politus L., *Philonthus sordidus* Grav., *Platystethus americanus* Erichson, *Platystethus spiculus* Er., *Staphylinus maxillosus* Grav.) ; Histeridae (*Carcinops pumilio* (Er.), *Gnathoncus nanus* (Scriba), *Margarinotus merdarius* (Hoffman), *Saprinus lugens* Er.) ; Scarabaeidae (*Aphodius fimentarius* (L.), *Aphodius granarius* (L.), *Aphodius lividus* (Oliv.) ; Anthocoridae (at least two species) ; Hydrophylidae (several species) ; and Tenebrionidae (*Alphitobius diaperinus* (Panzer)—see photos. In addition, predatory earwigs, mites, flies and ants are often prominent.

Parasites

The other type of natural enemy, parasites, attack young and full-grown larvae and pupae of flies. Parasites live in the fly breeding sites where they search for, sting, and deposit eggs in their hosts. The eggs hatch inside the immature flies and the parasite larvae rapidly consume the contents. Female parasites of a number of species prefer to attack robust, potentially more fecund flies. They are also able to accelerate their rate of kill and their own developmental time in response to increases in fly populations. By being selective in the time they have available to kill, they have a considerable effect on the fecundity and abundance of the next generation of flies, since more of the "weakling" flies escape parasitism. The weaklings not only find it more difficult to lay larger numbers of eggs than their parasite-killed sisters, but they transmit more weak inheritance characters (genes) to their offspring. Parasites also kill many flies that they do not lay eggs on, so their effectiveness in fly mortality is greater than the number of parasitized pupae would indicate.

The principal parasitic species active in California on house and stable flies are *Muscidifurax raptor* Girault and Sanders (a large and a small type), *Spalangia cameroni* Perkins, *S. endius* Walker, *S. nigra* Latreille, *S. nigroaenea* Curtis and *Aleochara* sp. (see photo). The *Fannia* group of flies also possess one or two species of *Stilpnus* which attack larvae. Although most of these parasites are active at all low elevations in the state, only the *Aleochara* sp., *Stilpnus* and *S. nigroaenea* appear to become prominent above 4,000 ft. None of the native parasites and few of the predators, are very active when the mean temperature drops below 60°F. There is comparatively less activity between December and April. However, in most areas fly problems are minimal during this period.

Prospects

A number of parasitic natural fly enemies obtained throughout the world are now being introduced into California by University scientists to strengthen the existing natural enemy complex. The species are: three reproductively isolated forms of *Muscidifurax raptor* from Puerto Rico, Central and South America showing varying characteristics of gregariousness, fecundity and uniparentalism; *Spalangia longepetiolata* Boucek from East Africa, *Sphegigaster* sp. from South Africa, *Tachinaephagus zealandicus* Ashmead from Australia and New Zealand, and *Aleochara taeniata* Erichson from the West Indies.

Some of these were very active in cold climates while others required intensely hot and dry environments. By distributing them through all climatic areas of the state, it is expected that parasite activity will be increased where it is now low, and that winter fly problems on the south coast can be reduced by the addition of the cold-hardy species.

Predator complexes in animal excrement in the Ethiopian and Neotropical regions differ considerably from the Holarctic region in the species they contain. Future efforts will be directed toward the introduction of key species into California.

The "inundation" method involving the periodic release of laboratory-reared cultures of parasites in a direct attempt to reduce the increasing fly populations, shows some promise but must be investigated further. Test results indicate that effective use of the adapted complexes of natural enemies is the best biological control method at this time. Since peaks in fly activity are correlated with seasonal weather conditions in each locality, these variations must be considered. Otherwise, the method involves the preservation of existing natural enemy complexes in animal excrement by alternating the removal of manure, and abstaining from chemical treatment of the manure; and favoring coned manure deposits for poultry. When frequent manure removal practices require stockpiling in an adjacent area (environmental poultry houses, dairy industry, etc.), a high steeply sloping mound will assist maximum natural enemy activity and also be least suitable for fly breeding.

E. F. Legner is Associate Entomologist, and G. S. Olton is Graduate Student, Department of Biological Control, University of California, Riverside.

