

# Feeding Ecology of Feral Horses in Western Alberta

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## Abstract

Foraging behaviour and diets of feral horses were studied throughout one annual cycle in western Alberta. The availability of preferred forage plants appeared to be a primary determinant of habitat utilization during all seasons. Horses spent about 75% of daylight hours foraging during winter and spring with an apparent decrease in feeding time in summer. They were adept at obtaining forage from beneath snow. Fecal fragments analysis showed that gramineous plants were the major dietary constituents, never falling below a level of 83% in monthly diets. Sedges (*Carex spp.*), hairy wild rye (*Elymus innovatus*) and fescues (*Festuca spp.*) were the most important food plants. A fecal index technique suggested strong seasonal variation in diet quality.

Horses are primarily grazers (Hafez et al. 1969), but until the recent interest in feral horses little else was known of their foraging behaviour or food preferences on natural range. Several studies have shown that horses spend the majority of their time foraging (Tyler 1972; Feist and McCullough 1976; Berger 1977) and may graze some areas repeatedly while others remain untouched (Odberg and Francis-Smith 1976, 1977). Grasses and sedges are the primary forages chosen (Hansen 1976; Hubbard and Hansen 1976; Hansen and Clark 1977; Hansen et al. 1977; Olsen and Hansen 1977). Although horses are able to utilize low quality forages (Slade et al. 1970) and are exceptionally hardy in cold climates (Andreyev 1971; Dieterich and Holleman 1973), environmental and nutritional stresses may sometimes result in widespread starvation (Dieterich and Holleman 1973; Welsh 1975). Objectives of the present study were to determine the annual diet composition of a population of feral horses in the foothills of western Alberta, and to examine behavioural adaptations of horses for foraging in this seasonally severe environment.

## Study Area

The study areas encompassed approximately 200 km<sup>2</sup> of the outer foothills of the Rocky Mountains, west-southwest of Sundre, Alta. The area was within the Upper Foothills section of the Boreal Forest as defined by Rowe (1972). Elevation varied from 1,300 to 1,900 m. A series of roughly parallel, forested ridges oriented along a NW-SE axis were the predominant topographical feature. Drainage was through numerous permanent streams.

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Forest cover consisted largely of lodgepole pine (*Pinus contorta*) with smaller stands of white spruce (*Picea glauca*), black spruce (*P. mariana*), alpine fir (*Abies lasiocarpa*), aspen (*Populus tremuloides*), and balsam poplar (*P. balsamifera*). Mixed woods formed a major forest component. Meadow vegetation types on a moisture gradient from flooded to dry comprised the nonforested cover. Sedge and low shrub fens with smooth to hummocky microtopography were characteristic of mesic conditions, such as occurred in flat or gently sloping valley bottoms. Associations dominated by bearded wheatgrass (*Agropyron subsecundum*), Junegrass (*Koeleria cristata*), and intermediate oatgrass (*Danthonia intermedia*) were developed on south-facing slopes and in gently rolling meadows. Meadow and scrub vegetation covered approximately 20% of the study area.

Daily minimum temperatures average above 0°C only during June–August in this region. Extreme maximum temperatures of 32°C have been recorded during August and September, while extreme minimum temperatures of –4°C have occurred during December (Environment Canada 1973a). Mild spells accompanied by warm west winds (Chinooks) are a prominent feature of the winter climate. March and April are the months of peak snowfall, averaging 49 and 48 cm respectively, although the monthly mean is between 12 and 21 cm throughout the period September–May (Environment Canada 1973b).

Over 200 feral horses were present on the area during the study.

## Methods

All or part of 205 days were spent on the study area in 1976 (11 to 24 days each month); information on feeding behaviour was obtained primarily during 298 hours of observation of horse herds within this period. Examination of feeding areas and salt licks throughout the year provided supplementary data.

Records of the number of animals engaged in specific, undisturbed activities were obtained by scan sampling (Altmann 1974) at regular intervals during 99 of the 298 hours of observation to obtain quantitative information on activity cycles in relation to time of day and season of year. Records were maintained at 15-min intervals during 25 hours and at 5-min intervals during 74 hours. These were summed on an hourly basis for the periods January–March and April–June, inclusive. Time spent feeding and resting was calculated as the percent of animals recorded in each activity. Activities such as walking, agonistic interactions, play, and grooming were noted in the field but were tabulated in the category *Other* for purpose of this analysis. In addition, individual horses foraging in various snow depths were watched for thirty-six 5-min periods to determine the frequency of pawing bouts and the number of strokes per bout.

