X. INFORMATION THEORY

Prof. R. M. Fano
Prof. P. Elias
A. Adolph
J. Capon
A. Feinstein
R. M. Lerner
S. Muroga
J. C. Stoddard
W. A. Youngblood

ERROR PROOF CODING

The error proof coding procedures discussed in our last report (1) have been further investigated and modified. The modifications make it possible to remain in the binary system throughout, rather than changing bases at each stage of the coding. The modified procedures still have the desirable characteristics of the original: first, the transmitter need not know in advance the whole of the message to be coded, but merely accepts information digits as they arrive and periodically adds check digits; second, the receiver may obtain as low an error probability as is desired, merely by waiting a sufficiently long time, without any recoding being required. This work is still in process, but the following preliminary results may be noted.

1. The error probability in the received message decreases rapidly enough so that the total equivocation vanishes in the limit as well as the probability of error. Thus this procedure shares a characteristic with Feinstein's demonstration of the channel capacity theorem (2).

2. For a binary channel with symmetrical error probability p_o per symbol, error free information may be transmitted at a nonzero rate for any $p_o \neq 1/2$. For small p_o, the channel capacity of the binary channel and this kind of coding scheme is

$$C' > 1 - 4E$$

where E is the equivocation of the channel

$$E = -p_o \log p_o - (1 - p_o) \log (1 - p_o)$$

Thus the efficiency of the coding is

$$R > \frac{C'}{C} \approx 1 - 3E$$

and R approaches 1 for small p_o.

P. Elias

References

1. P. Elias, Error free coding, Quarterly Progress Report, Research Laboratory of Electronics, M.I.T., April 15, 1954, p. 47.
2. A. Feinstein, A new proof of Shannon's theorem for noisy channels, Quarterly Progress Report, Research Laboratory of Electronics, M.I.T., Jan. 15, 1954, p. 40.