MASTITIS

. . . *a six-year*

SINCE 1955, the average herd size in the Fresno County Dairy Herd Improvement Association (DHIA) has increased from 105 to 256 cows per herd. This expansion has been accompanied by an increase in production of milk from 9,433 to 13,592 pounds and of butterfat from 391 to 509 pounds per cow. Mastitis is one of the problems in dairy management which becomes more complex as herd size increases. Clinical mastitis cases can be recognized readily; however, it is also of great economic importance to determine which cows in a herd have nonclinical cases of mastitis.

The Fresno County DHIA decided in July, 1961 to use the California Mastitis Test (CMT) in determining the degree of mastitis within a herd. The CMT has been well accepted and demonstrated throughout the world as a simple, economical, and practical method for estimating the mastitis cell count in milk.

Bucket milk testing (milk samples by the DHIA tester) proved to be an excellent device for screening individual cows in a herd. CMT scores were rated as follows: samples scoring negative (no mastitis cells detected) and trace (N+T) were combined into one group; samples scoring one were listed separately; samples scoring two and three (2 + 3) were also combined. Standardization procedures were established with quarterly checks made on tester procedure.

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RICHARD N. EIDE

TESTING

summary of Fresno County's DHIA program

Monthly data included the owner's name, date tested, cows in herd, cows tested, production figures, number of cows scoring CMT (N+T), 1, or (2+3), and number of cows culled. The intention in gathering such data was to determine what the average CMT score per herd might be during any given time period and to permit herd owners to compare their herd CMT scores.

When the results from over a million tests were summarized, it became evident that the percentage of CMT 2+3 scores decreased during the summer and increased during the winter (see table). The correlation coefficient of percent CMT 2+3 scores to mean temperature was –.790 (significant at the 1% level). A perfect correlation is ±1.0. While the data showed a correlation between CMT 2+3 scores and the mean temperature, it was suspected that there probably was a time lag between temperature and the development of mastitis. Therefore, a comparison was made using a one-month time lag (i.e., January's temperature plotted against February's per cent CMT 2 + 3, etc.). This increased the correlation from –.790 to –.972 (significant at the 0.1% level—graph 1). This increase in correlation indicated that a time lag was involved but the data do not preclude that the time lag might be for a period other than one month.

Comparing the per cent CMT 2+3 with production in pounds of daily milk per cow, (again using a one-month time lag) a correlation of –.859 (significant at the 0.1% level) was obtained. Part of this relationship may be due to a concentration of cells in the lower milk volume produced during the colder months which increases the incidence of CMT 2+3 scores.

Because the tester's report included the number of cows culled as well as cows dry per month, it was possible to determine to what degree culling and drying might be

