USE OF TB TESTS WITHIN THE NZ DEER TB CONTROL PROGRAMME

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Abstract

Diverging objectives are not uncommon within disease control schemes and veterinarians are sought to provide technical advice on the selection and interpretation of diagnostic tests. Within the New Zealand deer TB (*Mycobacterium bovis*) control/eradication scheme, 5 diagnostic tests or techniques are available; the Mid Cervical Test (MCT), post mortem inspection, the Comparative Cervical Test (CCT), Lymphocyte Transformation Test (LTT) and an ELIZA. An epidemiological approach to the use of these tests within the scheme has been utilised and guidelines have been formulated for the use of each test. In addition the principle that a single test positive deer does not result in the herd being classified as infected must be modified by combining the test result with information on other risk factors. Protocols for the use of tests in combination (either in series or parallel) must also take account of epidemiological information. The MCT and post mortem inspection are central to the surveillance mechanisms of the Deer TB scheme, with nearly 900,000 deer subject to either one or both techniques during 1993. In 1992, 25 percent of the 17,064 CCT's applied were used as ancillary tests; its use is also examined against the risk factors of a herd's TB status and TB area class. The application of the LTT in retesting CCT positive deer is also outlined. During 1992 and 1993 the majority of deer with TB lesions were detected at slaughter premises. The apparent prevalence of TB in New Zealand deer is decreasing and any inferences on the way tests have been used and interpreted must be seen in that light.

Introduction

Veterinarians when applying and interpreting diagnostic tests within a national disease control scheme have a role analogous to that of the judiciary. Why? Because individuals and sector groups involved in the scheme, each approach it from their own point of view. In the case of the New Zealand deer TB scheme, the Industry's wish is to reduce the number of infected herds to a pre-determined level over a given time and prevent the transfer of disease to feral and wild animals. While the individual farmer, although almost certainly assenting to the Industry's view-point, wishes to ensure his/her personal losses for the higher cause, are minimal.

Instant conflict! And we as veterinarians get caught in this process and are looked to, to apply and interpret diagnostic tests in a way which does not significantly undermine the objectives of any of the stake-holders.

Available Tests

The number of TB tests now officially approved for use in New Zealand deer and at the disposal of farmers and veterinarians has never been as varied. This does allow choice but choice also means decisions.

By far the most commonly used test is the standard intra-dermal tuberculin test using 1 mg bovine purified protein derivative (PPD) applied in the skin of the deer's neck. The Mid Cervical Test (MCT) as it is now being called, uses Koch's technology of the 1800's with 1930's modifications. Despite this its usefulness and cost-effectiveness as a primary test for detecting infected herds and eradicating TB has yet to be surpassed.

The sensitivity of the MCT in New Zealand deer herds has been reported as being between 80 and 85 percent (Carter et al 1984, Griffin et al 1993) while the specificity based on national statistics, is in excess of 98 percent.

The next most commonly used test (although often not thought as such) is that of post mortem inspection, as deer pass through Deer Slaughtering Premises (DSP's). As growth in the national deer herd has stabilised, so the number of deer being slaughtered has increased.

The sensitivity and specificity of post mortem inspection can vary enormously, based on the detail of the technique used and whether gross signs are confirmed by histology and/or culture. Corner et al reported for cattle a range in the sensitivity of detecting visible lesions of between 53 and 84 percent depending on technique. A later paper will detail further information on the issue of specificity of the post mortem technique in New Zealand deer.

When discussing sensitivity and specificity of tests, average figures are always quoted and the performance of any TB test in an individual herd or animal may show variation around this figure. The persistent anergic animal causes the most concern to veterinarians but farmers more often than not concentrate on specificity. In the deer industry's case, as the positive predictive value of the MCT began to decrease, farmers sought tests which decreased wastage through the slaughter of false positives.

