





United States Department of Agriculture,

BUREAU OF ENTOMOLOGY,

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THE PEA APHIS.<sup>2</sup>

(*Macrosiphum pisi* Kalt.)

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One of the most destructive and troublesome insects of recent years is a green plant-louse which, from its injury to peas, is known as the

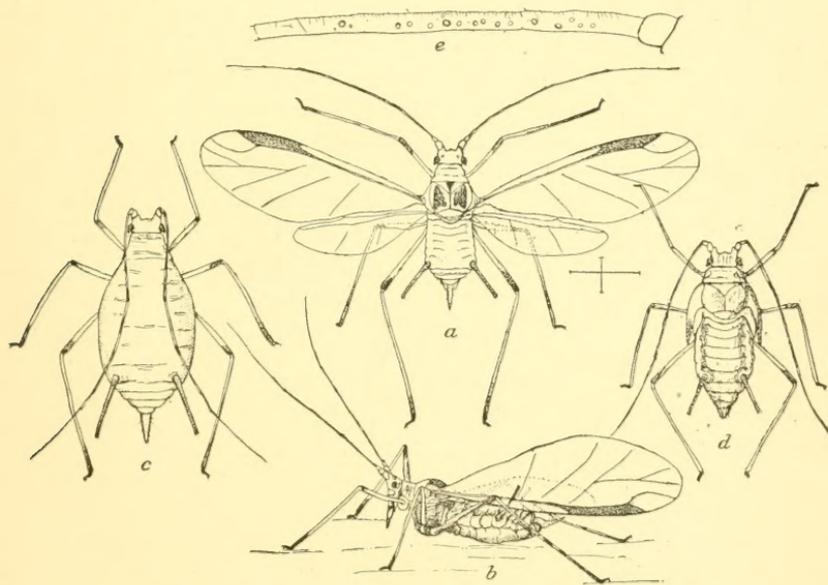


FIG. 1.—Pea aphid (*Macrosiphum pisi*): a, Winged female; b, same from side, with wings folded in natural position, as when feeding; c, apterous female; d, nymph in last stage; e, third joint of antenna of winged form. a-d, Much enlarged; e, more highly magnified. (Author's illustration.)

pea aphid. Since it first attracted attention by its ravages in May of 1899 it has steadily increased in injuriousness, and has been the cause

<sup>1</sup> Reprint, with slight revision, of Circular No. 43, Second Series, entitled "The Destructive Green Pea Louse (*Nectarophora destructor* Johns)."

<sup>2</sup> Several articles have been published on this insect, notably by Messrs. Johnson and Sanderson, as well as by the writer. The former gave it the scientific name *Nectarophora destructor*, but the latter gives reasons to show that this insect is in reality the European *pisi* Kalt.; hence the present change of title.

of great loss in the principal pea-growing regions of this country, especially where peas are grown for canning. It was, in fact, one of the most important of all insects that ravaged crops in the United States during the seasons of 1899 and 1900, and there appears to be little prospect, unless the unforeseen happens, of any decrease in its devastations. On the contrary, it is to be expected that it will widen its range, as it has apparently already done to some extent.

#### DESCRIPTIVE.

The pea aphid is one of unusual size among those found infesting gardens, and the largest of the green species which attack the pea and related plants. The length of the body of winged, viviparous females is about  $\frac{3}{16}$  inch (4.5 mm.), and the total wing expanse about  $\frac{4}{10}$  inch (9 to 11 mm.). The general color of both the winged and apterous or wingless forms is uniform pea-green, the same color as the insect's favorite food plant. The eyes are prominent and reddish brown in color. The antennæ are lighter than the body and the tubercles prominent; the joints are darker than the rest of the segments, the seventh joint filiform and fuscous. The legs are long and conspicuous; tarsi, distal ends of tibiæ, and femora fuscous. The nectaries are fuscous at the tips, otherwise of the same color as the body.

A typical female of this insect is shown in figure 1 with wings expanded, showing venation at *a*, and a lateral view of the same with wings folded in their natural position when the insect is at rest or feeding is presented at *b*. At *c* an apterous or wingless form of the insect is shown, and *d* illustrates the nymph in its last stage. The structure of the third antennal joint of the winged form may be seen at *e*, highly magnified.

