











ly more difficult to design feedback circuits with large loop gain, and therefore the over-all specifications of the amplifiers would be poorer.

There would appear to be no limit at the low-frequency end except for drift effects. Konigsberg's bridge extends down to 0.05 cps with chopper-stabilized amplifiers. D-c applications appear limited, but a d-c version of Logan's bridge might be a useful device, though it would require several good d-c amplifiers.

## CONCLUSIONS

The examples given show how measurement circuits with active devices can be used to avoid many of the design restrictions and operating limitations of conventional impedance bridges. Advantages include the avoidance of impractical variable components, the elimination of preliminary balances (for 4-terminal measurements) and guard balances (for 3-terminal measurements), the possibility of having  $D$  or  $Q$  direct reading at several frequencies, simplified means for applying d-c bias to the unknown, and the removal of bridge transformers. It seems apparent that many new applications would develop as bridges with special features are required.

It is difficult to state specifically the maximum accuracy possible in measurement circuits using active

devices. Certainly, most of the devices described would not appreciably reduce the calibration stability of 1 per cent bridges. On the other hand, one would not expect them to be used on the most accurate bridges used for intercomparison of impedance standards. Some of these devices could be used in bridges with accuracies of 0.1 per cent or better, if loading effects are minimized by proper design. More sophisticated feedback circuits could eventually find application in 0.01 per cent bridges.

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## Computer dates Babylonian clay tablets

Shown below are portions of three separate pieces of a Babylonian clay tablet which dates back to 183 B.C. Tablets like these are being dated by means of the astronomical information on them through use of tables produced

on an IBM computer by an IBM mathematician. The technique may help provide scholars with new insights into the pre-Christian civilization era.

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