

International Society of Soil Science
Second International Commission

President: Prof. Dr. Alex A. J. von 'Sigmund

Report of the Committee on Soil Reaction Measurements*)

**Part I. Results of comparative investigations
on the Quinhydrone electrode methode,
compiled by**

Dr. D. J. Hissink, Groningen,
President of the Committee

I. Formation, Object, and Working-plan of the Committee

The change with time on the pH-values obtained with the quinhydrone-electrode, was studied by Dr. Stefan Kühn, Budapest. In his communication at Budapest (July 1929) Kühn (1) expresses the opinion that with the quinhydrone-electrode, owing to the potential drifts which occur, no useful determinations can be made, and that no significance can be attached neither to the initial values, nor to the values after the lapse of some time, nor to an extrapolated final value (2). No significance can in general be ascribed, according to Kühn, even to the values which are not subject to potential drifts (op. cit. p. 29). At the conclusion of his treatise (Z. f. Pflanzenernährung usw., p. 32, 33, see also Budapest 1929, A, p. 132) Kühn even advocates "dass die Bodenforscher die pH-Bestimmungen nach der nicht gänzlich eindeutigen Chinhydronmethode aufgeben und sich der viel zuverlässigeren Indikatormethode zuwenden mögen".

In their well-known paper "On the determination of the reaction of soils by means of the Quinhydrone-electrode" (Groningen, Vol. B, p. 236—274), Biilmann and Tovborg-Jensen discuss the question

*) This Committee was appointed at the Meeting of the Second Commission at Budapest, July 1929, and consists of:

Prof. Dr. Einar Biilmann, Copenhagen, Denmark; Dr. E. M. Crowther and Miss S. Heintze, Rothamsted; Prof. Dr. G. Doby and Dr. D. Snasschel, Budapest; Dr. D. J. Hissink and Dr. S. B. Hooghoudt, Groningen; Dr. S. Tovborg-Jensen, Lyngby, Denmark; Dr. E. Scherf and Dr. S. Kühn, Budapest; Prof. Dr. Alex A. J. von 'Sigmund and Dr. Ir. J. di Gleria, Budapest; Dr. D. M. Trénel, Berlin.

as to whether measurements should be made immediately after the addition of quinhydrone, or only some time afterwards. They remark that a measurement made immediately after addition of quinhydrone gives the correct value (their first reading-off is made about one minute after addition of quinhydrone; see also p. 245 of their publication), or at least a more correct value than later measurements. Biilmann and Jensen, however, did not encounter in their experiments soils with appreciably drifting potentials (Volume B, p. 248). They do, however, utter a warning against the use of the quinhydrone-electrode in soil-water mixtures with pH above 8.5 (p. 265). They invariably lay stress on the reproducibility of the values found.

The Committee for Soil Acidity and Soil Adsorption (Lemmermann, Comber, Hissink) touch only briefly on this point in their report to the meeting of the Second Commission, Budapest, July 1929 (26), and only recommend that further work should be carried out on this point.

Heintze and Crowther, in their paper read at Budapest (Vol. A, p. 111), pointed out errors in soil reaction determinations by the quinhydrone method with a number of soils some of which contained small amounts of manganese dioxide. In these soils the Qh-pH values were considerably higher than the H₂-pH values. They suggest (p. 110, sub 6) that the reduction of acidity in these soils by their interaction with quinhydrone is due to the presence of an active form of manganese dioxide in intimate association with the soil colloids. This is reduced by hydroquinone to manganese-hydroxide, which neutralises a portion of the soil acids. Many of the Gold Coast soils tested, and some English soils (Budapest, Vol. A, p. 102) gave well-defined and closely reproducible potentials by the quinhydrone method, and there was no drift or any other reason to suspect the routine determinations. The first readings were, however, made one minute after adding the quinhydrone.

On the motion of Prof. von 'Sigmund it was resolved to appoint a committee for the further examination of the pH determination in soils by the quinhydrone-electrode, under the presidency of Dr. D. J. Hissink. The following members were appointed to this Committee:

Prof. Dr. Einar Biilmann, Copenhagen, Denmark;

Dr. E. M. Crowther and Miss S. Heintze, Rothamsted Experimental Station, Harpenden, England;

Prof. Dr. G. Doby and Dr. D. Snasschel, Agrochemisches Institut der Volkswirtschaftlichen Fakultät der Universität, Budapest, Hungary;

- Dr. D. J. Hissink and Dr. S. B. Hooghoudt, Institute of Soil Science, Groningen, Holland;
Dr. S. Tovborg-Jensen, the Danish State Laboratory for Plant Culture, Lyngby, Denmark;
Dr. E. Scherf and Dr. S. Kühn, Kön. Ung. Geologische Landesanstalt, Budapest, Hungary;
Prof. Dr. Alex. A. J. von Sigmund and Dr. Ir. J. di Gléria, Chemische Landesanstalt, Budapest, Hungary;
Dr. D. M. Trénel, Geologische Landesanstalt, Berlin, Germany.

The object of this investigation was, then, in the first place to ascertain — in addition to the reproducibility — the influence of the time on the results obtained with the quinhydrone-electrode in the case of an adequate number of soils of divergent types and pH values. Measurements were therefore to be made in watery soil-suspensions at various time intervals after the addition of quinhydrone. Especial care had to be taken in doing so that the first readings-off were made within the shortest possible time after the addition of quinhydrone. After the lapse of a certain time the soil-suspensions were again to be shaken up with quinhydrone, and the measurements carried out in the same way. Whilst the 7 Institutes participating were in any case to keep to this plan, it was recommended that other methods should be included in the investigation.

The following working-plan was drawn up. Each of the Institutes participating was to send its own soil samples in an air-dried condition to each of the other 6 participants, taking care that as homogeneous samples as possible should be distributed. Precise instructions were to be given by the president of the committee as to the manner in which the work was to be carried out. The soil samples were to be sent out in November 1929, and the tests were to be made as soon as possible after receipt of the samples. The results of the investigation were to be sent to the president in January 1930, after which the latter was to forward a statement of the results obtained to the participants. In February 1930 it was resolved on the proposal of the president that the results of the investigation should be published in *Soil Research*, accompanied by a text. Of course, the definite conclusions will have to be agreed upon at a meeting of the commission, to be held, if possible, before the opening of the Congress in Leningrad.

II. Short description of the 29 soil samples

Altogether 29 soil samples were sent out, viz:

- Dr. D. J. Hissink, Groningen, 6 soil samples, packed in tins;
- Prof. Dr. von 'Sigmond, Budapest, 5 soil samples packed in paper bags, enclosed in linen bags;
- Dr. Crowther, Rothamsted, 5 soil samples, packed in tins;
- Dr. Trénel, Berlin, 3 soil samples, packed in linen bags;
- Dr. Tovborg-Jensen, 5 soil samples, packed in tins;
- Dr. Scherf, Budapest, 5 soil samples, packed in tins.

The order agrees with the order of the dates of receipt of the soil samples at Groningen (8 Nov.—18 December).

A description of the samples as sent to me by the participants, is given in the 2nd column of Table Ia (see p.100). The values determined by the Institute at Groningen (CaCO_3 , sand, clay, and humus) are also given in columns 3 to 6 inclusive.

Description of soils, sent in by Dr. Crowther, Rothamsted (see also Table Ib see p. 99).

- R1. From Rothamsted Experimental Station, Harpenden, Herts, England.

Cultivated Surface Soil from Agdell Field. Plot 1 continuously cropped with swedes, barley, fallow, wheat since 1848 and receiving complete fertiliser applied to swedes.

The soil is a clay loam derived from the Clay-with-flints formation over the Chalk and is similar to one discussed by Heintze and Crowther in their Budapest 1929 paper.

- R2. From Shropshire, England.

Cultivated Surface Soil derived from Bunter Sandstone. A light sand.

- R3. From Maidencombe, near Torquay, Devon, England. A cultivated surface soil from a fertile district on sea cliffs, derived from Devonian Limestone.

- R4. From Enmore, Somerset, England.

Surface Soil, from old grass land. Red Clay loam derived from Devonian formation.

- R5. From Craibstone, Aberdeen University Farm, Scotland.

A acid sandy loam cultivated surface soil derived from granitic glacial drift.

III. Description of the methods followed

In order definitely to settle the method to be followed, Dr. S. B. Hooghoudt worked through the entire method to be followed, with Dr. Tovborg-Jensen, at Lyngby, for a week in September 1929, Prof. Biilmann also being consulted.

In these discussions Dr. Hooghoudt drew attention to the influence of the shaking-up of the suspension, and of the position of the siphon in the suspension (whether the end is surrounded or not by the settled soil particles has, in the case of the heaviest Dutch soils, a great influence on the potential of the electrode). This latter may possibly be ascribed to a very great diffusion-potential.

As a result of these discussions the following instructions (hereinafter called the "General Instructions") were sent out with the letter of October 2nd, 1929. (These are intended to be supplementary to the instructions given by Prof. Dr. E. Biilmann and Dr. S. Tovborg-Jensen, Groningen, Vol. B):

I. Test of the Method of Procedure

As the object is to test whether, when the given method of procedure is used, the same pH values are obtained from the same soil samples in different laboratories, the directions for use must be followed very carefully in every detail.

E. Biilmann and S. Tovborg-Jensen wish to emphasize certain points to which sufficient attention is not always paid, or which they have discovered later in using the method. The apparatus used is the one described in Groningen, Vol. B, p. 243, Fig. 2.

a) The Platinum Electrode

As it has been their experience that one of the causes of incorrect, unstable, or drifting potentials is mercury poisoning of the platinum electrodes, they recommend that all contact with mercury be avoided.

This is most readily accomplished by making the platinum wire longer than the glass into which it is fused.

When the platinum wire is welded to the platinum plate, use a clean, smooth, iron hammer, and pound on a clean, smooth, iron plate.

b) The Agar Siphon-tube

Another source of error is the agar siphon-tube. In their directions for use they have noted the fact that the surface of the soil-water mixture must be higher than the surface of the KCl solution at C (see Volume B, p. 243), and that the arm of the agar tube at a must be cut off in such

a way that contact is obtained on a plane agar surface. They emphasize this point again, and point out that in manufacturing agar tubes clean, dry glass tubes must be used, as otherwise a mobile film of moisture may arise between the walls of the tube, and the agar tube will then act as a siphon.