Diet composition was determined by identification of plant fragments in the feces. Fifty samples of fresh horse feces were collected during the last 3 weeks of each month in 1976, each sample consisting of one or two pellets. All samples were obtained within two areas (total

30 ha) utilized for quantitative assessment of habitat utilization. An attempt was made to collect horse feces from several sites during each month, and not more than 15 samples were obtained from any one site. Individual fecal samples were combined on an approximately equal dry weight basis into 12 composite samples representing monthly diets. Approximately 10 g of each thoroughly mixed composite sample were sent to the Composition Analysis Laboratory, Colorado State University, for analysis (Hansen et al. n.d.; Sparks and Malechek 1968). This technique provides results which approximate the relative dry weights of food categories in the diet (Hansen et al. 1973; Todd and Hansen 1973; Dearden et al. 1975).

Seasonal changes in diet quality were estimated indirectly through fecal analysis. Crude protein and acid detergent fibre levels in each of the 12 monthly fecal samples were determined by the Agricultural Soil and Feed Testing Laboratory, Alberta Department of Agriculture.

## Results

### Feeding Behaviour

Horses utilized virtually all habitat types for foraging, although seasonal use varied. Forage availability appeared to be a primary determinant of habitat selection during winter, and only habitats limited in aeral extent or with sparse forage growth were clearly underutilized. Habitat occupancy during spring was related to stage of forage growth; previously grazed meadows and disturbed areas were the first to green-up and were heavily used for feeding. This resulted in localized damage to vegetation from close cropping and trampling. Horses also fed under forest cover during spring; the pattern of use of both forested and meadow habitats for feeding continued through summer, fall, and early winter.

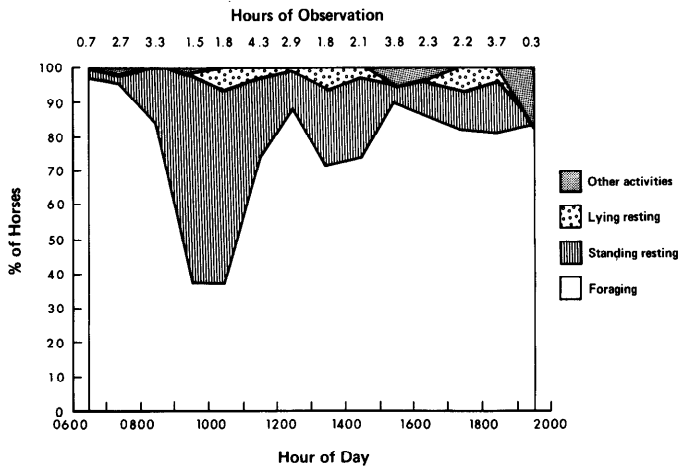


Fig. 1. Activity patterns of horses during daylight hours, January–March, 1976.

About three-quarters of daylight hours were spent foraging during winter (Fig. 1). Yearling and older horses continued to spend nearly 75% of daylight hours feeding in spring (Fig. 2), and except for a 2-hour lull in mid-morning, feeding activities predominated from dawn to dusk during both seasons. Foals spent an average 41% of their time foraging, 13% standing resting, 26% lying resting, 4% suckling, and 15% in other activities. Limited observations suggested that foraging by yearling and older horses continued throughout the night during all seasons, but with a decrease in diurnal feeding time (at least in open areas) during summer and fall.

### Foraging in Snow

During winter, horses pawed away the overlying snow to expose food plants. Although observed at all snow depths,

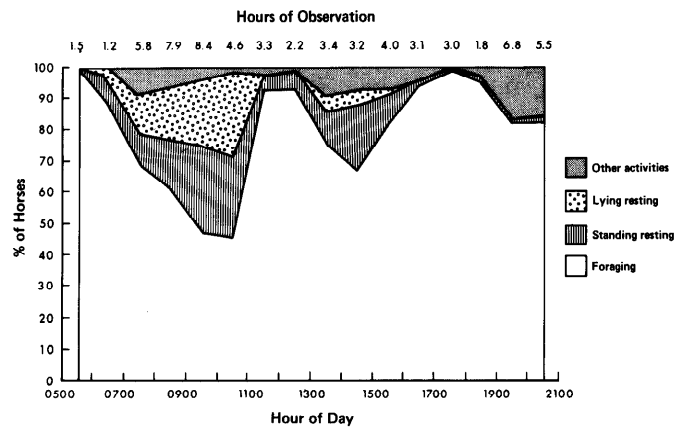


Fig. 2. Activity patterns of horses (exclusive of foals) during daylight hours, April–June, 1976.