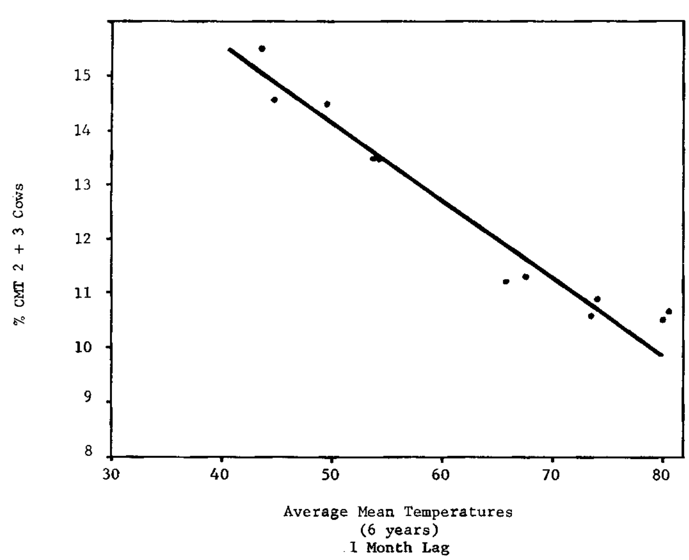
DHIA MASTITIS TESTING PROGRAM SIX-YEAR SUMMARY (1962–1967)
FRESNO COUNTY

Month	Total samples	Daily milk/cow	Cows culled	Cows dry	Cows with CMT 2+3*	Mean temperature
		lbs	%	%	%	°F
January	89,052	38.8	34.4	16.2	14.6	43.4
February	88,117	39.6	30.8	15.4	15.5	49.6
March	89,665	40.9	31.5	15.8	14.5	53.8
April	90,000	41.3	27.9	15.4	13.5	59.7
May	92,691	43.2	26.7	15.5	12.8	67.4
June	93,371	43.8	22.8	15.3	11.3	74.1
July	94,426	44.2	24.6	14.8	10.9	80.2
August	94,464	43.0	23.1	14.3	10.7	79.9
September	96,011	42.4	23.4	14.6	10.5	73.5
October	95,481	40.0	27.8	15.2	10.6	65.7
November	95,353	39.7	23.6	15.7	11.2	54.5
December	94,314	38.7	29.1	16.0	13.5	44.7
Total	1,112,945					

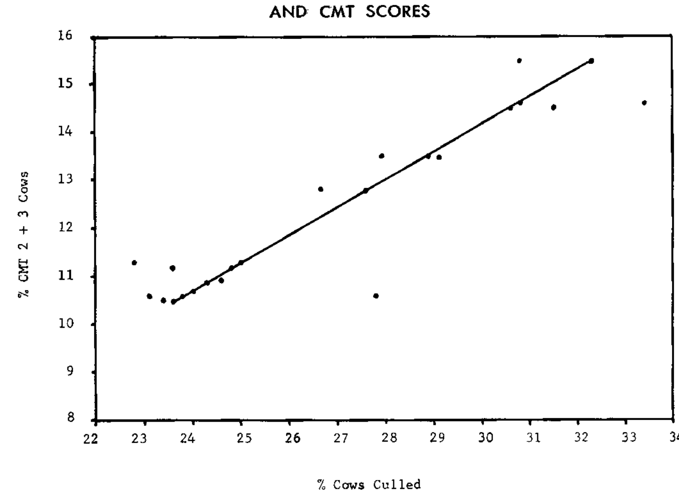
* Milk samples scoring 2 and 3 were combined in tabulation.

GRAPH 1. RELATIONSHIP BETWEEN TEMPERATURE AND CMT SCORES

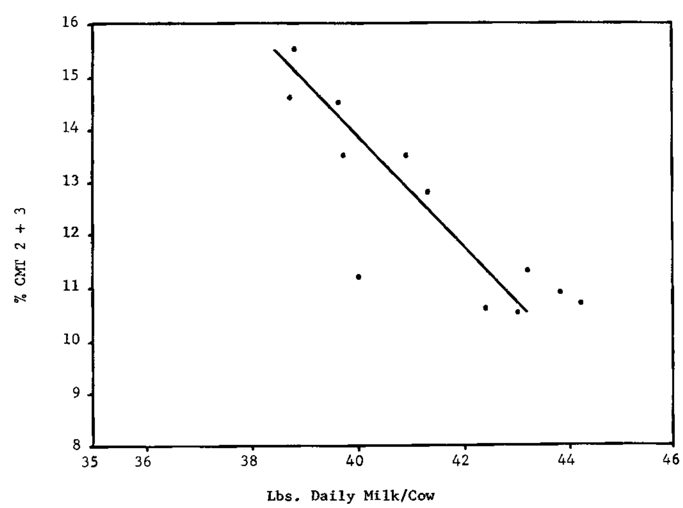
Y = 150.25 -7.06X



GRAPH 2. RELATIONSHIP BETWEEN PERCENTAGE OF COWS CULLED AND CMT SCORES



GRAPH 3. RELATIONSHIP BETWEEN MILK PRODUCTION AND CMT SCORES



associated with the CMT scores. The correlation between per cent CMT 2+3 versus per cent culled was found to be .778 (graph 2). The per cent dry versus per cent CMT 2+3 was .842. These two correlations were significant at the 1.0% level and 0.1% level, respectively.

The increase in positive CMT 2+3 scores, together with a higher rate of culling and per cent dry, may be accounted for in part by the fact that cows tend to be culled in late lactation and hence there are a greater number of such cows in the herd at the time more are being culled. The data indicate that while dairymen are using CMT for a culling guide, there are also other factors involving culling.

It is not believed that the effect of temperatures can be discounted completely, since it is possible that a combination of factors associated with winter weather create an environment favorable to mastitis. The reverse would be true for the summer months.