#### DISTRIBUTION.

There are good reasons for believing that this aphid was introduced from abroad, probably from Europe, one being that injury of the severity noted by a species of insect hitherto unrecognized as distinct from others of its kind is almost without a parallel in the history of economic entomology. It seems probable, therefore, that we have in the pea aphid a case analogous to that of the European gipsy moth, which was present in this country for about twenty-five years before it became a pest.

The first notice of severe attack to pea that can with positiveness be attributed to the pea aphid was reported to this office, in a letter dated May 16, 1899, by Mr. Thomas Bridges, Bridges, Va. This was followed within the next few days by reports from Virginia and Maryland, and soon afterward injury was recognized in other States and in Canada. During the previous season (1898), however, this pest was present in

some numbers in certain fields in Maryland and was noticed on late peas in New Jersey.

This insect, as has been stated, was generally injurious during the years 1899 and 1900, although somewhat locally in some States, from Nova Scotia south to North Carolina and westward to Wisconsin. The insect's occurrence in destructive abundance was noted by 1900 in Nova Scotia, New Brunswick, and Ontario, Canada; Maine, Vermont, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, District of Columbia, Virginia, North Carolina, Michigan, Ohio, Illinois, and Wisconsin.<sup>1</sup> Sanderson has recorded the species as occurring also in Minnesota and Nebraska. Injury in Wisconsin was not noticed prior to 1900.

At intervals since 1901 this species has been injurious locally but there have been no widespread outbreaks. During the past three years the species has been rather unusually troublesome, judging by complaints. In 1906 injuries were reported in localities in New York, Virginia, Illinois, and Texas. In 1907 the range of destructiveness embraced portions of eastern, central, and western New York and parts of Maryland, Virginia, and the District of Columbia. The insect also made its initial appearance as a pest in Louisiana. In 1908 complaints were made of ravages on Long Island and in Maryland, Virginia, Pennsylvania, New Jersey, and California. In New Hampshire early peas were destroyed and in tidewater Virginia late peas were injured. It is evident from recent reports, e. g., those of injuries in Texas, Louisiana, and California, that the species is likely to be a pest any year practically throughout the United States and Canada where peas are grown.

#### EXTENT OF INJURY AND METHOD OF WORK.

This pea aphid during the first season of its abundance overran and laid waste fields of peas from Nova Scotia and Maine to Virginia and Maryland, in the last and in some neighboring States destroying about 50 per cent of the annual output and doing similar injury the following year, in spite of vigorous efforts that were made to control it.

An estimate of the total loss for the year 1899 in the Atlantic Coast States reached the sum of \$3,000,000. During 1900 the loss over the same area was placed, as early as June 15, at \$4,000,000. Several cases of severe damage were reported in Maryland, in which 80 per cent or more of the peas on farms of 500 or 600 acres were completely destroyed. In short, the pea growers of the Atlantic region and westward as far as Wisconsin suffered very severe losses, which gave rise to the expression that this country had been visited by a veritable scourge.

<sup>1</sup>There is evidence that this species was observed on crimson clover in Delaware as early as 1890, and has perhaps been present along the Potomac River since, or prior to, 1886 (Bul. No. 26, n. s., Div. Ent., U. S. Dept. Agric., pp. 58, 72).

The reasons why the species has become so conspicuous a pest are threefold: *First*, because of its ravages to a crop hitherto little troubled by insect attack, if we except the pea weevil, which has always been present in gardens and fields for upwards of a century and has come to be looked upon as a necessary evil; *second*, because it is a species never before noticed, so far as records go, as having been destructive to peas in this country; *third*, because of the great difficulty that has been experienced in its treatment, pea growers during the first year of its ravages having met with almost complete failure in the remedial measures applied.

Although garden and field peas are the crops most injured by this aphid, sweet peas, red and crimson clover, as well as vetches and tares<sup>1</sup> are affected, and in some cases have been damaged. Attack begins on the young pea vines; the "lice" gather in clusters at first under and within the terminals, and as the leaves become covered they attack also the stems, and by their numbers and voracity sap the life of the plant. Whole areas of vines are frequently seen covered with the aphides, which in a very few weeks are able to destroy a crop. Attack is seldom noticed until May<sup>2</sup> in the more southern States in which the insect is found, and a little later in its more northern range.