pawing was resorted to more frequently in deep as compared to shallow snow cover, and each pawing bout tended to involve more strokes (Table 1). Up to 19 strokes per bout were used in deep snow cover. The animals appeared well able to cope with the snow depths encountered on the study area during January–March, and craters were found in snow as deep as 60 cm.

Table 1. Frequency of pawing by foraging horses in relation to snow depth.

| Snow depth (cm) | Number of 5-min observations | Mean number of pawing bouts/5 min $\pm$ 1 s.d. | Mean number of strokes/pawing bout $\pm$ 1 s.d. |
|-----------------|------------------------------|--|---|
| 10              | 16                           | 1.4 $\pm$ 2.0                                  | 5.4 $\pm$ 1.8                                   |
| 40–50           | 9                            | 9.1 $\pm$ 3.8                                  | 9.7 $\pm$ 3.6                                   |

Horses also were able to feed in shallow snow without pawing. In these situations snow was 'plowed' away by pushing the muzzle through the snow at a selected spot, and subsequent snow clearing was accomplished by thrusting the muzzle forward while feeding. It appeared that this technique also was used to enlarge or clear snow from craters already created by pawing; it was used without pawing only at the shallowest snow depths (Table 2).

Table 2. Number of herd sightings during which pawing was used by foraging horses in relation to snow depth.

| Number of observations involving: | Snow depth (cm) |       |       |       |     | Total |
|-----------------------------------|-----------------|-------|-------|-------|-----|-------|
|                                   | 1–10            | 11–20 | 21–30 | 31–40 | 40+ |       |
| Pawing                            | 10              | 7     | 4     | 5     | 2   | 28    |
| No pawing                         | 6               | 2     | 0     | 0     | 0   | 8     |

In addition to these behavioural adaptations for feeding in snow, horses took advantage of reduced snow depths at tree bases in woods, and on hummocks and around shrub bases in open areas. Steep south-facing slopes remained snow-free or had reduced snow depth throughout the winter and also were exploited as feeding habitat. However, bare areas were not always favoured as evidenced by observations of horses feeding in isolated snow patches.

### Drinking

Horses were seen drinking on only seven occasions. Water was readily available from the numerous streams in the study

area, and consequently horses did not gather at specific sites to drink as reported for more arid areas (Feist and McCullough 1976; Berger 1977). Water requirements in winter were probably met largely by ingestion of snow.

### Use of Salt Licks

Horses ingested quantities of soil at both natural mineral licks and cattle salt licks throughout much of the year. Chemical analyses of soil, feces, and vegetation indicated that soil-eating likely was related to Na deficiency (Salter and Pluth in prep.).

### Diet Composition

The annual diet was comprised of up to 43 plant categories (species and species groups). From 17 to 21 of these were found in each monthly diet (Table 3). Grasses, sedges, and rushes constituted the bulk of the diet throughout the year. Within this group grasses were most important. Hairy wildrye was utilized throughout the year, constituting on average over 25% of the monthly diet with a decrease in utilization, probably related to increased availability of more palatable forage, during May–July. Fescues (likely most *F. scabrella*) averaged 20% of the

Table 3. Percentages of plant fragments in feces of feral horses, 1976.