They also point out the fact that in using the agar tube the agar nucleus is gradually loosened somewhat from that end of the tube which penetrates the soil-water mixture. This may be remedied several times by cutting off a little piece of the tube, so that a plane agar surface is again obtained.

When the agar tubes are not in use they are stored with their arms dipped into a saturated KCl solution. Before using they should be rinsed in distilled water. Care should be taken that the agar siphon tube is placed as shown in fig. I (see p. 98). If the agar siphon-tube is placed lower, so that the agar surface is surrounded by solid soil particles, drifting potentials may result.

c) Standard Electrodes

Even though the potential of the quinhydrone standard electrode used by them remains constant for more than 24 hours, the electrode should be freshly renewed at the beginning of each series of experiment, and tested on a quinhydrone electrode in a buffer solution with a known pH. If this test is made with the apparatus to be used in a subsequent measurement, it acts as a test of the accuracy of the entire apparatus.

d) Quinhydrone

This is made according to the method described in Groningen, Vol. B, p. 273, and dried as described therein. It should never be dried under any circumstances by heating in an oven. They recommend for a soil-water mixture containing 15 grams water the use of about 0.15 g. quinhydrone.

e) Water

Distilled water should be used, from which carbonic acid must be removed from the distilled water by boiling or aearting with a current of carbonic-acid-free air.

f) The Amount of Soil

A sufficient quantity of soil should be used, so that the platinum plate of the electrode is entirely surrounded by the soil particles. The soil-water ratio should be as 1 : 2.5. The soil-water suspensions are prepared in the following way: place soil in the test-tube, add water, and shake vigorously for a minute.

g) The Electrode Vessel and the Electrode

Test-tubes should be made of Jena-glass, dimensions 15×1.5 cm. The platinum plate electrode should not be smaller than 5×13 mm. Dimensions should be given. If smaller electrodes are used, more time will elapse before the potential can be measured.

h) Standard Cell and Storage Battery

A standard Weston cell is to be used with a controlled potential. The voltage for a compensation is taken from a storage battery, and when a series of measurements is completed the adjustment of the apparatus is again checked with the standard cell. If the total resistance of the potentiometer is less than 2000 Ohm, this must be repeated several times during the series, and, if necessary, new adjustment made.

i) The Potentiometer

The type and total resistance of the potentiometer should be stated.

It should be remembered that, in measuring such low potentials as in the present instance, it is extremely important to have every detail of the apparatus checked.

Even the finest potentiometer of the Feussner type, Wolff, Berlin, may give unreliable contact when not handled in the proper way, and will then show unstable potentials even measuring the potential of completely stable cells. E. Biilmann and S. Tovborg Jensen point out that the best remedy in this instant is the apparently paradoxical treatment of lubricating the points of contact with vaseline or paraffin oil.

k) Galvanometer

If a galvanometer is used as zero-point indicator, its type and constants should be stated.

l) Other remarks

The temperature at which the measurement is made should be stated. Preferably the temperature should not deviate much from 18° C.

Measurements should be made in two portions drawn from each soil sample and 2 different platinum electrodes should be used.

II. Remarks of the Institutes

In addition to the quinhydrone method, the pH of the various soil samples was also determined in many cases by means of other

methods. A description of the methods followed by each Institute is included below. At the same time the deviations from the "general instructions" for the quinhydrone method are given as they were sent to me by the various participants.

Berlin: Dr. M. Trénel.

Quinhydrone-electrode.

The "general instructions" were closely followed with the following exceptions:

1. Instead of the "empfindlichen Agar-Röhren" the "KCl-Brücke nach Ostwald" was used.
2. 10 grams of soil were shaken with 25 cc. water for 1 minute; quinhydrone was then added and stirred for 15 seconds before the electrode was dipped into the suspension. Owing to this the first measurement did not take place until 30 seconds after the addition of the quinhydrone.
3. The re-shaken suspensions were not measured until 5 minutes after reshaking.

Dr. Trénel further makes the following remarks:

1. New Pt-electrodes, which had never been used before, (10 × 18 mm), without mercury contacts were used.
2. The quinhydrone was made according to the "general instructions". The product, re-crystallised from water, had a neutral reaction and was free from iron. (see also Trénel und Bischoff, Zeitschrift für angewandte Chemie, 1929, p. 288).
3. The potentiometer used was the "Azidimeter nach Trénel" (3, sub II).
4. After every 5 soil samples the apparatus was checked by a determination with a phosphate buffer mixture 1 : 1, (Sørensen).
5. With a few soil samples it was impossible to obtain duplicates which tallied. The cause of this was not found. The agreement was the worst in the case of RI, but with Groningen C and Lyngby B difficulties were also experienced. In contrast to these the reproducibility for the Hungarian alkaline soil samples was satisfactory.
6. Measurements were also taken in 0.1 N KCl suspension (see Table II, p. 101).

Budapest: Dr. Scherf and Dr. Kühn.

Quinhydrone-electrode.

The "general instructions" were followed closely with the following exceptions:

- I. Instead of 10 grams of soil and 25 cc. H_2O , 5 grams and 12.5 cc. were used respectively. After shaking well, they allowed the suspensions to stand for 5 minutes, with repeated shakings. Only in the case of the soil suspension Sigmond B was the suspension allowed to stand for $1\frac{1}{2}$ hours before quinhydrone was added, as equilibrium was reached (the pH values became constant) only after this time.
- II. 0.13 grams quinhydrone was added to the suspension, the quinhydrone remaining almost entirely on the inside of the tube in which the suspension was made, or on the surface of the suspension. For this reason the stop-watch was not set going until one person — immediately after the addition of the quinhydrone — vigorously shook the contents of the tube. Together with the immersion of the electrode this took at most 5 seconds, so that the first measurement (by another person) took place as quickly as 5 seconds after the shaking-up with quinhydrone. In all those cases in which a rapid potential drift occurred, it was possible to read off the first value exactly only in the 10th—12th second (3, sub I).

Dr. Scherf and Dr. Kühn add the following remarks:

- a) The Pt-electrodes — without mercury contacts — were of the following size: a; 5×13 and b; 6×14 mm. These electrodes, of which one (a) had already been in use for a long time, whilst the other (b) was quite new, were carefully cleaned and heated red hot in a spirit flame every day before beginning the measurements, and the same applies to the electrode of the "Veibel"-electrode.
- b) The connection of the soil electrode vessel with the Veibel-electrode was made in accordance with the general instructions. Special care was taken that no KCl got into the suspension. This was managed by having the level of the suspension but little higher than that of the saturated KCl solution in the connecting vessel.
- c) The quinhydrone was made according to the instructions of Biilmann-Jensen (Groningen, Vol. B). The product made in this way reacted neutrally.

- d) The water was freed from CO_2 by boiling. The water had no buffering capacity and reacted approximately neutrally (6.8—7.1). It was preserved in such a way as to exclude CO_2 .
- e) As potentiometer the "Azidimeter nach Trénel" was used. With the galvanometer used a deviation of 1° corresponded with 2.5×10^{-7} amp. or with 0.03 pH, whilst a third of this (0.01 pH) was still easy to estimate (3, sub II).
- f) Every day before the beginning of the measurements the apparatus was checked with a phosphate buffer of pH 6.81.
- g) The temperature in the suspension varied from 20 to 22° . No effort was made to keep this temperature constant.
- h) In each case 2 soil suspensions were made in the above way. One of these was previously used for the provisional measurement.

Hydrogen-electrode.

The measurements were made with the V-electrode with "stehender H-Gasblase". The suspensions were made in the same way as with the Quinhydrone-electrode. The soil sample Scherf A was measured not only in the proportion soil: water = 1 : 2.5, but also in the proportion 1 : 1.6 (pH 7.40; 7.50).

The hydrogen used was made electrolytically. The suspensions contained too coarse material to allow of their being put into the V-tube in their original state. The rapidly settling coarser fractions stopped up the bend in the V-tube, so that the "Gasblase" could not be inserted. For this reason the soil suspensions made in the ordinary way were allowed to settle for $\frac{1}{2}$ minute, and the turbid liquid now above the settled soil-particles were poured into the V-tube.

With regard to the number of rotary movements of the "Gasblase" with V-tube required to arrive at a constant potential, they further remark that for this as a rule some 40 rotary movements are sufficient; to be on the safe side, however, they rotated in every case 60 times.

As zero instrument the same galvanometer was used as with the Quinhydrone-electrode. Owing to the greater resistance the accuracy of the reading was estimated at 0.05 pH (Quinhydrone-electrode 0.01 pH) (3, sub III).

It may be remarked that the soil sample 'Sigmond E' was not measured, as no constant potential could be obtained.

Colorimetric method according to Kühn.

For the most detailed description of these methods see Stefan Kühn "Kritische Untersuchungen der Chinhydrone-Elektrode und der

Indikatorenmethode bei der Messung der pH's von Böden, ihre Anwendbarkeit einzeln und miteinander vergleichend geprüft", Zeitschrift für Pflanzenernährung usw., 1929, Teil A; see also the directions supplied with the "Reaktiometer".

Kühn and Scherf further point out that the comparison of the colours obtained was made partly with the colour-scale supplied with the "Reaktiometer" and partly with buffer solutions, to which the corresponding indicators were added.

The letters placed after the pH figures are the abbreviations of the names of the indicators used, the meaning being: M. R., Methyl Red; B. K. G., Brom Cresol Green; B. T. B., Brom Thymol Blue; T. P., Thymolphthaleine; α -N., α -Naphtholphthaleine; P. R., Phenol Red; K., Kompleksindikator; K. I., a new indicator-mixture, not yet published by Dr. Kühn and Dr. Scherf.

In order to increase the degree of accuracy and to obviate errors the pH values were determined by means of two different indicators.

These measurements took place before the measurements with the Quinhydrone-electrode.

Budapest: Prof. Dr. Doby and Dr. Snasschel.

Quinhydrone-electrode.

The "general instructions" were followed exactly.