The complete life history of this species is not known, but like other aphides it produces many generations each year.

According to present knowledge, the pea aphid hibernates chiefly on clover, particularly crimson clover, from Delaware southward. In the District of Columbia it winters also on vetch. From these plants the "lice" spread by flight in April and May to peas, which they attack while the vines are young.

As with other aphides, the females at certain periods produce living young. They attain maturity in from ten to fifteen days, and possibly in less time in the hottest weather. Young that were born March 4 reached maturity (winged form) March 16, or twelve days from the time of birth, and reproduced young three days later.

As an instance of the rapid reproductive powers of this insect, Professor Johnson's estimate is interesting. He found that females produce from 110 to 120 young and that in one case where aphides were observed on the first of May the fields were abandoned on account of ravages three weeks later. Calculating from the average number of

<sup>1</sup>A considerable number of alternate food plants has been observed for *Macrosiphum pisi* in Europe.

<sup>2</sup>In 1901 Mr. Samuel R. Haynes, Portsmouth, Va., reported the presence of this species in that locality about April 7. During the second week of May the writer found it numerous on crimson clover and vetches at Washington, D. C., and May 14 it was reported at work upon peas in the District of Columbia, near the Maryland State line.

insects produced each day, which is six, one individual would become the progenitor of 423,912 of these aphides in one season.

#### NATURAL ENEMIES.

The efficiency of natural agents in the destruction of aphides is so well known that it has been hoped that some one or more of the many species observed to attack the pea aphid would increase in such numbers as to have the effect of limiting its multiplication. In spite, however, of the closest observation by a number of persons, the natural enemies have been found to produce only transient relief, and this only in limited areas, as a rule late in the season after damage has been accomplished.

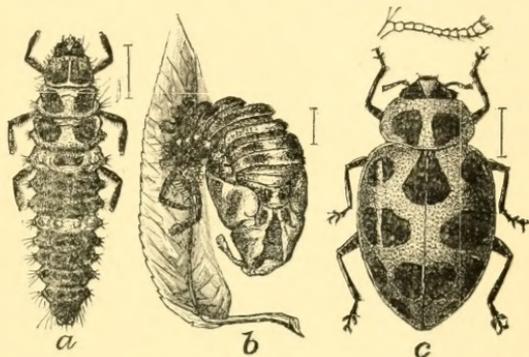


FIG. 2.—Spotted ladybird (*Megilla maculata*): a, Larva; b, empty pupal skin; c, beetle, with enlarged antenna above. All enlarged. (Author's illustration.)

The present list of insects known to attack this

aphis includes seven species of ladybirds, or "ladybugs" as they are familiarly termed,<sup>1</sup> three species of syrphus flies,<sup>2</sup> a lace-wing fly,<sup>3</sup> a soldier beetle,<sup>4</sup> and a few minute four-winged hymenopterous parasites.<sup>5</sup>

The ladybirds are destructive both as beetles and larvæ; the syrphus flies only in the larval condition, which is true also of the lace-wing fly. The efficiency of the syrphus flies is greatly impaired by the presence of a braconid parasite,<sup>6</sup> which is sometimes very prevalent, almost completely exterminating its hosts in many fields. Nearly all the species observed are well-known enemies of other aphides, and in fact greatly prefer as hosts the cabbage aphis and species found on weeds to the pea aphis. The spotted ladybird (*Megilla maculata* DeG.) and a lace-wing fly (*Chrysopa oculata* Say) are shown in their different stages in figures 2 and 3 respectively.

In addition to the natural enemies that have already been enumerated, several other insects attack the pea aphis, among them a small red mite, *Rhyncholophus parvus* Banks.

<sup>1</sup> *Coccinella novemnotata* Hbst., *Hippodamia convergens* Guér., *Megilla maculata* DeG., *Hippodamia glacialis* Fab., *Adalia bipunctata* L., *Hippodamia 13-punctata* L., and *Coccinella sanguinea* L. <sup>2</sup> *Allograpta obliqua* Say, *Syrphus americanus* Wied., and *Spharophoria cylindrica* Say. <sup>3</sup> *Chrysopa oculata* Say. <sup>4</sup> *Podabrus rugosulus* Lec. <sup>5</sup> *Aphidius washingtonensis* (Ashm. MS.), *A. fletcheri* (Ashm. MS.), *Praon cerasaphis* Fitch, *Isocratus vulgaris* Walk. <sup>6</sup> *Bassus letatorius* Fab.

