(Tonomura et al., Am. J. Phys. (1989) Vol. 57, p. 117.)

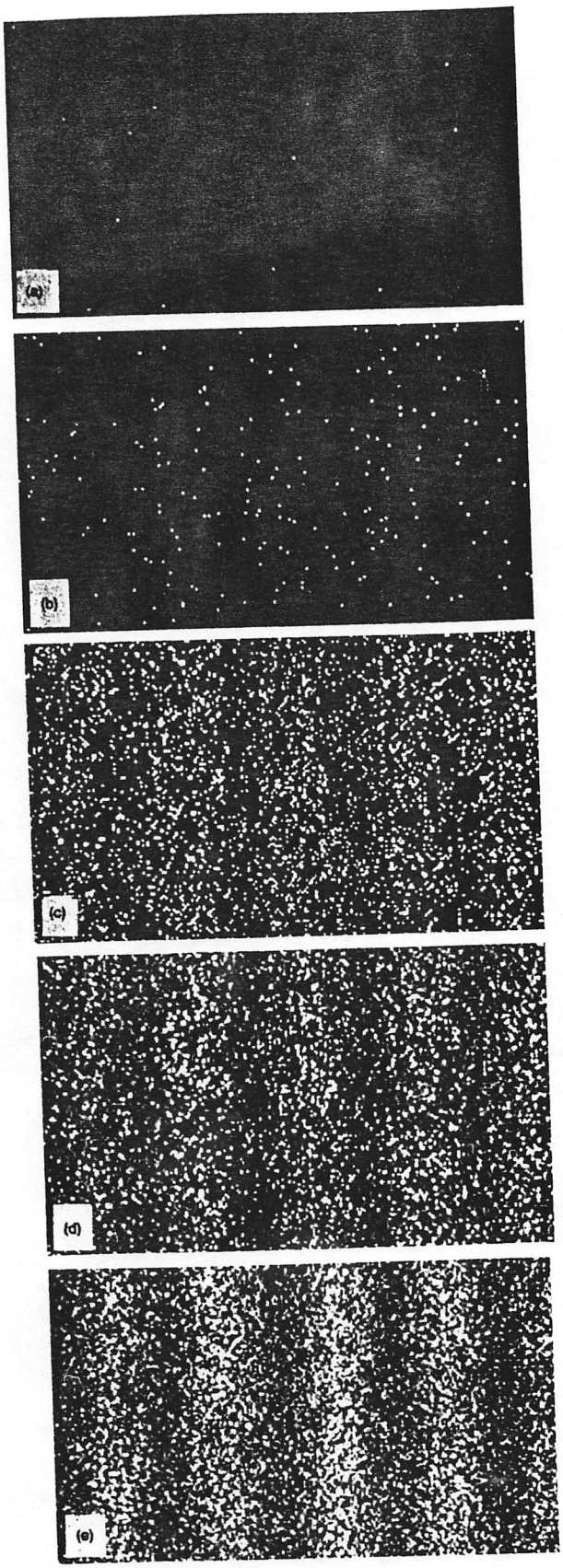

Fig. 5. Buildup of the electron interference pattern. The central field of view, $\frac{1}{4}$ width and $\frac{1}{3}$ length, of the whole field of the detector plane is shown here. The picture extends similarly to the whole field: (a) Number of electrons = 10; (b) Number of electrons = 100; (c) Number of electrons = 3000; (d) Number of electrons = 20 000; and (e) Number of electrons = 70 000.

tron is not even produced from the cathode till long after the preceding electron is detected. At the detector, on the other hand, an electron is observed as a localized particle. We must conclude that a certain position on the screen is selected, onto which the electron wavefunction collapses. The position cannot be predicted, but occurs in the probabilistic way dictated by the probability amplitude.

A series of similar experiments was carried out for different electron intensities ranging from 5000 to 200 electrons/s. The contrast of the fringes obtained remains the same within experimental error of 10%. At the smaller intensity, the error often became large due to the long exposure time, since the error originates mainly from the drift of the biprism filament.

IV. CONCLUSION

We realized a two-slit interference experiment, once regarded as a pure thought experiment with no hope of precise execution, with a combination of both electron-counting and magnifying techniques. The resultant buildup of the interference pattern is exactly as predicted by quantum mechanics.

ACKNOWLEDGMENTS

We should like to thank Dr. Yoshiji Suzuki, Dr. Yutaka Tsuchiya, and Nobuyuki Hirai of Hamamatsu Photonics K.K. for their cooperation in developing the electron detector. Thanks are also due to Dr. Hideo Todokoro of Central Research Laboratory and Shuji Hasegawa of Advanced Research Laboratory, Hitachi, Ltd., for their helpful discussions and assistance in the experiment.

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Fig. B