The following remarks are added:

- a) The total resistance of the measuring wire was 24 ohms.
- b) The galvanometer (Martin-Sigra, Budapest) had a resistance of 659 ohms and a sensitiveness of 1×10^{-7} Amp. per 1°.
- c) Both electrodes were checked by means of phosphate buffers.

Colorimetric: according to Kühn.

Nothing is stated as to this. Probably, therefore the directions supplied with the "Reaktiometer" were followed exactly.

Budapest: Prof. Dr. von 'Sigmund and Dr. di Gléria.

Quinhydrone-electrode.

The "general instructions" were followed precisely, except that the soil-suspensions were made 24 hours before they were used.

The following remarks are added:

For carrying out the electrometric measurements a potentiometer with a total resistance of 88 ohms was used. The potentiometer used was of the usual type, viz. 11 resistances connected in series, of which one (the measuring wire) was subdivided into 1000 equal parts. The

galvanometer used was a Siemens-Halske mirror-galvanometer of 100 ohms resistance and a sensitiveness of 10^{-6} ampères, for a deviation of one scale division. As a standard electrode the Veibel-electrode was used (see "General Instructions").

The area of the electrodes used was 8.15 qmm (wire-electrodes). The Veibel-electrode and the Agar-KCl-siphon made in accordance with the "General Instructions" were filled afresh every day.

The Veibel-electrode as well as the entire apparatus were checked every day with a phosphate mixture 1:1. The quinhydrone used was made according to the "General Instructions". The distilled water was boiled twice.

Hydrogen-electrode.

The apparatus shown in fig. II (see p. 98) served as hydrogen-electrode. The hydrogen was made by electrolysis. In some cases the soil showed a lower pH if measured shortly after the hydrogen stream into the suspension began. But by flowing in of the hydrogen for about 15 minutes a higher and constant pH could be observed. The pH-values given in the Table Va (see p. 132) were determined by following the later method.

Antimony-electrode.

The experience gained with the antimony-electrode will be communicated to the Congress in Leningrad by Dr. di Gléria in a separate publication.

For the moment only the following can be stated:

The antimony-electrode was made electrolytically in such a way that the antimony given off was oxidized electrolytically in an alkaline solution. The potential of the electrode was determined with respect to a Veibel-electrode with buffer solutions and at 20° C. The potentials obtained plotted on a diagram as abscissa against the pH-values as ordinate, do not give a straight line when the corresponding points are connected with each other.

Colorimetric: according to Kühn.

These measurements were carried out in strict accordance with Kühn's instructions.

This method gave variable values, which, according to the above investigators is due to the indicator coming into contact with the soil, which absorbs the indicator either partly or completely (e. g. G. L. A. I did not give an appreciable colour until 2.1 cc. indicator solution

had been added). As the soil colloids are usually negatively charged, it is principally the positively charged portion of the indicator that is absorbed. Thus R3 gave with Bromthymolblue 7.4 and with the complex-indicator 8.0, which according to the above investigations is to be attributed to the above-mentioned cause.

Groningen: Dr. D. J. Hissink and Dr. S. B. Hooghoudt.

Quinhydrone-electrode.

The measurements were made precisely in accordance with the "General Instructions", except for the following:

I. The Pt-electrodes (9×14 mm) used had mercury contacts. There was, however, no risk in doing so, owing to there being a constant daily checking with several phosphate buffers.

II. The duplicates were not always carried out with 2 different Pt-electrodes, as it was never possible to detect any difference in the behaviour of the 2 new electrodes used.

The following remarks may further be made:

The potentiometer used (Land und See-Kabelwerk, Cologne) had a total resistance of 60 ohms. As zero instrument use was made of a Capillary-Electrometer with a sensitiveness of 0.5 m. V.

To reduce diffusion of the KCl from the siphon into the suspension to a minimum, capillary KCl-agar-siphons were used (internal diameter 0.5 mm). The tubes used were of the dimensions given in the "General Instructions".

The quinhydrone used was — as usual — made in accordance with the instructions of Biilmann-Jensen. The product obtained reacted approximately neutrally. As standard electrode a Veibel-electrode was used.

The measurements were carried out very quickly after the addition of the quinhydrone. This time was 8 seconds (partly measured by two persons). The time of readings obtained in this way agrees with those of Kühn and Scherf after 5 seconds, as in our case the time was reckoned from the moment that the quinhydrone was put into the tube. The pH's were of course first determined approximately by preliminary tests.

Hydrogen-electrode.

For the hydrogen-electrode the somewhat modified apparatus of de Bray (Ind. and Eng. Chem., **20**, 241, 1928) was used. Fig. III (see p. 99) shows the apparatus used, which had already been used by Heintze and Crowther in their Budapest 1929 paper and by Dr. Tovborg-Jensen and Dr. S. B. Hooghoudt at Lyngby. As this method permits of

extremely rapid measurements (within 1 to 2 minutes after starting the H_2 -stream), and can also be very simply constructed, it may here be described in some detail.

A is an ordinary Büchner flask, almost entirely filled with pure distilled water (for stability, and so as not to be obliged to displace a greater volume of air by H_2 -gas than is absolutely necessary). B is a spherical funnel with upright edge. Into this is fitted a rubber stopper (hatched) with a hole wide enough to admit a vessel consisting of a sintered glass Jena crucible C. The best thing to use for this is an old filter crucible of which the porosity is so great that air can easily be blown through it by means of the mouth when this crucible is half filled with water. This crucible is closed by means of a rubber stopper with 2 holes, one for the electrode (E) and one (too wide so that the hydrogen can escape) for the capillary KCl-agar-siphon (F). The electrode E consists of a platinum plate (5×10 mm), on which a Pt-wire is fused, which in turn is fused into a glass tube. The Pt-tin is thinly platinized, only one point of which is placed in the suspension to be measured, so that equilibrium can quickly be reached.

To prevent diffusion of the KCl from the siphon (some soils are very sensitive even to traces of KCl) owing to the vigorously agitated suspension, H_2 -gas is first passed through for from 1 to 2 minutes, before the siphon (F) is put into the suspension. Measurement then takes place within 15 seconds. That equilibrium has been reached is shown by the fact that the potential no longer rose, and gave the correct values in buffer solutions, within 0.05 pH (usually 0.02 pH).

There is no need to purify the hydrogen. Ordinary good commercial hydrogen gas such as is supplied in cylinders, can be used for these measurements. The cylinder is connected directly with the flask A by means of a rubber tube. The hydrogen stream must be so strong that the fine H_2 -bubbles set the suspension or solution in vigorous motion. The suspensions are made in the same way as for the quinhydrone method.

Antimony-electrode.

As a publication "On the application of the antimony-electrode for the measurement of the degree of acidity of soil suspensions" by Dr. Hooghoudt, is shortly to appear, and will be sent to members of the Commission and others interested, a few short remarks may here suffice.

The measurements are performed with a rotating (50—100 times per minute), very slowly cooled, cast antimony rod electrode.

The calibrating of this electrode was carried out at 19—20° C., in several buffer solutions, and with respect to a Veibel-electrode. The pH's were calculated from the following comparisons:

$$\text{pH } 2-8: E = 0.0346 + 0.0557 \text{ pH}$$

$$\text{pH } 8-11: E = 0.4806 + 0.052 (\text{pH} - 8).$$

The potentials are expressed in volts. The measurements were made quickly (within ½ minute) after starting the rotating electrode.

Only with 1 soil suspension (Scherf C) were there any difficulties in measuring. The value found is too acid.

The suspensions were made in the same way as for the quinhydrone-electrode.

Colorimetric determination: according to Kühn.

The directions supplied with the "Reaktimeter" were strictly adhered to and the colours were compared with the colour scales annexed. No effort was made to improve this method by means of a comparator. For this test the "Azidimeter" as supplied to us — according to the instructions of Dr. Scherf and Dr. Kühn — was employed. In addition to the colour scales (see also under Institute 2, p. 87) and to the BaSO₄ pro Röntgen supplied, the measurements were carried out by means of the 4 following indicators (also supplied), viz.: Methyl Red, Brom Cresol Green, Brom Thymol Blue and Komplex indicator. This was the reason why Clark and Lubs' sulphonephthalein indicators were not the only ones used.

Our experiences agree with those described by Prof. Dr. von'Sigmond and Dr. di Gléria; viz., complete or partial absorption of the colouring matters. Methyl Red was strongly absorbed. In several soil samples (Gron. A, 'Sigmond B and C) no determinations whatever were to be made with this indicator; even when 35 drops were added the clear layer was still colourless. There is moreover a certain risk attached to the use of such a quantity, in view of badly buffered soils.

In the Tables the figures after the abbreviated name of the indicator used (the same abbreviations as those used by Kühn and Scherf) indicate the number of drops of indicator added. Where no figure is to be found, the number is 7. A second consequence of the absorption was that the colour obtained often did not agree at all either with those given on the colour scale or with conceivable intermediate colours. Estimation was in these cases extremely arbitrary, and was strongly influenced by the figures previously determined by means of the quinhydrone-electrode. A third objection was that independently of the amount of soil or BaSO₄ used, a suspension occasionally refused to

become clear, or cleared only after standing for 24 hours. This same phenomenon was also frequently observed with other Dutch soils, especially boulder-clay.

MnO₂ content.

Finally the content of MnO₂ was determined. It has already repeatedly been pointed out in the literature that there is a connection between MnO₂ content and potential drifts (of bad soils); see i. a.:

W. T. Mac George, *Soil Science* **27**, 83 (1929);

S. G. Heintze and E. M. Crowther, *Budapest*, Vol. A, p. 102 (1929);

S. Osugi, H. Kahihara and K. Kawai, *Journal of the Science of Soil and Manure*, Vol. 3, Nr. 4, 55 (1929).

For this reason the content of MnO₂ was determined with the aid of the specific oxidation reaction from benzidine to benzidine blue (from private communication, Dr. F. Feigl, Vienna).