In the above list the species of each class are named in approximate order of abundance in Maryland, Virginia, and the District of Columbia, and consequent efficiency as destroyers of the aphis in that region.

Considering the inefficiency of natural agencies, if we except atmospheric conditions, in the control of this pest, it is hoped that a common fungous disease of aphides, known as *Empusa aphidis*, may become an important factor. As the development of this fungus is dependent upon rather warm, humid weather and is retarded by drought, it is fairly certain that atmospheric conditions, after all, are most important in the limitation of this insect. It is within the bounds of possibility that the fungus might be cultivated artificially and be used during weather conditions favorable in the control of this pest.

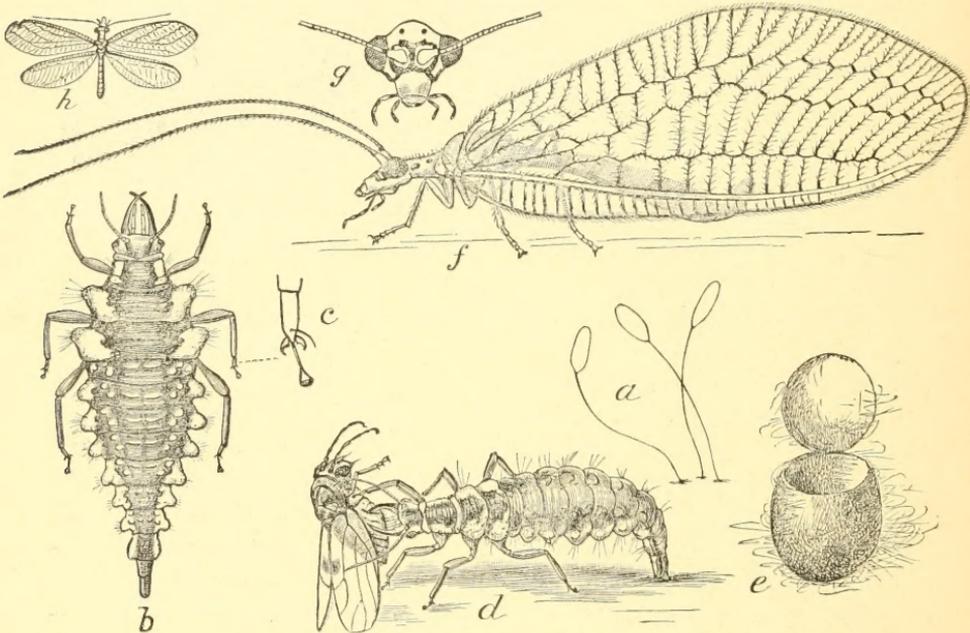


FIG. 3.—A lace-wing fly (*Chrysopa oculata*): a, Eggs; b, full-grown larva; c, foot of same; d, same devouring pear-tree psylla; e, cocoon; f, adult insect; g, head of same; h, adult. All enlarged except h, which is natural size. (From Marlatt.)

#### METHODS OF CONTROL.

In some instances natural enemies of the pea aphid have rendered efficient service. Seldom, however, do they destroy the insects early enough in the season to save a crop. In the course of time—many years in all likelihood—these enemies may become more effective; hence, in view of the fact that the extermination of the species even in a limited area is a practical impossibility, anything that can be done to destroy the aphid without harming its insect enemies is advisable. If this can be accomplished it will afford in itself a reason for the rejection of insecticides, none of which is in all respects satisfactory.<sup>1</sup>

<sup>1</sup> For the benefit of some persons who are not wholly familiar with the feeding habits of this species it should be stated that it obtains nourishment by suction, and can not therefore be reached by means of internal or stomach poisons such as Paris green and other arsenicals.