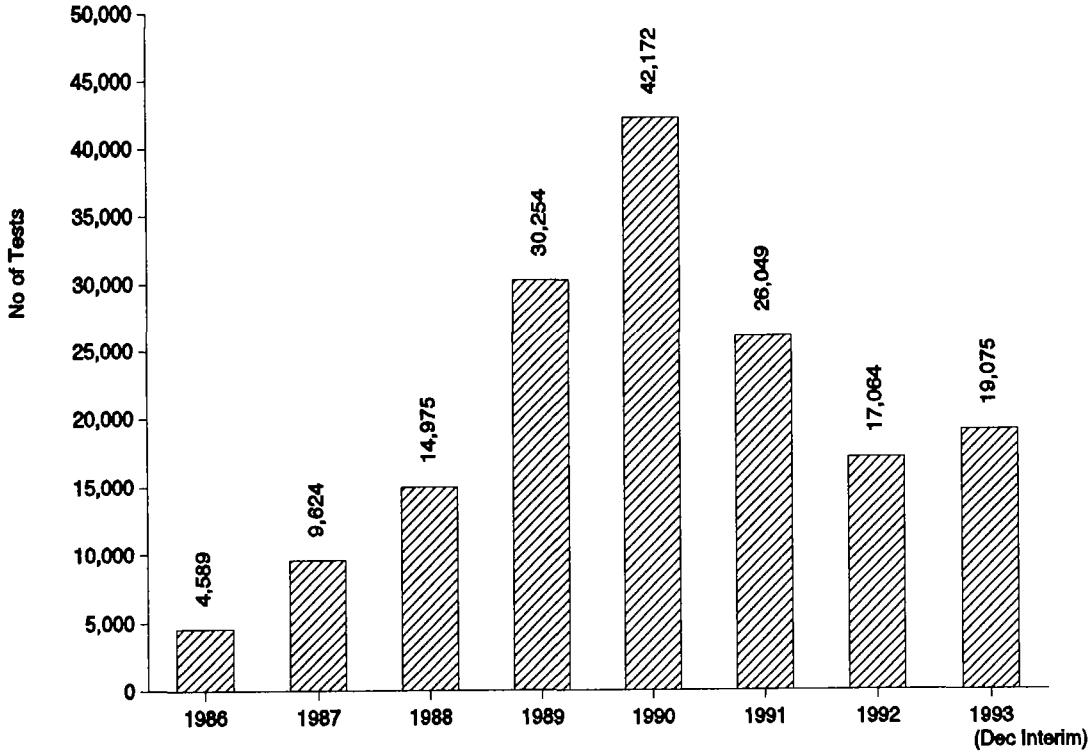
The first of these ancillary tests was the Comparative Cervical Test (CCT) introduced in 1986. This test involved comparing reactions to intra-dermal injections of 0.5 mg avian PPD tuberculin and 1 mg bovine PPD tuberculin. It was a test primarily aimed for use in herds where non-specific reactivity to the MCT had been proven. The CCT was designed to be used in series, for individual deer which had given a positive MCT.

Initial use of the test was cautious but by 1990 it had been fully embraced and its was clearly being used not just as an ancillary test but also as a primary test (Figure 1).

Under field conditions the sensitivity of the CCT is not expected to exceed 80 percent. Kollias et al (1982) reported a sensitivity of 84 percent in naturally infected deer where either the response to bovine PPD exceeded the response to avian PPD by 3 mm or more, or there was a positive response to bovine PPD and no response to avian PPD. A trial involving artificially infected deer, reported a sensitivity of 92 percent (Corrin et al, 1993) when the deer were considered infected when the response to bovine PPD was 2 mm and was either equal to or greater than the response to avian PPD.