This was done by shaking 2 grams of soil with a few grains of benzidine hydrochloride, 10 cc. H₂O, and 1 drop KOH (1 : 10), in some cases followed by the addition of a few drops of diluted acetic acid (especially if too much KOH has been added). The strength of the blue colouring which appears is compared with the blue colour which appeared with artificially made mixtures of soil (Gron. C, containing no MnO₂) with MnO₂. These mixtures contain respectively 0.1, 0.01, 0.001 and 0.0001 % MnO₂. Even 0.0001 % MnO₂ can in this way very easily be shown. The estimate is, of course, somewhat rough (owing to the colour of the soil itself, etc.). From the determinations it follows only (see also Table III, p. 102) that soil samples which give potential drifts (bad soils) — apart from the Wiegner effect — also contain MnO₂, with the possible exception of Lyngby C (see also Table III column 6). The converse, however, can certainly not be said. In this regard the result with the soils Gron. A and Gron. B is striking; why should only one (Gron. B) give a potential drift and both contain approximately the same amount — even more than R1 — of MnO₂. This reaction may thus be a help in tracing "bad soils".

Postscript. In the circular to the members of the pH-Committee it was requested that the first reading should be made "immediately" after addition of the quinhydrone; to make the matter still clearer, the words "15 seconds" were added. The Groningen Institute, it will be seen, gives its results after 8 seconds and after 30 seconds, but not after 15 seconds. With 21 of the 29 soils the difference between the pH values after 8 seconds and after 30 seconds is so slight that the "pH values after 15 seconds" can be found with practically absolute certainty by arithmetical interpolation. In the case of the 8 so-called "bad soils" matters

are different. Here the drift, immediately after the addition of the quinhydrone, is very great, but then very soon decreases somewhat. By means of graphic interpolation, however, the following "pH values after 15 seconds" may be calculated with a fairly high degree of accuracy:

Groningen B 7.45; RI 6.51; RIH 7.93; RIV 6.26; Scherf A 7.64; Scherf B 8.40; Scherf C 7.85; and Scherf D 6.39.

The "pH values after 15 seconds" of two of these 8 soils, viz., Groningen B and RI, had already been determined; the results were, Groningen B = 7.41 and RI = 6.51, which values agree very well with the interpolated values 7.45 and 6.51.

Lyngby: Dr. S. Tovborg-Jensen.

Quinhydrone-electrode.

The quinhydrone measurements were carried out in details as prescribed. The potentiometer of the Feussner type was from O. Wolff, Berlin; total resistance 20000 ohms. As zero-point indicator a Siemens and Halske mirror-galvanometer was used. The sensitiveness of the galvanometer used as stated by Siemens and Halske is (at a scale distance of 1 m.) 1 mm. deflection for 120×10^{-7} Volt.

Hydrogen-electrode.

The hydrogen-electrode used is of the same type as was used at Groningen (see above).

Readings were taken when the potential has stopped increasing and remained constant (within 2—3 m. V.) for about 5 min.

Colorimetric measurements were made in soil extracts (soil water ratio 1:2.5) after centrifuging; the indicators used were of the Clark and Lubs' series.

Rothamsted: Dr. E. M. Crowther and Miss S. Heintze.

Quinhydrone-electrode.

The determination were carried out at 18° C., using the technique exactly as described in Dr. Hissink's circular (General Instructions). 5 grams soil and 12.5 cc. water were shaken by hand for 1 min., the quinhydrone added, shaken for a few seconds, and the first reading taken 15 seconds after adding the quinhydrone. The tubes used had the following dimensions: 1.5 × 12.5 cm. It should be added that the KCl-agar bridge was left in the suspension throughout the measurements; this makes possible a salt error, owing to the possibility of diffusion of KCl for 30 minutes. It is our custom not to insert the bridge until immediately before making the voltage measurements, but in making measurements so frequently and at such small intervals as were required in this case, it was necessary to avoid frequent disturbance

of the suspension by moving the bridge. The end of the bridge was 1 cm. below the surface of the liquid, and was therefore several cms above the settled soil in which the electrode was immersed. No addition of quinhydrone was made on re-shaking the suspension.

Hydrogen-electrode.

Suspensions (1:2.5) were shaken mechanically for 1 hour and measured as above by the quinhydrone method and also by the hydrogen-electrode in a vessel consisting of a sintered Jena crucible. Hydrogen was passed vigorously through the bottom into the suspension and escaped through a narrow glass jet in a stopper, which also carried two palladium-coated platinum electrodes (1 cm. square) and a KCl-agar bridge; the agar bridge was pushed down into the suspension only during the actual period of measurement, so as to reduce to a minimum the introduction of KCl into the suspension. Readings with each electrode were made at intervals of 3, 5, 7, and 9 minutes. Equilibrium was usually reached in 5 minutes; the two electrodes almost invariably agreed to 1 m. V. The measurements were repeated on a new suspension for a number of soils and gave very good agreement in all cases. After the hydrogen measurements the suspension was again measured by the quinhydrone-electrode. These results differed from the direct Qh-measurements only by 0.04 on the average, and only in 3 out of 28 soils did the difference exceed 0.1 in pH.

Potassium Chloride Suspensions.

Suspensions of 5 gm. soil in 12.5 cc. of N. KCl were shaken occasionally by hand and left overnight. A few cc. of the clear supernatant liquid were removed by a pipette and Qh-measurements made immediately on this solution and on the remaining suspension (see Table III).

Acid soils with large Qh-errors can be detected by the fact that their KCl suspensions give much higher Qh-values than the clear supernatant liquids in equilibrium with them. In alkaline soils this rule breaks down presumably through a Wiegner effect.

Colorimetric Measurements.

These were made by Kühn's method of shaking together soil, barium sulphate, indicator solution and water, but the following modifications were introduced to obtain better results. Clark and Lubs' sulphonephthalein indicators were used singly instead of Kühn's indicators to avoid the errors introduced by absorption of methyl-red and similar basic indicators through ionic exchange with the soil.

(Crowther, J. Agric. Science, 1925, 15, 211). The indicators were compared against the appropriate glass colour standards of the Hellige dix comparator. This made it possible to make much more precise determinations. The colorimetric pH determinations were repeated using a saturated neutral solution of Qh. instead of distilled water (see Table III). The values agreed to 0.3 except in 7 soils, all of which gave considerably higher results in the presence of Qh. whether measured electrometrically or colorimetrically. The "bad" soils can therefore be detected by this colorimetric test. Further the reduction in acidity corresponding to the higher pH-values with Qh. points to an actual liberation of basic material from the soil by Qh. rather than to a failure of the Qh-electrode as such.

Time of contact between soil and water.

To test the approach to equilibrium obtained by shaking the soil and water for 1 minute, comparisons were made against suspensions shaken mechanically for 1 hour before adding the Qh. The differences are small and irregular, and suggest that the shorter period is adequate (see Table III).

Hydrogen peroxide. Manganese dioxide is known to be a strong catalyst for the decomposition of H_2O_2 and its presence in soils may be detected by either the marked increase of temperature or the rapid evolution of oxygen when the soil is shaken with H_2O_2 . The reaction with the soil organic matter in the cold proceeds so much more slowly than the MnO_2 catalysis that it is not likely to disturb the test. The results in Table III may be divided into 2 groups with more or less than 10^0 temperature rise or to 10 ccs. gas in 1 min. The 8 more active soils include 6 with large Qh-errors and 2 strongly alkaline soils. This is some additional confirmation for the association of the Qh-error with active MnO_2 . The 21 soils with feeble catalytic powers include only 1 "bad" soil (Scherf D). The associations of large Qh-errors with strong H_2O_2 decomposition has been confirmed in many other soils but a few African soils with large Qh-errors resemble Scherf D in their low catalytic powers. These soils may contain some other form of manganese and are being further examined.

IV. Results

The results with the quinhydrone-electrode are communicated in Table IV, consisting of 29 separate tables (p. 103-131). The numbers in this Table indicate the following Institutes:

- Nr. 1 Trénel,
- Nr. 2 Scherf-Kühn,
- Nr. 3 Doby-Snasschel,
- Nr. 4 'Sigmond-di Gleria,
- Nr. 5 Hissink-Hooghoudt,
- Nr. 6 Jensen,
- Nr. 7 Crowther-Heintze.

The figures a and b signify the duplicate determinations. The figures in the horizontal direction relate to successive measurements of one and the same soil suspension; thus, e. g., Institute 2 found in the case of soil sample Gron. A, Nr. a, from 2 to 15 sec. resp. the values 5.87—5.87—5.88. A query (?) means that difficulties have occurred, either as a result of discrepant duplicate determinations so that no average value was to be determined, or owing to a continual change of the potential rendered a reading impossible.

Table V consisting of 3 separate tables (p. 132—134) contains the results with the hydrogen-electrode and the antimony-electrode, and the colorimetric results.

A summary of the results is given in the two Synoptic Tables A and B

That such a voluminous material should already have been completed, no more than eight months after the appointment of the pH Committee at the meeting of the Second Commission at Budapest (July 1929), is due to the energetic co-operation of all the participating Institutes. I take leave to express my thanks for this. In particular I wish to thank Dr. S. B. Hooghoudt, Groningen, who lent his invaluable co-operation in compiling with the material, and to Dr. E. M. Crowther, Rothamsted who was kind enough to undertake the correction of the English text.

A detailed discussion with recommendations is postponed until the Committee has examined the whole of the data

Groningen, March 1930.

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- (1) Dr. Stefan Kühn's article in the Zeitschrift für Pflanzen-ernährung usw., Vol. A, XV, 13—33, 1929, agrees for the most part with his article in Budapest, Vol. A. The first named article is only somewhat longer, for which reason this article only is referred to below.

- (2) See e. g. Dr. Stefan Kühn op. cit, p. 15 et seq., especially p. 18 sub ε and (ξ).
- (3) Here follows some remarks made by Scherf-Kühn in a later letter:

- I. Nach der Erreichung des Endwertes in der 900. Sekunde wurde die Bodensuspension ohne neuerlichen Chinhydron-zusatz etwa 1 Sekunde lang wiederum kräftigst aufgeschüttelt und die so erhaltenen Zahlen sind unter „re-shaken“ angeführt.
- II. Das Galvanometer hatte für sich selbst einen inneren Widerstand von etwa 640 Ohm, zusammen mit den im Trénelschen Apparat eingebauten, ihm vorgeschalteten Serienwiderständen 3200 Ohm, während der Widerstand des Meßdrahtes in unserem Trénelapparate etwa 100 Ohm beträgt, so daß auf die Apparatur insgesamt etwa 3300 Ohm Widerstand entfallen; hierzu kommt bei der Messung mit Chinhydron noch der Widerstand der Versuchszelle, der bei unserer Zusammenstellung je nach der Art des Bodens mit 500—3000 Ohm zu veranschlagen sein dürfte.
- III. Bei der Messung mit der V-förmigen Wasserstoffelektrode betrug der innere Widerstand der Versuchszelle mit der Bodensuspension je nach dem Boden etwa 500—15000 Ohm.

