quite surprised to find that the crater has a diameter of only 70 feet and a depth of only 10½ feet.

The crater had been reported originally by E. S. Simpson in 1938. Simpson's report was based upon a description given him by a former manager of the Dalgaranga sheep station, who reported finding several meteorite fragments around the crater in 1923. Simpson did not go to see the crater. His erroneous report was the basis of the incorrect measurements which were incorporated in the recent British Museum Catalog of Meteorites and which have been given in numerous other publications.

A survey, including a description of the meteorite fragments that were recovered at the site during the recent visit to the crater, is being prepared by the museum.

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## Effect of Chlorine Dioxide on Lignin Content and Cellulose Digestibility of Forages

A significant negative correlation exists between the percentage of lignin in a forage and the digestibility of the dry matter and the crude fiber. Lignin is susceptible to decomposition by chlorine and its oxides. The removal of lignin from plant material by sodium chlorite in aqueous acid solutions is part of the procedure for the preparation of holocellulose. Holocelluloses prepared from wood have been found to have digestion coefficients of 80 to 90 (*1*), which are higher than those of cellulose in untreated wood. The treatment of forages to remove lignin should lead to an improved utilization of the fibrous constituents of forages. Various treatments of forages or low-grade feeds have been carried out with delignifying agents; an example is the work of Prianishnikov and Tomme (*2*). They treated straw with aqueous $ClO_2$ and then with aqueous sulfite; however, a loss in soluble constituents resulted, even though the digestibility of the crude fiber was increased. So far as we know, no observations on the effect of $ClO_2$ gas in the dry state on the digestibility of forage have been made.

Experiments were carried out on a laboratory scale to degrade the lignin without loss of soluble constituents of forage. Three forages were treated as follows: Air was bubbled through a solution of sodium chlorite, sodium acetate, and acetic anhydride and then passed through a glass tube containing 5 to 10 gm of finely ground roughage in an air-dry state for 4 to 24 hours. The sample, still apparently air-dry, had an acid odor which could be removed by exposure to air, by vacuum treatment, or by a short aeration with air containing ammonia. The product was analyzed for acid-insoluble lignin (*3*), and the digestion coefficient of its cellulose was determined by an artificial-rumen technique developed at the Pennsylvania Agricultural Experiment Station (*4*). The results appear in Table 1. The dry treatment of dried and ground grass and straw with $ClO_2$ resulted in a marked decrease in the acid-insoluble lignin content as determined by chemical analysis and in a significant increase in the digestibility of the cellulose as indicated by the artificial-rumen technique. The changes were related to the amount of sodium chlorite that was used (*5*).

Table 1. Lignin content and cellulose digestibility of forages treated with $ClO_2$ gas.

| Treatment | Hygroscopic moisture (%) | Acid-insoluble lignin (%) | Digestion coefficient of cellulose |
|---|---|---|---|
| *Orchard grass, flowering, treated in 10-gm lots* | | | |
| No treatment | 5.6 | 5.3 | 36.9 |
| 0.2 gm $NaClO_2$ | 6.2 | 5.3 | 39.2 |
| 2.4 gm $NaClO_2$ | 5.7 | 3.9 | 48.0 |
| 3.0 gm $NaClO_2$ | 6.2 | 3.6 | 46.3 |
| *Reed canary grass, late dough, sample previously extracted with benzene-alcohol, treated in 5-gm lots* | | | |
| No treatment | 5.2 | 5.5* | 30.9 |
| 1.2 gm $NaClO_2$ | 6.2 | 3.7* | 40.0 |
| 3.0 gm $NaClO_2$ | 7.2 | 2.0* | 46.9 |
| *Wheat straw, treated in 8-gm lots* | | | |
| No treatment | | 6.7 | 22.8 |
| 2.5 gm $NaClO_2$† | | 2.8 | 36.2 |
| 3.0 gm $NaClO_2$ | | 3.9 | 24.0 |
| 3.2 gm $NaClO_2$ | | 1.85 | 52.2 |

* Percentage of original grass. † Final aeration with vapor from ammonium carbonate solution.

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5. This report is contribution No. 173 of the U.S. Regional Pasture Research Laboratory, Crops Research Division, U.S. Agricultural Research Service, in cooperation with the 12 northeastern states and authorized for publication 10 July 1959, as paper No. 2385, Journal Series, Pennsylvania Agricultural Experiment Station.

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## Sodium- and Potassium-Sensitive Glass Electrodes for Biological Use

*Abstract.* Continuous, accurate recording in circulating fluids from a sodium and a potassium electrode is described. The Na electrode is capable of discriminating $\triangle[Na^+]$ of less than 1 meq/lit. in 140 meq/lit., and the K electrode is capable of discriminating $\triangle[K^+]$ of less than 1 meq/lit. in the range of 1 to 10 meq/lit. with good reproducibility. The electrodes may be used singly or in pairs with a common reference calomel electrode for simultaneous monitoring of $\triangle[Na^+]$ and $\triangle[K^+]$ in mixed solutions. Problems of streaming potential dependent on flow rate and electrode shape, as well as transient $K^+$ response by the Na electrode, are discussed.

Eisenman, Rudin, and Casby have elegantly demonstrated that the ternary glass system, $Na_2O$-$Al_2O_3$-$SiO_2$, may be systematically varied to produce electrodes with high selective affinity for individual cations (*1*). They reported that $NAS_{11-18}$ glass ($Na_2O$, 11 moles percent; $Al_2O_3$, 18 moles percent; $SiO_2$, 71 moles percent) was a particularly effective Na electrode and that effective K electrodes might also be prepared. Since then, working in cooperation with Eisenman *et al.*, we have been able to adapt $NAS_{11-18}$ glass for practical use in biological systems by using metal-connected electrodes to overcome problems inherent in the nature of the glass (*2*). The present report (*3*) is concerned with the limits of precision of the Na electrode operating alone or paired in a two-electrode system with a K-selective electrode.

Tests of precision and reproducibility were carried out with a continuous flow system at constant rate. The electrode was mounted in a shielded cage, and the inflow and outflow tubes were interrupted by an air gap to reduce stray electrical interference. In such a system, solutions flowing past the electrode membrane can be changed only gradually and, theoretically, never completely. Pockets of solution in the line may also produce erratic mixing. The reproducibility of potentials is, nevertheless, limited only by the drift rate of the electrometer which, for short intervals, is negligible (Fig. 1*A*). Precision is limited mainly by the accuracy of the standards and the $\pm 20$ $\mu$v noise level of the Cary electrometer (equivalent to less than 0.2 meq/lit. on a base of 140). Recovery of Na added to plasma can be equally good.

As in the case of the $H^+$ electrode the streaming potential of the $Na^+$ electrode is affected by flow rate, particularly in unbuffered solutions. The response is a function peculiar to each electrode but, in general, for electrodes with a capacity of less than 1 ml, the