| Species   | Jan.-Mar. | Apr.-May | June—Aug. | Sept.—Oct. | Nov.-Dec. | Annual |
|---|-----------|----------|-----------|------------|-----------|--------|
| <b>Grasses</b>  |           |          |           |            |           |        |
| <i>Agrostis scabra</i> (hairgrass)  | 0.1       | 0.7      | 0.5       | 1.3        | 0.4       | 0.5    |
| <i>Agropyron</i> spp. (wheatgrass)  | 0.2       | 0.1      | 0.2       | 0.0        | 0.1       | 0.1    |
| <i>Bromus</i> spp. (bromegrass)   | 0.1       | 0.0      | 0.3       | 0.5        | 0.1       | 0.2    |
| <i>Calamagrostis</i> spp. (reedgrass)   | 0.2       | 0.1      | 0.1       | 0.3        | 0.0       | 0.1    |
| <i>Danthonia intermedia</i> (timber oatgrass)   | 0.6       | 2.4      | 2.3       | 3.0        | 1.6       | 1.9    |
| <i>Deschampsia caespitosa</i> (tufted hairgrass)                                      | 0.8       | 1.1      | 1.4       | 1.6        | 1.7       | 1.3    |
| <i>Elymus innovatus</i> (hairy wildrye)   | 27.5      | 18.3     | 21.1      | 32.0       | 37.7      | 26.8   |
| <i>Festuca</i> spp. (fescue)  | 15.2      | 22.1     | 24.1      | 22.5       | 19.0      | 20.4   |
| <i>Glyceria</i> spp. (mannagrass)   | 0.0       | 0.0      | 0.0       | 0.0        | 0.0       | T      |
| <i>Helictotrichon hookeri</i> (hooker's oatgrass)                                     | 0.0       | 0.1      | 0.0       | 0.0        | 0.0       | T      |
| <i>Koeleria cristata</i> (Junegrass)  | 1.0       | 1.0      | 0.0       | 1.5        | 2.5       | 1.1    |
| <i>Muhlenbergia</i> spp. (muhly grass)  | 0.0       | 0.0      | 0.1       | 0.0        | 0.0       | T      |
| <i>Phleum</i> spp. (bluegrass)  | 0.0       | 0.0      | 0.0       | 0.0        | 0.0       | T      |
| <i>Poa</i> spp. (bluegrass)   | 0.6       | 2.3      | 2.6       | 5.2        | 0.8       | 2.2    |
| <i>Schizachne purpurascens</i> (false melic)  | 1.7       | 1.2      | 0.3       | 0.9        | 0.1       | 1.0    |
| <i>Stipa</i> spp. (needlegrass)   | 0.0       | 0.7      | 0.1       | 1.6        | 0.3       | 0.4    |
| <i>Tristeum spicatum</i> (spike trisetum)   | 0.1       | 0.0      | 0.0       | 0.0        | 0.0       | T      |
| Total grasses   | 48.2      | 49.9     | 53.1      | 70.0       | 64.9      | 56.1   |
| <b>Sedges and Rushes</b>  |           |          |           |            |           |        |
| <i>Carex</i> spp. (sedge)   | 35.2      | 42.4     | 41.1      | 24.0       | 22.6      | 33.9   |
| <i>Eriophorum viridi-carinatum</i> (cotton grass)                                     | 0.4       | 0.1      | 2.0       | 0.4        | 0.0       | 0.7    |
| <i>Juncus balticus</i> (wire rush)  | 3.7       | 0.0      | 2.3       | 0.9        | 2.0       | 1.9    |
| <i>Scirpus caespitosus</i>  | 0.0       | 0.0      | 0.0       | 0.0        | 0.0       | T      |
| Total sedges and rushes   | 39.3      | 42.6     | 45.3      | 25.2       | 24.5      | 36.5   |
| Total grasses, sedges and rushes  | 87.5      | 92.5     | 98.5      | 95.2       | 89.3      | 92.6   |
| <b>Forbs</b>  |           |          |           |            |           |        |
| <i>Artemisia</i> spp. (sagewort)  | 0.0       | 0.0      | 0.0       | 0.0        | 0.1       | T      |
| <i>Astragalus frigidus</i> (milk vetch)   | 0.0       | 0.0      | 0.0       | 0.7        | 0.1       | 0.1    |
| <i>Mertensia paniculata</i> (tall mertensia)  | 0.0       | 0.0      | 0.0       | 0.0        | 0.0       | T      |
| <i>Petasites</i> spp. (sweet coltsfoot)   | 0.0       | 0.0      | 0.0       | 0.0        | 0.1       | T      |
| <i>Potentilla-Geum</i> spp. (cinquefoil-avens)  | 0.3       | 0.6      | 0.3       | 0.3        | 0.2       | 0.3    |
| <i>Solidago</i> spp. (goldenrod)  | 0.0       | 0.0      | 0.0       | 0.0        | 0.1       | T      |
| <i>Stellaria</i> spp. (chickweed)   | 0.0       | 0.0      | 0.1       | 0.0        | 0.0       | T      |
| <i>Vicia americana</i> (wild vetch)   | 0.1       | 0.0      | 0.0       | 0.4        | 0.0       | 0.1    |
| Unidentified forbs  | 0.2       | 0.3      | 0.2       | 0.5        | 0.0       | 0.2    |
| Total forbs   | 0.6       | 0.8      | 0.8       | 1.9        | 0.4       | 0.8    |
| <b>Browse</b>   |           |          |           |            |           |        |
| <i>Picea</i> spp. (spruce)  | 0.9       | 0.2      | 0.0       | 0.0        | 0.3       | 0.3    |
| <i>Pinus contorta</i> (lodgepole pine)  | 4.7       | 2.0      | 0.1       | 1.4        | 4.9       | 2.6    |
| <i>Populus</i> spp. (poplar)  | 0.2       | 0.0      | 0.0       | 0.0        | 0.0       | T      |
| <i>Salix</i> spp. (willow)  | 0.1       | 0.4      | 0.0       | 0.0        | 0.0       | 0.1    |
| <i>Shepherdia canadensis-Elaeagnus commutata</i> (Canadian buffaloberry-silveryberry) | 0.0       | 0.5      | 0.2       | 0.1        | 0.0       | 0.2    |
| Total browse  | 5.9       | 3.0      | 2.3       | 1.5        | 5.1       | 3.6    |
| <b>Miscellaneous</b>  |           |          |           |            |           |        |
| <i>Equisetum</i> spp. (horsetail)   | 2.6       | 1.4      | 0.3       | 0.5        | 3.5       | 1.6    |
| Lichen  | 0.0       | 0.0      | 0.0       | 0.2        | 0.1       | T      |
| Moss  | 3.3       | 2.5      | 0.1       | 0.8        | 1.4       | 1.6    |
| Total miscellaneous   | 5.9       | 3.8      | 0.4       | 1.5        | 4.9       | 3.3    |