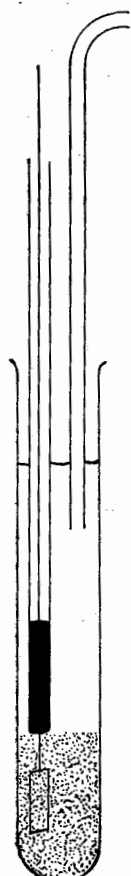


Fig. I

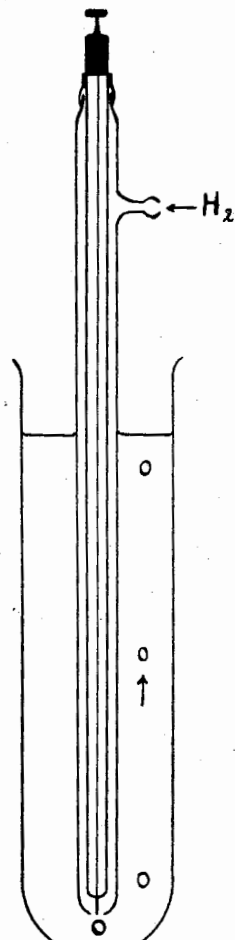


Fig. II

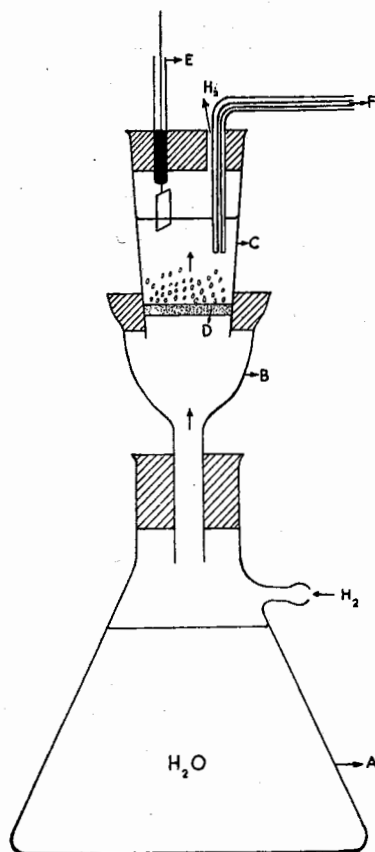


Fig. III

Table Ib
Mechanical Analyses of Soils, determined at Rothamsted
(Weight of oven dry fractions as per cent of air dry soil. Analyses by International
Official Pipette Method)

	R 1	R 2	R 3	R 4	R 5
Coarse Sand (2—0.2 mm) . . .	7.5	57.0	35.0	15.2	43.2
Fine Sand (0.2—0.02 mm) . .	41.7	25.6	24.2	33.9	27.7
Silt (0.02—0.002 mm)	24.7	7.7	15.5	23.0	11.0
Clay (0.002 mm)	22.3	7.5	19.0	21.5	9.0
Air dry moisture	2.9	0.9	2.4	2.2	1.8
Carbonates	—	—	0.4	—	—
R ₂ O ₃ etc. dissolved	0.7	0.4	0.7	1.0	1.4
Difference	0.2	0.9	2.8	3.2	5.9
Total	100.0	100.0	100.0	100.0	100.0

Table Ia

Soil sample marked	Description	in % of dried matter			
		CaCO ₃ 1)	Sand	Clay <0.016 mm.	Humus 2)
Gron. A	Experimental Farm, heavy sea clay	—	22.3	73.8	3.9
" B	Experimental Farm, heavy sea clay	—	23.0	73.7	3.3
" C	Roden, heavy loam soil	—	15.8	82.6	1.6
" D	Harkstede (II), peat-soil	—	33.6	30.5	35.9
" E	Sappemeer, "dal"-soil; humus, sandy	—	71.2	7.2	21.6
" F	Rolde, humus, sandy soil	—	85.0	7.2	7.8
Rothamsted, R I	Clay loam, Rothamsted, Agdell Plot 1 (as used in Heintze and Crowther's Budapest, 1929 paper)	—	53.6	44.3	2.1
" R II	Light sand from Bunter Sandstone	—	83.9	14.3	1.8
" R III	Loam from Devonian Limestone	0.3	61.3	35.7	2.7
" R IV	Red clay loam from Devonian	—	52.6	43.2	4.2
" R V	Sandy loam from granitic glacial drift	—	73.8	20.2	6.0
Berlin, G.L.A. I	humoser, sandiger Waldboden (Kiefer), Horizont A, Umg. Potsdam	—	95.2	3.3	1.5
" G.L.A. II	wie I, a. Umg. Ketzin b. Brandenburg	—	90.4	1.6	8.0
" G.L.A. III	Heideboden, Horizont a, Provinz Hannover	—	75.6	11.1	13.3
Sigmond A . . .	Moorboden vom Moore Ecsedi Láp, Ungarn	—	3.7	72.8	23.5
" B . . .	Schicht A ₂ eines Waldbodens von Hűvösvölgy, Budapest	—	47.5	45.0	7.5
" C . . .	Schicht B ₁ des Bodens B	—	48.2	51.1	0.7
" D . . .	Kalkhaltiger Waldboden aus Kamaraedő	6.8	28.8	60.4	4.0
" E . . .	Kalk und Soda enthaltender Szikboden Dunatetőten, Ungarn	11.8	36.2	48.8	3.2
Lyngby A	glacial origine { loam loam sandy loam humus sand humus sand	—	72.5	24.7	2.8
" B		—	71.8	25.4	2.8
" C		1.4	77.8	17.8	3.0
" D		—	93.5	4.3	2.2
" E		—	92.0	5.6	2.4
Scherf A	Schwach humoser Flugsand 0 bis 10 cm, aus der Ackerbauschule Kecskemét, Ungarn	—	95.8	3.1	1.1
" B	Schwarzerde, in Löß gebildet, 0 bis 10 cm, aus der Ackerbauschule Kecskemét, Ungarn	6.6	55.5	33.8	4.1
" C	Sandiger Lehm, 0—10 cm, von Vence, Ungarn	0.5	59.0	36.7	3.8
" D	Lehmiger Sand, 0—10 cm, aus der Ackerbauschule Csermajor, Ung.	—	74.8	24.9	0.3
" E	Waldboden, 0—10 cm, aus dem Hűvösvölgy bei Budapest	—	34.1	59.9	6.0

1) CO₂ content calculated as CaCO₃.

2) Determined by heating air-dry soils to a red heat (treat soil samples containing CaCO₃ first with dilute HNO₃ and evaporate again on water-bath), with a correction for moisture, CaCO₃ and fixed water (6.3 grams per 100 grams clay = <0.016 mm.; this is fraction I and II).

It remains, of course, to be seen whether this water content of 6.3% of the clay fraction is applicable to other than Dutch soils.

Table II
0,1 N.KCl Suspension (Results Dr. Trénel)
Temperature 21°

Time after addition of Quinhydrone	0,5 Min.		1 Min.		2 Min.		5 Min.		5 Min. after re-shaken	
Electrode	I	II	I	II	I	II	I	II	I	II
Gron. A	4.84	4.82	4.85	4.83	4.85	4.86	4.85	4.85	4.86	4.85
„ B	6.25	6.48	6.48	6.76	6.68	6.90	6.82	6.95	6.88	6.97
„ C	5.95	5.92	5.85	5.85	5.83	5.81	5.75	5.74	5.74	5.75
„ D	4.35	—	4.33	4.35	4.30	4.33	4.29	4.31	4.30	4.29
„ E	3.45	3.45	3.48	3.46	3.50	3.49	3.52	3.50	3.51	3.50
„ F	4.61	4.64	4.65	4.66	4.69	4.66	4.73	4.68	4.73	4.70
Rothamsted, R I	6.30	5.25	6.50	5.90	6.61	6.15	6.55	6.27	6.56	6.35
„ R II	4.10	4.05	4.12	4.03	4.05	4.03	4.06	4.04	4.17	4.05
„ R III	7.25	7.35	8.25	7.65	8.3	7.95	8.4	8.2	8.42	8.25
„ R IV	6.05	5.65	6.15	5.85	6.25	6.05	6.34	6.25	6.35	6.25
„ R V	4.45	4.42	4.45	4.39	4.43	4.40	4.45	4.41	4.46	4.42
Berlin, G.L.A. I	4.21	3.93	4.13	3.94	4.11	3.93	4.11	3.93	4.09	3.93
„ G.L.A. II	3.27	3.27	3.27	3.25	3.27	3.25	3.27	3.25	3.27	3.25
„ G.L.A. III	3.33	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35
Sigmond A	3.73	3.70	3.70	3.73	3.69	3.73	3.68	3.75	3.66	3.73
„ B	5.33	5.28	5.33	5.32	5.36	5.35	5.42	5.40	5.43	5.40
„ C	4.94	4.88	4.94	4.88	4.95	4.88	4.96	4.93	4.99	4.93
„ E	7.12	7.26	7.26	7.28	7.35	7.32	7.45	7.35	7.50	7.46
„ F	9.19	9.19	9.20	9.20	9.23	9.23	9.25	9.27	9.21	9.23
Lyngby A	3.70	3.67	3.70	3.68	3.72	3.71	3.74	3.74	3.73	3.75
„ B	4.64	4.64	4.66	4.66	4.68	4.68	4.72	4.72	4.74	4.74
„ C	6.63	6.78	6.80	6.85	6.84	6.87	6.97	6.93	6.94	6.97
„ D	6.76	6.76	6.80	6.82	6.85	6.88	6.88	6.92	6.90	6.89
„ E	4.14	4.16	4.16	4.11	4.16	4.11	4.18	4.12	4.25	4.16
Scherf A	6.48	6.56	6.70	6.76	6.90	7.06	7.16	7.22	7.35	7.38
„ B	7.82	7.97	8.19	8.26	8.33	8.36	8.34	8.40	8.40	8.42
„ C	7.50	7.60	7.75	7.75	7.92	7.91	7.90	7.90	7.91	7.94
„ D	5.75	5.70	5.88	5.78	5.90	5.87	5.90	5.89	5.96	5.91
„ E	3.50	3.50	3.50	3.50	3.50	3.50	3.48	3.50	3.50	3.51