Figure 1

DEER TB COMPARATIVE CERVICAL TESTS

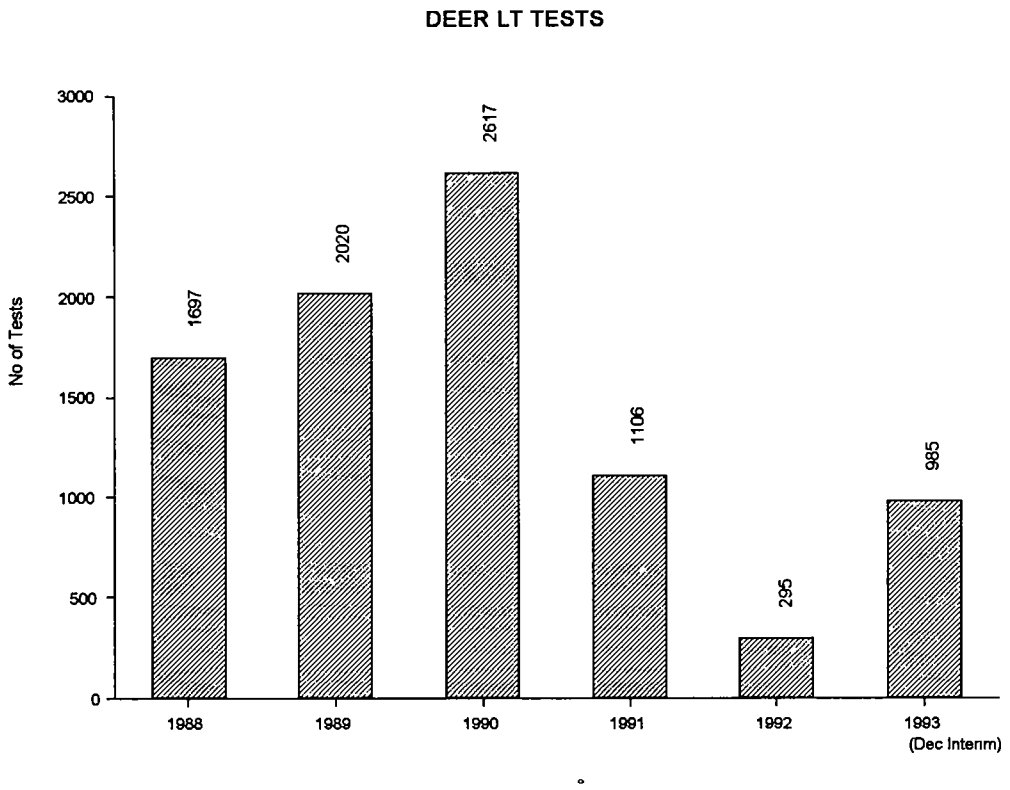


A trial involving animals which had previously reacted to a MCT and came from herds with no history of infection with *Mycobacterium bovis*, indicated the CCT had a specificity of greater than 98 percent (Corrin et al, 1993).

The CCT's introduction was followed (1988) by the commercial development of the lymphocyte transformation test (LTT) for TB and by 1993 an ELISA test had also been approved for use. The LTT offered higher sensitivity than the other approved tests (88.5 percent, Griffin et al, 1994), a specificity in excess of 98 percent and when used as a retest it gave a quicker result for the farmer than did the CCT. The LTT was used both as an ancillary and primary test (Figure 2).

The use of the ELISA test was directed at improving the diagnosis of infected deer which were negative to either a tuberculin skin test or LTT. It was also the first test designed to be applied in parallel. Griffin et al (1994) reported sensitivity figures for the MCT/ELISA and LTT/ELISA of 95 percent.

Figure 2



Guidelines for the Use of Tests

Since the beginning of the Deer TB Control/Eradication Scheme, an epidemiological approach to the use of the diagnostic tests has been adopted. This was a pivotal decision if the scheme was to succeed and anticipated:

- A decreasing TB prevalence for both animals and herds;
- That the risk of a herd being infected with TB would increasingly relate to the presence or absence of endemic infection in feral/wild animals;
- That an analysis of a herd's TB history and the history for any test positive animal would be applied prior to the use of any test.

In this way guidelines were established for the use of individual tests.

For example, the MCT and inspection at slaughter, were the central surveillance tools, supplemented by the CCT, LTT and ELISA tests. The use of the CCT either as an ancillary or as a primary test, was only encouraged when the herd had a substantiated history of non-specific reactivity to bovine tuberculin and was actively discouraged in the face of disease.