The program has created a high degree of interest among owners whose herds have CMT 2 + 3 scores above the monthly average as reported by DHIA. The mechanical factors found to be most responsible for mastitis were milking systems that lacked the capacity to handle the volume of milk put into them, malfunctioning equipment, and the improper handling of the milking units by the milkers.

The last six years have seen widespread improvement, not only increased milking system capacities, but more efficient dairy barns and dairy management. Over the last four years an average of only 11.5 per cent of the cows on CMT had a score of 2 + 3, compared with an average of 15% (2 + 3) in the first two years of the program.

The summary indicates that with present methods of herd management it is possible to maintain an average CMT score at the 10 to 12 per cent level. If the milk of all cows tested had gone into the bulk tank, the tank CMT would be well within the commercially acceptable CMT 1 range (500,000 to 800,000 cells per ml). Since most herd managers withhold many of the CMT 2+3 cows from the milk supply, the bulk tank CMT average is usually in the negative and trace range. It remains to be seen whether it is economical and practical to reduce this score below the present average.

R. N. Eide is Fresno County Dairy Farm Advisor.

A preliminary report . . .

ZYTRON

E. C. LOOMIS · E. L. BRAMHALL · L. L. DUNNING

EARLIER STUDIES of insecticides for fly control have shown that resistance is unequally distributed in California's numerous species of flies and that one chemical used for the control of the little house fly, *Fannia canicularis,* may not result in effective control of the house fly, *Musca domestica.* These differences in chemical effectiveness are particularly noticeable when poor control permits numerous adults to cause a serious nuisance problem on agricultural premises. In some cases, it may be profitable to spray for control of fly larvae in the manure and thereby prevent adult fly emergence.

These tests are of preliminary studies conducted with the herbicide Zytron (O-[2-4 dichlorophenyl] O-methyl isopropyl phosphoramidothioate), which has been found to have fly larvicidal activity. Early studies in 1966 with granular formulations of this chemical applied to animal manures showed excellent fly control, but the methods of granule application were not considered practical or economic. The studies reported here are on the use of Zytron as an emulsifiable concentrate which can be readily mixed with water and easily applied by spraying the surface of the manure piles.

In the three studies reported here, Zytron was applied by means of a two-gallon-capacity Hudson hand sprayer operated at 40 psi. Quantitative manure samples were taken from all treated and untreated replicates before each spray application. The samples were covered by an insect emergence cage for four weeks after which time all adult flies were collected and identified.

A small test plot was established at the University of California poultry ranch, Davis, in which Zytron (at 4.5 per cent) was sprayed at the rate of one gallon per 100 sq ft to coned manure under poultry cages. These spray applications were made during May and June at biweekly intervals, with two weekly applications thereafter. Fly control was not successful following the first biweekly application. These results showed that the insecticide did not penetrate the four-week-old manure droppings to kill developing larvae and thereby prevent adult emergence. Excellent fly control (95 to 100 per cent) was achieved following the second biweekly, and two weekly applications. It was more difficult, however, to prevent the emergence of adult *Fannia* (*F. canicularis* and *F. femoralis*) than to prevent emergence of adult muscid flies (house flies, *Musca domestica;* false stable flies, *Muscina stabulans;* and black garbage flies, *Ophyra leucostoma*). Different habits during immature stages of these flies contributed to the reasons for these differences in effectiveness. The larvae of *Fannia* species are less active than those of the muscid group. Also, larvae of *Fannia* species are more commonly found in drier pockets of manure than are the muscid-type larvae.

Commercial ranches

Additional studies were conducted on two commercial ranches during August to September, 1966, using a 1 per cent concentration of Zytron. At the E. Hodel poultry ranch, Sacramento County, a biweekly to weekly Zytron application resulted in excellent control of house flies, garbage flies, and biting stable flies, *Stomoxys calcitrans*—but from excellent (99 to 96 per cent) to fair (68 per cent) control of *F. femoralis.* Less effective *Fannia* control occurred subsequent to the biweekly applications (September 2 and 16) although the general *Fannia* population started to decline at this time, and more "pocketing" of larvae was evident in the increased amount of poultry droppings.

Adult house fly emergence was satis-