diet. No other grass constituted more than a mean of 2.2% of the monthly diet although several approximated or surpassed this figure during one or more months. Sedges were important throughout the year, ranging between 18% (September) and 56% (May) of diet composition. Wire rush (*Juncus balticus*) was consistently present but averaged less than 2% of the monthly diet, as did horsetails (*Equisetum spp.*).

Forbs were utilized very little by horses and were found at a total level of less than 3% during each month. Species in the *Potentilla-Geum* group were the only ones that appeared consistently.

Browse was a highly variable dietary constituent, ranging from 0% in June to 9% in March. Although willows (*Salix spp.*), poplar, and buffaloberry (*Shepherdia canadensis*) (or possibly silverberry (*Elaeagnus commutata*), were all identified, none reach a level of 1% during any one month and all were inconsistent in occurrence. In contrast, lodgepole pine needles and to a lesser extent spruce needles were consistently found in the feces; both were absent only during May and June.

### Diet Quality

Fecal crude protein and acid detergent fibre levels showed strong seasonal variation (Fig. 3). Assuming that low values of fecal crude protein and high fibre levels indicate a poor quality diet, and that the opposite situation indicates a relatively higher quality diet, the curves in Figure 3 reflect the growth stage of forages selected. During winter only weathered forages were available. Greenup began in March (first noted March 13) and the increasing availability of new growth was reflected in a rapid rise in diet quality between April and May, with a peak in June. Diet quality declined steadily thereafter as forages matured, cured, and began to weather.

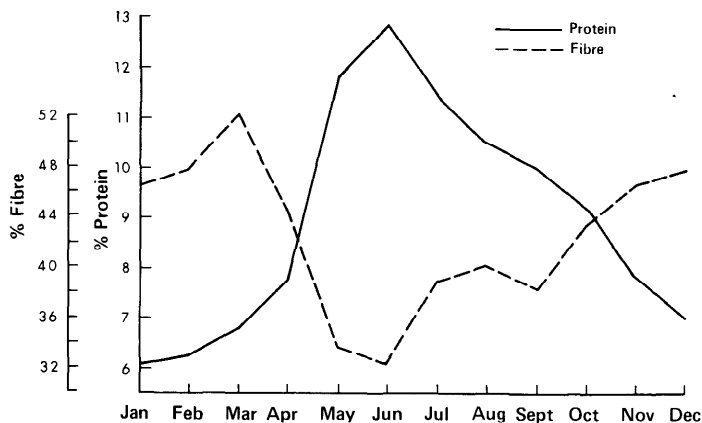


Fig. 3. Monthly variation in levels of crude protein and acid detergent fibre (%DM) in composite samples of horse feces, 1976.