*Kerosene emulsion.*—Kerosene-soap emulsion, a standard remedy for aphides, carefully prepared and diluted with about twelve parts of water, sprayed upon the infested plants upon the first appearance of the aphides, and so applied that the leaves are wet on both the under and upper surfaces, has thus far been found to be the most effective of the insecticides tried. A stronger solution than that specified is apt to burn or scald the plant, particularly while the vines are young and tender. Sprays of whale-oil and other soaps have been found less useful. The cost of the kerosene emulsion remedy, however, and the difficulty of underspraying, its rapid evaporation, and the necessity for frequent applications, are such as hardly to warrant its use on a large scale.

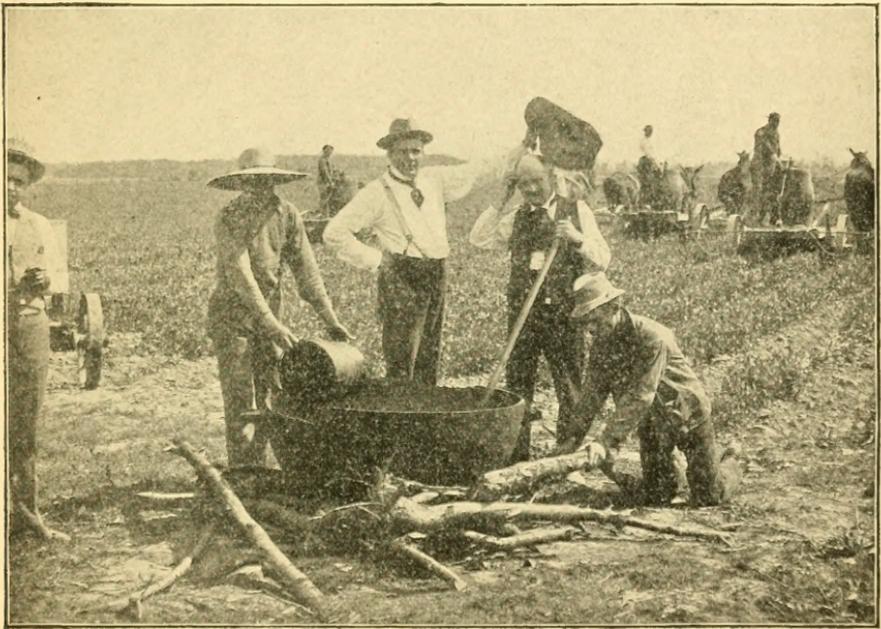


FIG. 4.—Spraying peas with tobacco-whale-oil soap, showing method of preparation and application.

The method of preparing tobacco-whale-oil soap, a special preparation of soap of particular value for aphides, and the implements used in its application are illustrated by figure 4.

*The brush-and-cultivator method.*—The best remedial measure that has yet been devised is the growing of peas in rows with sufficient distance between them to admit a one-horse cultivator. The "lice" are brushed from the plants with boughs of pine with their leaves on, and a cultivator then follows down the rows as soon afterward as possible. For the perfect success of this method it should be practiced in the heat of the day, when the ground is dry and hot, and the repetition of the brushing is necessary every three to seven days until the crop is ready

for picking. Such lice as are not buried in the ground by the cultivator will be killed by the dust which closes their breathing pores, while a considerable proportion is destroyed also by the force of the brushing. This method has the advantage of not being so destructive to the natural enemies as other means that might be employed, the aphid being more fragile and delicate than any of its insect enemies. Moreover, peas planted in rows to permit of frequent cultivation suffer much less injury than when sown broadcast. As soon as the last picking has been made infested plants should be promptly destroyed by plowing under.<sup>1</sup>



FIG. 5.—Field of peas saved by brush-and-cultivator method, showing implements used.

*The brush-and-pan method.*—A method which consists in jarring the aphides from the vines into specially prepared, long, shallow pans in which a little kerosene is floating, dragged between the rows, has given good results, the insects as they come into contact with the kerosene being all killed. A bushel of "lice" was caught to each row, 125 rods long, in one instance where this remedy was used. It is practicable only for small areas.

<sup>1</sup> We have abundant testimony to the value of this method, but perhaps none more striking than that on the farm of Mr. C. H. Pearson, a Maryland peagrower. During the season of 1900, a 600-acre pea plantation was practically saved by this method. After other means had failed, the fields were brushed and cultivated every third day for a period of two weeks. The previous season peas over the same area were sown broadcast; so that it was impossible to combat the pest in this manner, and as a consequence 480 acres were entirely ruined. (Bul. 20, n. s., p. 94; Bul. 26, p. 57, Div. Ent., U. S. Dept. Agr.)

