assuming 100 per cent. yield, it would be necessary to begin with $0.1 \div 10^{-12} \times \frac{1}{6.06}$, or 606,000,000 liters of juice.

In making such a calculation it should be emphasized that the figures used for the molecular weight of the infective principle and for the number of infective particles per cubic centimeter are assumptions.

Little definite evidence is at hand as to the size of the infective particles in virus diseases. Duggar and Karrer[1] concluded on the basis of filtration experiments that the infective particles of tobacco mosaic approximate those of fresh 1 per cent. hemoglobin solution, which would indicate a diameter of around 30 millimicrons. Waugh and Vinson[2] state that preliminary experiments show the radius of the infective particle of tobacco mosaic in purified preparations to be less than 5 millimicrons. MacClement and Smith[3] recently report diameters of 15 millimicrons for tobacco and yellow mosaic viruses, 40 to 50 millimicrons for aucuba mosaic and 150 millimicrons for *Hyoscyamus* virus. If these figures represent the particle size of the infective agent of tobacco mosaic and the molecular weights usually given for proteins are employed, a molecular weight of the order of 100,000 for the virus of tobacco mosaic does not seem an unreasonable assumption.

The number of infective particles per cubic centimeter is not known and it is probably impossible with the data at hand even to approximate it. Allard[4] inoculated young tobacco plants by puncturing every leaf of any size, usually four or five, in several places with a needle dipped in the infective juice. Diluting the juice 1,000 times with tap water had no effect on its infectiousness; at a dilution of 1 to 10,000 some attenuation was found; and at a dilution of 1 to 1,000,000 infection was rare. Assuming that a successful inoculation represents an infective particle and the amount of juice introduced by the needle prick is 0.0001 cubic centimeter, we might estimate the number of infective particles at 10,000 per cubic centimeter in the juice diluted 10,000 times or at 100,000,000 per cubic centimeter in the undiluted juice. Geoffrey[5] using a glass spatula, rubbed leaves with infected juice. He secured as many as 283 local lesions per leaf with juice diluted 1 to 10,000. Assuming that each lesion represents an infective particle and 0.01 cubic centimeter of juice was used on each leaf, this would mean 283,000,000 particles per cubic centimeter. On the basis of the number of local lesions formed on *N. glutinosa,* Caldwell[6] has calculated the concentration of the virus of aucuba mosaic to be 3×10^7 particles per cubic centimeter.

The following table shows how great the number of infective particles must be per cubic centimeter of juice if an infective principle of molecular weight of the order of 100,000 can be isolated from reasonable quantities of juice. Assuming a molecular weight of 100,000, the varying number of infective particles per cubic centimeter in the table given below would require the quantities of juice indicated, to yield one tenth gram of infective material, if no loss of the principle occurs during isolation.

Number of infective particles per cubic centimeter of juice	Quantity of juice necessary to yield 0.1 gm of infective material of molecular weight of 100,000
10^6	606,000,000 liters
10^7	60,600,000
10^8	6,060,000
10^9	606,000
10^{10}	60,600
10^{11}	6,060
10^{12}	606
10^{13}	60
10^{14}	6

From the above table it is evident that if 0.1 gram of infective material of molecular weight of 100,000 exists in 6 liters of juice the number of infective particles would necessarily be 10^{14} per cubic centimeter. This figure is a million times the number indicated by the work discussed above. Highly speculative as the figures on the molecular weight of the virus principle and especially on the number of infective particles per cubic centimeter may be, the figures given in the table are of interest to the general problem of the isolation of the active principle of virus diseases.

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1 Duggar and Karrer, *Ann. Missouri Bot. Garden,* 8: 343, 1921.
2 Waugh and Vinson, *Phytopath.,* 22: 29, 1932.
3 MacClement and Smith, *Nature,* 130: 129, 1932.
4 Allard, *Jour. Agr. Res.,* 3: 295, 1915.
5 Geoffrey, *Ann. App. Biol.,* 18: 494, 1931.
6 Caldwell, *Ann. App. Biol.,* 20: 100, 1933.

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