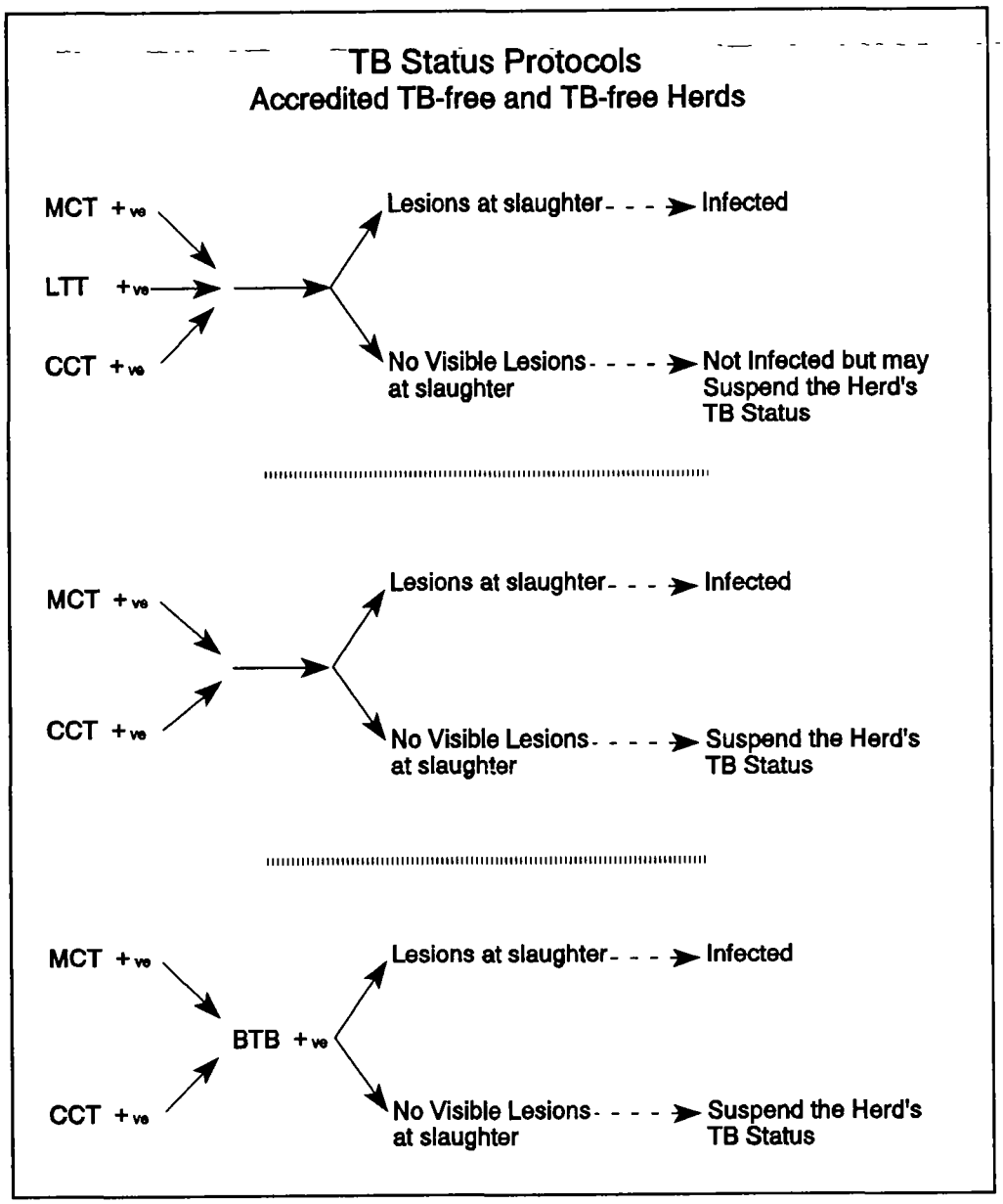
Definition of a Tuberculous Case

The definition of an infected case is central to any disease control programme. For the Deer TB scheme the culturing of *Mycobacterium bovis* has been the gold standard for the definition of each of the approved tests.

Any non-tested deer with lesions typical of TB at slaughter is considered infected when *Mycobacterium bovis* is cultured.

But definition of infection obviously becomes more complicated with the use of diagnostic tests in the live animal. Is a MCT positive animal with no visible lesions at slaughter infected? And what combination of positive tests applied in series would lead an animal to be classified as tuberculous?

Figure 3



The guiding principle has been that a single deer positive to one test but not having any visible lesions at a critical post mortem, does not result in the herd being classified as infected. But this principle is modified by combining other information with the test result. For example, a single deer is traced forward from a breakdown herd, in which the TB prevalence in the cohort group was 50 percent; although positive to the MCT, no lesions were detected at slaughter. Such an animal obviously has a high risk of being infected.