### Discussion

The predominance of grasses and sedges in the diet of feral horses in the Alberta foothills is consistent with reports from other areas. Grasses and sedges together constituted from 50% to over 90% of annual diets of feral horses in the western United States (Hansen 1976; Olsen and Hansen 1977), although the relative importance of each group varied with local availability. In the U.S.S.R., under conditions more comparable to the Alberta foothills, grasses and sedges were considered to be among the best plants for winter feeding (Andreyev 1971).

In the present study, the importance of individual species in the annual diet and seasonal shifts in diet composition likely were related to both palatability and availability factors. Thus, although hairy wildrye is considered to be unpalatable at all

seasons (Campbell et al. 1966), it was widely available and formed an important constituent of the annual diet. Fescues and sedges, the other major dietary constituents, are both considered valuable forages (Campbell et al. 1966; Hermann 1970) and were widespread within the study area. Browse plants and forbs also were widely distributed but were little used by horses. Because no evidence of browsing on living conifers was found at any time during the study, it seems most likely that material in the feces represented fallen needles ingested accidentally while grazing other forage. This hypothesis is strengthened by the fact that levels were highest during the winter months when snow cover presumably decreased the ability of the horses to graze selectively. Mosses and lichens present in the feces may have been ingested under similar circumstances.

Fecal protein and fibre levels were used in this study to infer seasonal trends in diet quality, following Hebert (1973), who showed a positive correlation between fecal protein and quality of forages ingested by bighorn sheep (*Ovis canadensis*), and Gates (1975) and McFetridge (1977), who interpreted variation in fecal crude protein as indicating seasonal shifts in vegetation quality on bighorn sheep and mountain goat (*Oreamnos americanus*) ranges, respectively. Klein (1962) suggested a negative correlation between fibre content in the feces and the quality of range used by blacktailed deer (*Odocoileus hemionus columbianus*). Major forages in the Alberta foothills are highest in crude protein and lowest in fibre during spring, but reach a low quality during winter (Johnston and Bezeau 1962). As expected, quality of diet ingested by horses followed this trend. Horses selected new growth on previously grazed areas in spring—and to some extent throughout the growing season—and may thus have effectively prolonged the period of availability of high quality forage. Ungrazed areas were utilized primarily during the period of snow cover.

Horses can survive even subarctic conditions if forage of sufficient quality is available (Andreyev 1971; Dieterich and Holleman 1973). They are adept at obtaining forage from beneath snow and can successfully utilize low quality feeds (Slade et al. 1970), but nevertheless experience weight loss when maintained on native range over winter (Dawson et al. 1945; Andreyev 1971). Nutritionally stressed animals are predisposed to starvation under deep snow and severe weather conditions (Dieterich and Holleman 1973; Welsh 1975), and large die-offs have been documented along the Alberta foothills and in interior British Columbia by Forest Service personnel. However, in the absence of long-term data the importance of nutritional stress in regulating population levels cannot be determined.

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# THINK BAUSCH & LOMB...FOR GRAPHICAL DATA TRANSFER WORK

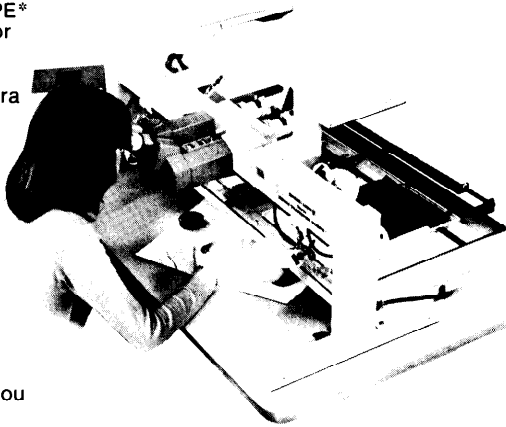
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