is possible to test samples of bees or honey from colonies for the presence of spores to indentify these colonies[1]. If a colony returns a positive test for AFB disease it should receive a complete brood check as soon as possible. If diseased larvae are found it must be destroyed. If no clinical symptoms of the disease is found it should be marked so it can be checked regularly.

If the overall incidence of AFB disease does not warrant the expense of testing every colony individually then composite samples of bees or honey (collected during extraction) could be taken from each apiary and tested. This information could be then used to target further inspections.

HIVE MANAGEMENT

There are three main types of management that can be usefully applied to controlling disease problems. These are hive, apiary or area quaratines. They all serve to limit the impact of hive management on the spread of AFB.

1. Hive quarantine

This is where each colony is managed by itself with no interchange of equipment between hives. It is usually only employed where there is a significant risk of anything that swapped between colonies being contaminated with AFB spores.

An example of this might be where a beekeeper has a 20% AFB incidence. The programme would consist of numbering every floorboard whether or not it is in use. This can be simply done by nailing a small sheep eartag on each flight board. When this is done every colony will have a unique number. From then on no equipment is swapped between colonies. Queen excluders, feecders, division boards etc either stay with the hive or are numbered when removed, extracted and the same frames placed back in the same super.

These are returned to the same hive in the spring.

This process is obviously very time consuming and requires the beekeeper to be very organised. However it can and has been used for commercial beekeeping operations and can have dramatic effects on reducing disease levels. Assuming all the available equipment is used on hives each year, comprehensive inspection and hive quarantine programmes are employed and these are few ouside sources of spores such as feral colonies, it should be possible to eliminate American foulbrood disease from an outfit in a couple of years.

Hive quarantines could be used for colonies that return a positive culture test but have no clinical disease symptoms. If there are a number of hives testing positive they could all be moved to the same apiary to reduce the possibility of them cross infecting other colonies.

2. Apiary quarantine

This is where each apiary is managed separately. This type of quarantine has been employed by beekeepers with a wide range of disease levels in their hives. Any equipment from an apiary is coded in some way and always remains with that apiary. It has the advantage that it is much less time consuming than a hive quarantine but can still be very effective. It is used as a matter of routine in some operations. If an AFB problem develops it will probably only effect the colonies in one yard rather than affecting the whole outfit. Some beekeepers use a modified system whereby they quarantine any apiary where an AFB hive is found and keep it in place until the apiary has been free of AFB for a specified time, possibly two-three years. Interestingly if you find an AFB hive in an apiary you are legally required to not remove anything from that apiary without the consent of an inspector.

3. Area quarantine

This might consist of dividing an operation into two such as those apiaries with a recent history of AFB and those without. The two parts are managed separately with no interchange of equipment between parts. Apiaries may be added to the AFB free part if they remain free of AFB for a certain length of time or added to the AFB part if a colony develops AFB.

CONCLUSION

Probably the most effective way in which you can combat American foulbrood disease in your outfit is to conduct a complete brood inspection before you remove anything from a hive and reduce the exchange of equipment between colonies as much as possible.

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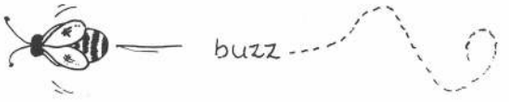

THOUGHTS ABOUT HEALTH FOODS

from George Nichols

We have made a big mistake in marketing "pure" honey while the rest of the food market has gone in for expensive additions and subtractions.

Let us try some additions, how about pollen? We can shake a very obvious dusty layer on top of our pots from the local pine trees or privet bushes. How about vitamin enriched honey? Our diet is already loaded with too much of everything including vitamins, yet the local chemist's shop will gladly sell us an even greater excess which, luckily, passes straight through us. Not the fat soluble ones.

Then we can put royal jelly into honey and add a rumour on the label hinting at male fertility. As an alternative to royal jelly for the Far Eastern market we can add ground up deer horn, or even rhino horn if the Auckland zoo will oblige. I will offer to lend them a suitable rasp but I am not very certain if I have time to help with the job. Honey toffee with propolis should sell well, then cappings' wax could be added though I am not sure what for but the faddy feeders can, no doubt, find something marvellous. A brilliant thought suddenly struck me, we must add bran to our "Regular" honey. Another additive which might be tried is hydrogen, long ago when I was a student we added hydrogen to vapourised cottonseed oil using a nickel catalyst and margarine came out of the end. Now margarine has a reputation for being entirely "Natural" whatever that means so we could try adding hydrogen to hot honey to see what happens.

The other end of the food fad market extracts most of the nutriment from food - no cholestrol - no kilo calories - no - fat - sugar reduced. Can we extract laevulose or dextrose from honey, sell the resultant remains at an inflated price and then sell the laevulose or dextrose back to the gullible public, this is rather like selling a nationalised industry back to the tax payer who thought he already owned the industry. In the extreme case we could sell honeyless honey water with only the smell remaining. Slimmers take note, you can be slim enough to wear your daughter's knickers!

Now, here are some suggestions for advertising our products. We must have television advertising programmes with extremely healthy young women who, for some totally unknown reason, know facts about honey which are hidden from men. This would go down well in Womens' Suffrage Year. For royal jelly honey we need a nubile young woman having a romp with a elderly beekeeper. Voice from behind my back "That's just wishful thinking, be your age George." " That's the trouble, I am my age!"

Finally a short poem: (voice from the back "Oh good, we've got there at last.)

On Diet

Cholestrol is poisonous so never, never eat it.
Sugar too may murder you, there is no way to beat it.
And fatty food may do you in, be certain to avoid it.
Some food is rich in vitamins but processing destroys it.