A field of peas saved by the use of the brush-and-cultivator method is illustrated in figure 5.

In figure 6 the manner of applying the brush-and-pan method is shown. Figures 4-7, illustrating the practical methods of combating the pea aphid, were first used by the late W. G. Johnson in an article published in Bulletin No. 26 of this Bureau.

*Cultural methods.*—Of cultural methods, there is testimony to the value of early planting, the earliest peas seldom being infested, or at least only slightly injured. Very large plantings of peas to be used for canning have also escaped ravages in some instances, but it may be



FIG. 6.—Field of peas saved by the brush-and-pan method, showing the apparatus used.

that atmospheric conditions have had something to do with exemption in the cases which have come under notice.

Rotation of crops is advisable, and it is unwise to plant peas on the same portion of a farm or garden, in successive years, or in the vicinity of fields of red or crimson clover, or other leguminous plants, such as vetch, which are likely to harbor this species.

As has been said, this insect passes the winter on the plants mentioned, because peas are not available, and it might be possible to use small plants of some one of them as trap crops. Crimson clover would probably be best because of its conspicuousness and the early start that it gets in the spring. On the trap plants the aphides could be killed by hand methods, such as brushing from the plants into pans,

and thus large numbers of the insects could be killed early in the season before they had opportunity to spread to peas.

In Delaware it has been shown that the practice of keeping the land well fertilized and frequently cultivated enables the peas, in spite of aphid attack, to produce better crops than would otherwise be made.

*Alternate host plants.*—The subject of alternate host plants is an important one, since the pea, being an annual, is not available as food for this aphid during winter. It is desirable to ascertain all of the host plants of the pea aphid, and more especially the weeds, as some one or

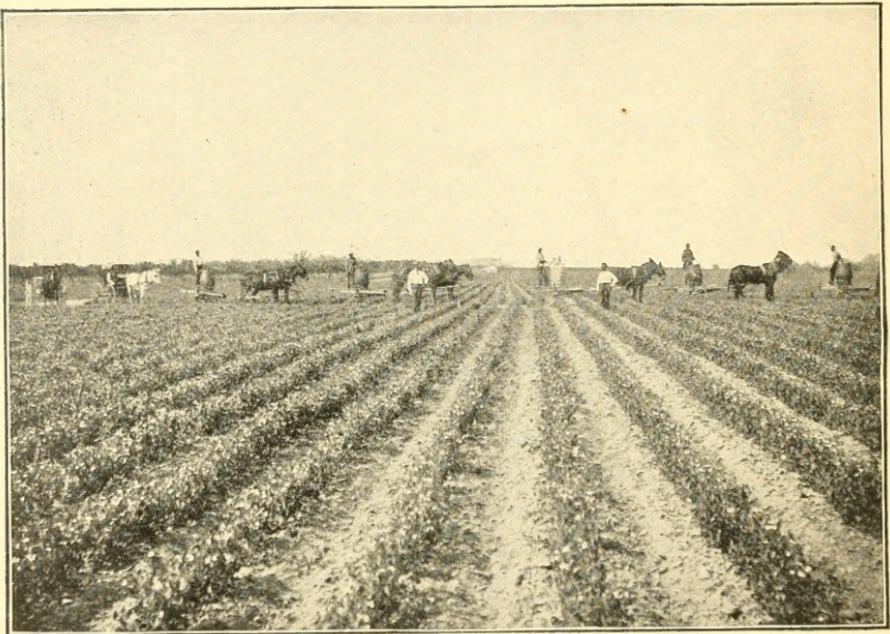


FIG. 7.—Section of a 600-acre pea field, rows one mile long, showing spraying outfit ready for work. Peas finally saved by brush-and-cultivator method.

more of these may be factors of importance in the life economy of the species. It might be necessary in the future, should the depredations of this insect increase, to limit the growing of clover and other legumes, as well as other alternate host plants, if such be found, in the vicinity of pea fields. If all of the principal alternate plants could be discovered this might furnish a solution of the problem of how to deal with the insect.

Approved :

JAMES WILSON,  
*Secretary of Agriculture.*

WASHINGTON, D. C., January 21, 1909.

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