Careful epidemiological evaluation is required where deer are subject to a series of tests each of which are positive but there are no lesions at slaughter. Protocols such as that laid out in Figure 3 for Accredited TB-free and TB-free herds, assist but cannot do away with careful technical judgement. The protocols recognise the limitations of testing animals to obtain a negative result at the expense of ignoring the sensitivity of each test in the chain.

In setting out such protocols one is always mindful that the overall sensitivity of some of these combinations is approaching 45 percent. Correct selection of test(s) and their interpretation takes precedent over testing recipes.

Application of Tests

During 1993 over 490,000 MCT's were applied and 395,000 deer were subject to inspection at slaughter (Figures 4 and 5).

In the previous year (1992), on-farm testing resulted in 1798 deer being slaughtered as reactors; 5575 deer were positive to the MCT and there were 157 and 39 positive CCT's and LTT's respectively.

In the same year (1992), of the 17,064 CCT's applied, 25 percent ($^{4231}/_{17,064}$) were as an ancillary test. More than 2000 CCT's were in herds where TB had been diagnosed and were under movement restrictions. Of these, nearly 600 were ancillary tests and 470 of the 600 were in herds which had yet to have a clear herd test following a confirmed case of tuberculosis.

Analyzing the same data but from the view-point of the TB Status of an area, nearly a third of all CCT's ($^{5422}/_{17064}$) were performed in herds located in endemic areas.

For herds which used the CCT (either as an ancillary or primary test) during 1991, at least 20 of these herds were found to be infected in the 12 months following the use of the test.

During 1991, 73 deer positive to either an ancillary or primary CCT, were retested using the LTT; 10 of these animals were positive. Twenty eight (28) of the 73 deer were being farmed in infected herds.

Discussion

The apparent prevalence of TB in New Zealand's deer herd (based on lesion reactors and tuberculous deer found at slaughter) has been decreasing since the introduction of the voluntary herd accreditation scheme in 1985 and the compulsory programme in 1991 (Table 1). Any interpretation on the way in which diagnostic tests are being used must be seen in light of this significant progress.