Table III
Results Dr. Crowther and Miss Heintze

Soil sample marked	Quinhydrone: Readings after 1 minute				Effect of adding Qh. in colorim. pH-meas- urements	H ₂ O ₂ - Decomposition	
	Water- suspensions		N. KCl suspensions			Tempe- rature Rise in 2 min.	c. c. O ₂ evolved in 1 min.
	Shaken 1 min.	Shaken 1 hr. mecha- nically	KCl- suspension	KCl- solution			
Gron. A	5.88	5.93	4.70	5.58	0	9	4
„ B	8.00	7.85	6.65	6.04	+ 0.6	20	15
„ C	6.80	6.84	5.69	5.72	0	3	1
„ D	4.94	4.92	4.21	4.56	+ 0.1	3	5
„ E	4.06	4.00	3.52	3.64	0	2	1
„ F	5.49	5.44	4.63	4.73	+ 0.1	3	3
Rothamsted, R I	7.44	7.44	6.43	5.46	+ 1.2	22	20
„ R II	5.17	5.20	4.11	4.18	+ 0.4	4	1
„ R III	8.67	8.56	8.06	6.85	+ 0.9	20	18
„ R IV	6.91	7.02	5.91	5.72	+ 0.7	19	15
„ R V	5.31	5.30	4.32	4.42	0	4	2
Berlin, G.L.A. I	4.52	4.52	3.88	3.96	0	2	1
„ G.L.A. II	3.96	3.97	3.26	3.31	0	3	2
„ G.L.A. III	4.13	4.08	3.33	3.40	+ 0.1	5	5
Sigmond A	4.07	4.04	3.69	3.80	0	3	1
„ B	5.93	6.05	5.29	5.56	0	9	4
„ C	5.41	5.48	5.15	5.17	— 0.1	5	1
„ D	8.17	8.16	7.31	7.02	+ 0.3	14	7
„ E	9.48	9.34	8.41	7.78	0	13	17
Lyngby A	4.78	4.77	3.95	4.19	0	3	1
„ B	6.11	6.12	4.61	4.70	0	3	1
„ C	7.55	7.54	6.92	6.69	— 0.1	3	2
„ D	7.36	7.23	6.64	6.45	0	2	1
„ E	4.79	4.80	4.14	4.28	— 0.1	1	1
Scherf A	7.92	7.78	7.34	6.43	+ 0.3	2	2
„ B	8.87	8.83	8.08	6.88	+ 0.2	21	21
„ C	8.22	8.23	7.65	6.91	+ 0.6	18	13
„ D	6.88	6.81	5.60	5.14	+ 0.8	4	4
„ E	4.41	4.45	3.43	3.57	0	6	6

Table IV, 1

Soil sample: Groningen A; sent in by Dr. Hissink, Groningen

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	1/2 min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	A	{ a b	— —	6.05 5.70	6.05 5.80	6.02 5.80	5.81 5.80	— —	— —
		A reshaken	{ a b	— —	— —	— —	— —	5.60 5.70	— —	— —
2	20 to 22	A	{ a b	5.87 5.87 5.88 5.70 5.83 5.85	5.93 5.88	5.93 5.87	5.93 5.83	5.93 —	5.91 —	— —
		A reshaken	{ a b	5.97 5.96 5.83 5.83	5.94 5.82	5.91 5.80	5.90 5.78	— —	— —	— —
3	20	A	{ a b	. 5.85 5.88 . 5.85 5.87	5.88 5.82	5.83 5.82	5.82 5.81	5.81 5.81	5.85 5.82	5.85 5.84
		A reshaken	{ a b	. 5.83 5.83 . 5.81 5.82	5.83 5.82	5.81 5.79	5.85 5.84	5.85 5.84	5.83 5.84	5.85 5.85
4	20	A	{ a b	. 6.01 5.97 . 5.99 5.85	5.97 5.85	5.95 5.82	5.92 5.79	5.92 5.75	5.89 5.72	5.89 5.72
		A reshaken	{ a b	. 5.92 5.90 . 5.82 5.80	5.90 5.80	5.89 5.79	5.89 5.79	5.87 5.80	5.87 5.80	5.87 5.82
5	18	A	{ a b	5.93 5.92 . .	5.95 5.93	5.93 5.93	5.86 5.88	5.76 5.79	5.72 5.72	5.71 5.69
		A reshaken	{ a b	5.93 5.93 . .	5.90 5.93	5.86 5.90	5.83 5.88	5.81 5.85	5.78 5.83	5.78 5.83
6	18	A	{ a b	. 5.93 5.91 . 5.98 5.94	5.91 5.91	5.88 5.91	5.84 5.86	5.72 5.79	5.65 5.73	5.58 5.70
		A reshaken	{ a b	. 5.89 5.86 . 5.88 5.86	5.86 5.86	5.84 5.84	5.81 5.82	5.75 5.79	5.72 5.79	5.72 5.79
7	18	A	{ a b	. 5.84 5.86 . 5.89 5.91	5.86 5.91	5.89 5.87	5.86 5.86	5.75 5.77	5.73 5.73	5.65 5.65
		A reshaken	{ a b	. 5.65 5.63 . 5.60 5.58	5.63 5.58	5.61 5.56	5.61 —	5.60 5.49	5.56 5.49	5.49 5.46

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Table IV, 2

Soil sample: Groningen B; sent in by Dr. Hissink, Groningen

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	B	a	—	7.55	7.70	7.75	7.75	—	—
		B	b	—	7.60	7.78	7.90	7.85	—	—
		reshaken	a	—	—	—	—	7.80	—	—
			b	—	—	—	—	7.82	—	—
2	20 to 22	B	a	7.0	7.45	7.52	7.81	7.96	8.00	8.03
		B	b	7.16	7.50	7.64	7.79	7.84	7.84	7.84
		reshaken	a	8.03	8.02	8.01	7.98	7.97	7.96	—
			b	7.81	7.83	7.87	7.87	7.87	7.87	—
3	20	B	a	.	7.48	7.43	7.57	7.69	7.70	7.57
		B	b	.	7.48	7.43	7.67	7.72	7.72	7.64
		reshaken	a	.	7.49	7.57	7.61	7.76	7.76	7.74
			b	.	7.48	7.57	7.62	7.73	7.73	7.73
4	21	B	a	.	7.88	7.91	7.91	7.89	7.83	7.83
		B	b	.	7.83	7.87	7.87	7.87	7.84	7.84
		reshaken	a	.	7.93	7.91	7.91	7.89	7.91	7.91
			b	.	7.88	7.88	7.88	7.88	7.88	7.88
5	18	B	a	7.20	.	7.60	7.91	7.96	7.94	7.91
		B	b	7.20	7.41	7.86	7.94	8.01	8.05	8.05
		reshaken	a	7.99	.	7.99	7.99	7.97	7.97	7.97
			b	7.99	.	7.99	7.99	8.01	8.03	8.05
6	18	B	a	.	8.02	8.01	7.99	7.97	7.92	7.83
		B	b	.	7.92	7.92	7.90	7.88	7.80	7.77
		reshaken	a	.	8.02	8.02	8.02	8.01	7.99	7.99
			b	.	8.06	8.06	8.04	8.02	8.01	7.99
7	18	B	a	.	7.67	7.88	7.99	8.00	7.99	7.90
		B	b	.	7.61	7.89	8.00	8.00	8.08	7.97
		reshaken	a	.	7.97	7.99	7.99	7.99	7.97	7.97
			b	.	7.94	7.94	7.92	7.94	7.97	7.97

Table IV, 3

Soil sample: Groningen C; sent in by Dr. Hissink, Groningen

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	C	a	—	5.05	5.10	5.10	5.08	—	—
			b	—	6.90	6.90	6.90	6.85	—	—
		reshaken	a	—	—	—	—	5.10	—	—
			b	—	—	—	—	6.80	—	—
2	20 to 22	C	a	6.89 6.91	6.93	6.94	6.94	6.95	6.96	—
			b	6.84 6.86 6.86	6.87	6.87	6.87	6.88	6.89	—
		reshaken	a	6.91 6.91	6.91	6.91	6.90	—	—	—
			b	6.82 6.82 6.82	6.82	6.82	6.82	—	—	—
3	20	C	a	. 6.74	6.74	6.71	6.69	6.68	6.66	6.64
			b	. 6.74	6.73	6.72	6.69	6.68	6.68	6.66
		reshaken	a	. 6.74	6.63	6.60	6.60	6.56	6.53	6.53
			b	. 6.74	6.63	6.61	6.59	6.56	6.52	6.54
4	21.5	C	a	. 6.93	6.93	6.93	6.91	6.91	6.89	6.89
			b	. 6.89	6.89	6.89	6.88	6.88	6.86	6.88
		reshaken	a	. 6.93	6.93	6.93	6.91	6.93	6.93	6.91
			b	. 6.91	6.91	6.91	6.91	6.91	6.89	6.91
5	18	C	a	6.99 .	6.89	6.89	6.89	6.90	6.90	6.91
			b	7.02 .	6.99	6.97	6.96	6.90	6.87	6.83
		reshaken	a	6.87 .	6.87	6.85	6.83	6.80	6.78	6.74
			b	6.90 .	6.92	6.94	6.94	6.92	6.92	6.90
6	18	C	a	. 6.98	6.98	6.97	6.93	6.91	6.90	6.88
			b	. 6.90	6.90	6.90	6.91	6.91	6.90	6.90
		reshaken	a	. 6.86	6.84	6.83	6.83	6.81	6.79	6.79
			b	. 6.86	6.86	6.86	6.86	6.86	6.84	6.84
7	18	C	a	. 6.74	6.80	6.81	6.81	6.83	6.87	6.85
			b	. 6.72	6.78	6.78	6.80	6.80	6.81	6.81
		reshaken	a	. 6.71	6.71	6.71	6.71	6.71	6.89	6.89
			b	. 6.72	6.72	6.72	6.72	6.70	6.70	6.70

