VIII. SUMMARY AND CONCLUSIONS

We have carried out an experimental study of the neutron and proton deep-inelastic electromagnetic structure functions. The structure functions were extracted from electron-proton and electron-deuteron differential cross sections measured with the SLAC 8 GeV spectrometer in two experiments at laboratory angles of 15^{o}, 18^{o}, 19^{o}, 26^{o}, and 34^{o}, and from data from a prior experiment at 6^{o} and 10^{o} carried out with the 20 GeV spectrometer. We report here on the large angle (15^{o}-34^{o}) measurements and data analysis.

The experiments using hydrogen targets at the larger angles repeat earlier measurements but with improved statistical accuracy and expanded kinematic range. These measurements were supplemented by matched measurements using deuterium targets. Neutron cross sections were extracted from the deuteron data using an impulse approximation and the measured proton cross sections. Corrections were made for the Fermi motion of the bound nucleons. We were thus able to make a detailed comparison of the inelastic electron-proton and electron-neutron scattering cross sections. The program of measurements allowed more stringent tests of structure function scaling than earlier measurements. One of the primary objectives of the measurements was the determination of the ratio of neutron to proton cross sections because the measured ratio puts constraints both on parton and on other models of nucleon structure.

An additional objective of the experiment was a detailed examination of the angular dependences of the cross sections so as to determine the kinematic variations, for fixed x, of R_p and R_d, the ratios of the longitudinal to transverse cross sections.

The behavior of $R(Q^2)$ for fixed x reflects the spin quantum numbers of those charged partons carrying a fraction x of the nucleon's momentum.

These measurements, covering an extended range of Q^2, confirm that scaling is only an approximate behavior of the structure functions. A study of fits to the data with scale breaking forms has been made. Over the range of Q^2 of the data, 1.0 to 20.0 GeV^2, we observe deviations from scaling in the scaling variable ω' in the range of 14 to 22%. Deviations in the Bjorken variable ω, for ω in the range 1.3 to 10.0, are as large as 40%, confirming the trend of earlier results. A number of theories, including asymptotic field theories, predict small deviations from scaling aside from the low Q^2 turn on of νW_2 scaling. The kinematic range of these data alone is not sufficient to allow us to make a choice among the various models.

The results indicate that the ratio of the neutron to proton inelastic cross sections falls continuously as the scaling variable x approaches 1. The experimental ratio falls to about 0.3 in the neighborhood of x = 0.85 and hence is still above the lower limit of 0.25 imposed by the quark-parton model.

From a comparison of the experimental results for R_p and R_d, we find that within experimental errors $R_d = R_p = R_n$ and that their values over the kinematic range are consistent with spin 1/2 constituents of the nucleon.

We conclude that the combined results of these experiments are consistent with the predictions of the quark-parton model of the structure of the nucleon over an extended kinematic range, confirming the interpretation of earlier results.