Figure 4

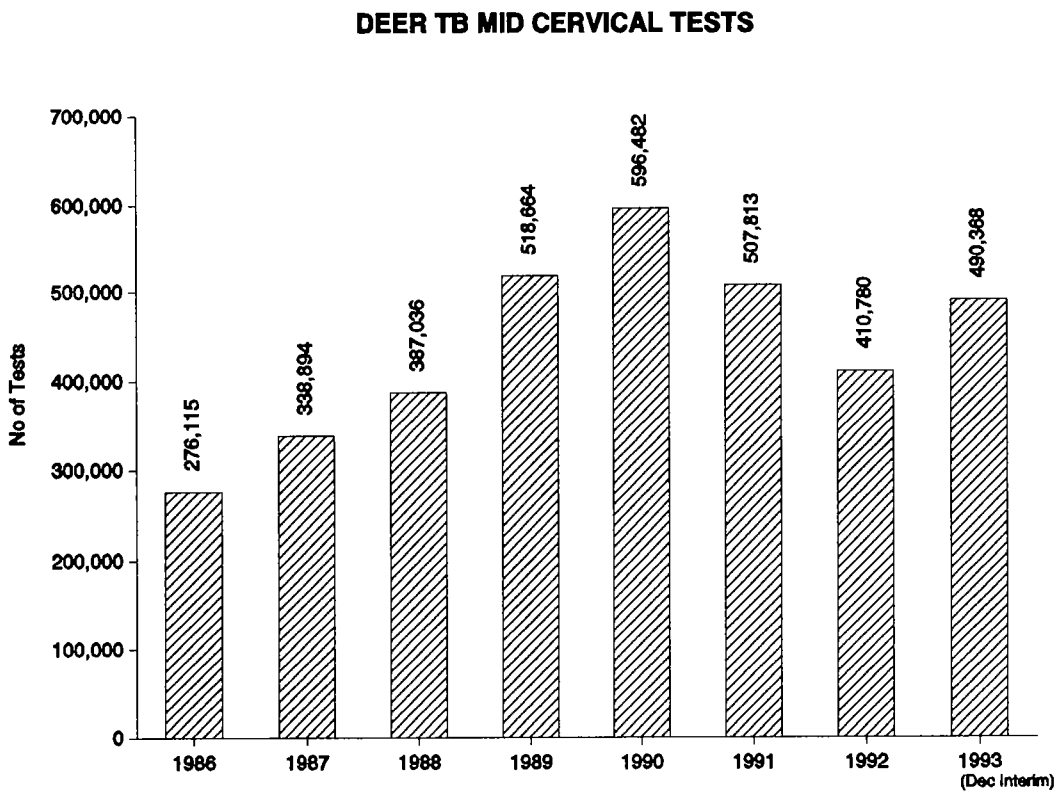
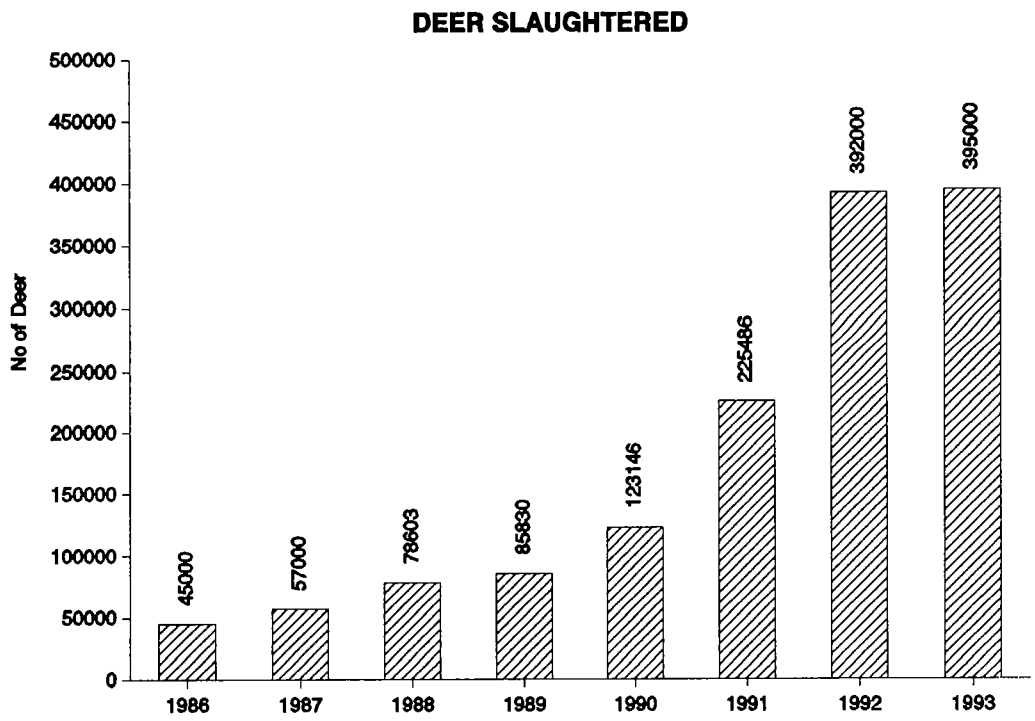


Figure 5



However as the prevalence of the disease decreases its eradication will become increasingly more difficult.

Table 1

INCIDENCE OF TUBERCULOSIS

	NZ Deer Population	No Reactors	Lesion Reactors	Lesion Non-Tested Deer & Clinicals	TB Prevalence
1986	392,154	2390	Not Available	234	-
1987	500,397	1870	Not Available	Not Available	-
1988	606,042	2132	Not Available	Not Available	-
1989	780,066	2144	640	254	0.11
1990	976,290	2941	404	165	0.06
1991	1,130,000	1790	240	308	0.05
1992	1,200,000	1798	327	379	0.06
1993 Dec Interim	1,330,000	1679	213	305	0.04

For the last 2 years the majority of deer with TB lesions have been detected through slaughter house inspection. Although there is substantial evidence that owners of infected herds are currently either partially or totally depopulating to slaughter, the ability of the on-farm surveillance programme to detect infection will need to be closely monitored

Early detection of TB is a key strategy for the control/eradication scheme; early diagnosis will assist in minimising the movement of TB from herd to herd by the uncontrolled movement of deer as well as minimising the length of time infected herds stay under movement restrictions.

For these reasons the integrity of the Deer TB scheme relies on a clear understanding by veterinarians of the epidemiological principles for the use and interpretation of diagnostic tests when used singly or in combination.

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