Table IV, 4

Soil sample: Groningen D; sent in by Dr. Hissink, Groningen

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	D	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	—	4.41	4.42	4.59	4.35	—	—
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	—	4.80	4.80	4.75	4.75	—	—
2	20 to 22	D	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	4.83	4.92 4.92 4.84	4.92 4.92 4.84	4.90 4.90 4.81	4.90 4.90 4.78	4.88 4.88 4.76	4.88 —
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	4.83	4.92 4.92 4.84	4.92 4.90 4.83	4.89 4.89 4.82	— — —	— — —	— — —
		D	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.79 4.78 4.79	4.78 4.78 4.79	4.75 4.75 4.79	4.75 4.75 4.77	4.68 4.68 4.75	4.68 4.70
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.79 4.79 4.79	4.79 4.79 4.79	4.77 4.77 4.77	4.75 4.75 4.76	4.75 4.75 4.76	4.75 4.75
4	21.5	D	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.87 4.87 4.92	4.87 4.85 4.90	4.85 4.85 4.89	4.82 4.82 4.87	4.82 4.82 4.85	4.82 4.82 4.83
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.87 4.85 4.85	4.85 4.83 4.83	4.83 4.83 4.83	4.80 4.80 4.82	4.82 4.82 4.82	4.82 4.82 4.82
		D	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	4.95	.	4.93 4.93	4.93 4.93	4.93 4.93	4.92 4.92	4.90 4.90
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	4.93	.	4.95 4.95	4.95 4.93	4.93 4.91	4.91 4.86	4.89 4.84
6	18	D	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.89 4.85 4.89	4.85 4.85 4.85	4.84 4.84 4.84	4.84 4.84 4.84	4.80 4.80 4.82	4.78 4.80
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.89 4.87 4.87	4.87 4.85 4.85	4.85 4.84 4.84	4.85 4.84 4.84	4.84 4.82	4.84 4.82
		D	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.94 4.94 4.92	4.94 4.94	4.94 4.94	4.94 4.94	4.94 4.94	4.94 4.94
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.94 4.92 4.90	4.92 4.90 4.90	4.90 4.90 4.90	4.90 4.89	4.89 4.89	4.89 4.87

Table IV, 5

Soil sample: Groningen E; sent in by Dr. Hissink, Groningen

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	$\frac{1}{2}$ min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	E	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	—	3.90	3.90	3.87	3.85	—	—
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	—	3.95	3.90	3.88	3.85	—	—
		E reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	—	—	—	—	3.85	—	—
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	—	—	—	—	3.85	—	—
2	20 to 22	E	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	4.00 4.00	4.00	4.00	4.00	4.01	4.01	—
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	3.95 3.95	3.95	3.95	3.94	3.93	3.91	—
		E reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	4.01 4.01	4.03	4.03	4.03	—	—	—
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	3.93 3.93	3.93	3.92	3.92	—	—	—
3	20	E	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.90	3.89	3.88	3.85	3.84	3.85
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.92	3.90	3.87	3.85	3.83	3.84
		E reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.90	3.89	3.88	3.85	3.85	3.85
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.90	3.89	3.88	3.86	3.86	3.86
4	22	E	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.95	3.95	3.95	3.94	3.93	3.93
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.95	3.95	3.94	3.93	3.93	3.93
		E reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.95	3.95	3.94	3.93	3.93	3.93
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.93	3.93	3.94	3.94	3.94	3.94
5	18	E	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	3.99	.	3.97	3.97	3.95	3.92	3.89
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	4.01	.	3.99	3.98	3.97	3.91	3.89
		E reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	3.99	.	3.97	3.97	3.95	3.94	3.92
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	3.99	.	3.99	3.99	3.97	3.95	3.93
6	18	E	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.00	3.99	3.99	3.95	3.94	3.90
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.00	3.99	3.97	3.94	3.90	3.90
		E reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.00	4.00	3.99	3.95	3.95	3.95
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.00	4.00	4.00	3.97	3.97	3.95
7	18	E	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.04	4.06	4.06	4.04	3.97	3.94
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.06	4.06	4.06	4.04	3.97	3.94
		E reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.02	4.02	4.02	3.97	3.97	3.97
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.00	4.00	4.00	3.98	3.97	3.97

Table IV, 6

Soil sample: Groningen F; sent in by Dr. Hissink, Groningen

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	F	a	—	5.50	5.46	5.41	5.35	—	—
			b	—	5.45	5.42	5.39	5.32	—	—
		F reshaken	a	—	—	—	—	5.30	—	—
			b	—	—	—	—	5.32	—	—
2	20 to 22	F	a	5.40	5.40	5.40	5.40	5.39	5.39	—
			b	5.38 5.37	5.37	5.37	5.37	5.37	5.36	5.35
		F reshaken	a	—	—	—	—	—	—	—
			b	5.34	5.34	5.34	5.33	5.33	—	—
3	20	F	a	.	5.37	5.34	5.28	5.24	5.15	5.10
			b	.	5.37	5.35	5.30	5.25	5.16	5.11
		F reshaken	a	.	5.38	5.37	5.37	5.35	5.31	5.24
			b	.	5.37	5.37	5.36	5.35	5.34	5.25
4	22	F	a	.	5.47	5.47	5.45	5.45	5.42	5.44
			b	.	5.49	5.47	5.45	5.45	5.44	5.44
		F reshaken	a	.	5.42	5.42	5.42	5.42	5.41	5.41
			b	.	5.42	5.41	5.41	5.41	5.40	5.40
5	18	F	a	5.57	5.55	5.53	5.52	5.52	5.52	5.50
			b	5.57	5.55	5.55	5.54	5.53	5.52	5.50
		F reshaken	a	5.55	5.53	5.52	5.52	5.52	5.52	5.50
			b	5.57	5.55	5.54	5.54	5.52	5.52	5.51
6	18	F	a	.	5.48	5.49	5.49	5.48	5.48	5.47
			b	.	5.51	5.51	5.51	5.49	5.48	5.42
		F reshaken	a	.	5.49	5.48	5.48	5.47	5.44	5.42
			b	.	5.47	5.44	5.44	5.42	5.42	5.41
7	18	F	a	.	5.42	5.46	5.49	5.49	5.49	5.44
			b	.	5.42	5.48	5.49	5.49	5.49	5.46
		F reshaken	a	.	5.40	5.39	5.39	5.39	5.39	5.36
			b	.	5.36	5.36	5.36	5.36	5.34	5.34

Table IV, 7

Soil sample: R I; sent in by Dr. Crowther, Rothamsted

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH _½	pH ₁	pH ₂	pH ₅	pH ₁₀	pH ₁₅
1	21	I	a	—	6.40	6.10	6.35	6.50	—	—
			b	—	6.00	6.90	7.10	7.00	—	—
			b	—	7.20	7.30	7.50	7.55	—	—
		I reshaken	a	—	—	—	—	6.30	—	—
			b	—	—	—	—	7.10	—	—
			b	—	—	—	—	7.40	—	—
2	20 to 22	I	a	6.00 6.45	6.95	7.24	7.34	7.36	7.32	7.28
			b	6.45 7.00	7.08	7.30	7.38	7.34	7.31	—
			b	—	—	—	—	—	—	—
		I reshaken	a	7.20 7.22	7.22	7.24	7.24	—	—	—
			b	7.27 7.27	7.27	7.26	7.26	—	—	—
			b	—	—	—	—	7.30	—	—
3	21	I	a	. 6.92	6.95	7.13	7.14	7.16	7.13	7.13
			b	. 6.92	6.97	7.13	7.13	7.13	7.13	7.11
			b	—	—	—	—	—	—	—
		I reshaken	a	. 6.90	6.98	7.04	7.14	7.11	7.11	7.11
			b	. 6.90	7.04	7.06	7.14	7.14	7.14	7.12
			b	—	—	—	—	—	—	—
4	21	I	a	. 7.35	7.37	7.37	7.37	7.32	7.30	7.30
			b	. 7.17	7.17	7.17	7.15	7.15	7.14	7.12
			b	—	—	—	—	—	—	—
		I reshaken	a	. 7.30	7.30	7.30	7.30	7.28	7.28	7.28
			b	. 7.10	7.10	7.08	7.08	7.08	7.08	7.08
			b	—	—	—	—	—	—	—
5	18	I	a	6.02 6.13 6.51	7.02	7.16	7.25	7.18	7.09	7.02
			b	6.07 .	6.78	7.21	7.30	7.26	7.18	7.11
			b	—	—	—	—	—	—	—
		I reshaken	a	7.30 .	7.28	7.28	7.28	7.28	7.26	7.26
			b	7.28 .	7.26	7.26	7.25	7.21	7.21	7.23
			b	—	—	—	—	—	—	—
6	18	I	a	. 7.31	7.31	7.30	7.24	7.13	7.04	6.95
			b	. 7.33	7.33	7.35	7.31	7.21	7.10	7.04
			b	—	—	—	—	—	—	—
		I reshaken	a	. 7.28	7.28	7.26	7.26	7.23	7.21	7.19
			b	. 7.30	7.28	7.28	7.28	7.26	7.24	7.23
			b	—	—	—	—	—	—	—
7	18	I	a	. 7.00	7.30	7.44	7.49	7.50	7.40	7.37
			b	. 6.88	7.24	7.45	7.45	7.44	7.35	7.35
			b	—	—	—	—	—	—	—
		I reshaken	a	. 7.30	7.28	7.28	7.28	7.24	7.21	7.21
			b	. 7.30	7.30	7.31	7.30	7.28	7.24	7.23
			b	—	—	—	—	—	—	—

Table IV, 8

Soil sample: R II; sent in by Dr. Crowther, Rothamsted

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	II	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	—	5.20	5.20	5.20	5.20	—	—
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	—	5.20	5.20	5.22	5.25	—	—
		II reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	—	—	—	—	5.00	—	—
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	—	—	—	—	5.20	—	—
2	20 to 22	II	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	5.22 5.06	5.22 5.06	5.21 5.07	5.20 5.08	5.20 5.08	5.20 5.08	5.20 —
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	5.12 4.99	5.12 4.98	5.12 4.98	5.12 4.98	5.14 4.97	5.15 —	— —
		II reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.95	4.98	5.00	5.06	5.05	5.05
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.95	4.98	5.00	5.05	5.06	5.09
3	21	II	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.95	4.98	5.00	5.06	5.05	5.05
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.95	4.98	5.00	5.05	5.06	5.09
		II reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.95	4.98	5.00	5.00	5.06	5.07
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.95	4.98	5.00	5.00	5.01	5.07
4	21.5	II	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	5.16	5.14	5.14	5.12	5.11	5.11
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	5.09	5.08	5.08	5.08	5.06	5.06
		II reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	5.09	5.09	5.08	5.08	5.08	5.08
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	4.99	4.99	4.99	4.99	4.97	4.97
5	18	II	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	5.14 5.12	.	5.14	5.14	5.14	5.12	5.10
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	5.16 5.14	.	5.14	5.14	5.14	5.12	5.10
		II reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	5.16 5.14	.	5.14	5.14	5.14	5.12	5.09
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	5.14 5.14	.	5.14	5.14	5.14	5.13	5.13
6	18	II	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	5.27	5.23	5.23	5.20	5.16	5.14
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	5.14	5.14	5.14	5.14	5.14	5.13
		II reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	5.10	5.10	5.08	5.08	5.06	5.06
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	5.11	5.10	5.10	5.10	5.08	5.08
7	18	II	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	5.11	5.15	5.18	5.18	5.17	5.17
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	5.04	5.06	5.17	5.17	5.17	5.18
		II reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	5.11	5.08	5.08	5.08	5.08	5.04
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	5.08	5.08	5.08	5.08	5.08	5.08

Table IV, 9

Soil sample: R III; sent in by Dr. Crowther, Rothamsted

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone							
				immediately (about 8—15 sec.)	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.	
				pH	pH	pH	pH	pH	pH	pH	
1	21	III	a	—	8.50	8.62	8.80	8.85	—	—	
		b	—	8.35	8.59	8.81	8.87	—	—		
2	20 to 22	III	a	7.65 8.20	8.51	8.68	8.77	8.86	8.89	8.92	
		b	7.80 8.08 8.32	8.57	8.70	8.75	8.81	8.84	—		
		reshaken	a	—	—	—	8.85	—	—		
		b	8.85	8.83	8.82	8.83	8.78	8.78	—	—	
3	19.5	III	a	. 7.90	7.93	8.23	8.46	8.64	8.64	8.64	
		b	. 7.90	7.99	8.23	8.49	8.64	8.65	8.65		
		reshaken	a	. 7.90	7.99	8.27	8.53	8.62	8.62	8.61	
		b	. 7.90	8.01	8.25	8.53	8.62	8.62	8.62		
4	21.5	III	a	. 8.04	8.04	8.42	8.52	8.57	8.59	8.61	
		b	. 8.37	8.44	8.57	8.65	8.75	8.85	8.85		
		reshaken	a	. 8.69	8.69	8.71	8.73	8.82	8.90	8.95	
		b	. 8.65	8.65	8.65	8.71	8.77	8.87	8.92		
5	18	III	a	7.77 .	8.19	8.39	8.53	8.52	8.52	8.53	
		b	7.65 .	8.19	8.39	8.53	8.59	8.59	8.62		
		reshaken	a	8.78 .	8.78	8.78	8.79	8.83	8.86	8.90	
		b	8.78 .	8.78	8.79	8.81	8.86	8.90	8.93		
6	18	III	a	. 8.39	8.44	8.44	8.39	8.26	8.23	8.23	
		b	. 8.65	8.68	8.72	8.73	8.77	8.80	8.85		
		reshaken	a	. 8.77	8.75	8.75	8.75	8.78	8.80	8.84	
		b	. 8.82	8.82	8.82	8.82	8.87	8.92	8.98		
7	18	III	a	. 8.09	8.51	8.69	8.82	8.86	8.93	8.93	
		b	. 8.16	8.47	8.66	8.77	8.86	8.91	8.91		
		reshaken	a	. 8.82	8.82	8.82	8.82	8.82	8.84	8.86	
		b	. 8.80	8.82	8.82	8.82	8.82	8.84	8.88		

Table IV, 10

Soil sample: R IV; sent in by Dr. Crowther, Rothamsted

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurement at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	IV	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	— —	6.95 6.80	7.05 7.00	7.10 7.05	6.96 6.94	— —	— —
		IV reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	— —	— —	— —	— —	6.90 7.00	— —	— —
2	20 to 22	IV	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	6.20 6.37 6.45 6.19 6.34 6.66	6.72 6.82	6.91 6.91	7.02 6.92	7.07 6.92	7.08 6.92	7.08 —
		IV reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	7.05 7.02 7.02 7.04	7.03 7.04	7.03 7.02	7.05 7.00	— —	— —	— —
3	19.5	IV	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 6.37 . 6.37	6.44 6.47	6.52 6.54	6.66 6.68	6.66 6.68	6.68 6.66	6.61 6.59
		IV reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 6.37 . 6.37	6.55 6.59	6.73 6.75	6.91 6.91	6.97 6.95	7.00 6.97	7.00 7.00
4	22	IV	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 6.65 . 6.60	6.68 6.63	6.75 6.68	6.82 6.72	6.85 6.80	6.87 6.85	6.87 6.85
		IV reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 6.97 . 6.87	6.97 6.85	6.97 6.85	6.97 6.85	6.97 6.87	6.97 6.87	6.97 6.87
5	18	IV	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	6.14 . 6.14 .	6.50 6.35	6.68 6.54	6.78 6.63	6.80 6.50	6.73 6.28	6.70 6.18
		IV reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	7.06 . 6.96 .	7.04 6.94	7.04 6.92	7.04 6.87	7.04 6.85	7.06 6.81	7.06 6.76
6	18	IV	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 6.90 . 7.02	6.90 7.02	6.90 7.02	6.88 7.00	6.84 6.97	6.81 6.93	6.79 6.90
		IV reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 7.04 . 7.12	7.04 7.12	7.04 7.12	7.05 7.10	7.05 7.12	7.05 7.12	7.04 7.12
7	18	IV	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 6.46 . 6.52	6.78 6.76	6.95 6.88	7.02 6.99	7.06 7.02	6.99 6.97	6.97 6.95
		IV reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 6.97 . 6.99	6.97 6.99	6.99 6.99	6.99 7.00	7.00 7.03	7.03 7.05	7.05 7.06

Table IV, 11

Soil sample: R V; sent in by Dr. Crowther, Rothamsted

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurement at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	V	a	—	5.35	5.35	5.25	5.05	—	—
			b	—	5.30	5.30	5.20	5.00	—	—
		V reshaken	a	—	—	—	—	4.92	—	—
			b	—	—	—	—	4.90	—	—
2	20 to 22	V	a	5.05 5.12 5.16	5.16	5.16	5.17	5.18	5.18	5.19
			b	5.10 5.20 5.20	5.22	5.24	5.23	5.23	5.22	—
		V reshaken	a	5.18 5.18	5.18	5.18	5.18	—	—	—
			b	5.21 5.22	5.25	5.24	5.23	—	—	—
3	19.5	V	a	.	5.51	5.43	5.34	5.27	5.21	5.14
			b	.	5.51	5.37	5.29	5.27	5.14	5.12
		V reshaken	a	.	5.51	5.34	5.20	5.20	5.18	5.13
			b	.	5.51	5.34	5.25	5.20	5.18	5.13
4	22	V	a	.	5.28	5.28	5.28	5.26	5.25	5.21
			b	.	5.28	5.28	5.21	5.21	5.21	5.21
		V reshaken	a	.	5.19	5.19	5.19	5.19	5.19	5.19
			b	.	5.14	5.14	5.14	5.14	5.14	5.14
5	18	V	a	5.26 .	5.26	5.24	5.24	5.23	5.19	5.17
			b	5.22 .	5.22	5.22	5.21	5.14	5.07	5.04
		V reshaken	a	5.29 .	5.29	5.29	5.29	5.29	5.27	5.26
			b	5.26 .	5.26	5.26	5.24	5.22	5.21	5.19
6	18	V	a	.	5.37	5.34	5.34	5.30	5.27	5.25
			b	.	5.32	5.32	5.32	5.30	5.29	5.27
		V reshaken	a	.	5.30	5.30	5.29	5.29	5.27	5.27
			b	.	5.34	5.34	5.34	5.32	5.32	5.30
7	18	V	a	.	5.18	5.22	5.29	5.30	5.32	5.30
			b	.	5.29	5.30	5.32	5.32	5.30	5.27
		V reshaken	a	.	5.17	5.20	5.20	5.22	5.18	5.17
			b	.	5.11	5.13	5.11	5.10	5.08	5.08

Table IV, 12

Soil sample: G. L. A. 1; sent in by Dr. Trénel, Berlin

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	1	a	—	5.35	5.30	5.25	5.11	—	—
			b	—	5.00	4.85	4.80	4.75	—	—
		1	a	—	—	—	—	5.10	—	—
		reshaken	b	—	—	—	—	4.75	—	—
2	20 to 22	1	a	4.30	4.48	4.47	4.47	4.47	4.50	4.51
			b	4.40	4.40	4.41	4.41	4.41	4.43	—
		1	a	4.50	4.49	4.48	4.48	4.48	—	—
		reshaken	b	4.40	4.40	4.41	4.41	4.41	—	—
3	19.5	1	a	.	4.70	4.68	4.65	4.65	4.49	4.51
			b	.	4.68	4.65	4.65	4.65	4.51	4.51
		1	a	.	4.70	4.55	4.53	4.42	4.37	4.44
		reshaken	b	.	4.65	4.53	4.51	4.46	4.37	4.44
4	21	1	a	.	4.57	4.45	4.47	4.48	4.47	4.47
			b	.	4.57	4.55	4.53	4.53	4.53	4.53
		1	a	.	4.45	4.43	4.43	4.43	4.43	4.43
		reshaken	b	.	4.45	4.45	4.45	4.45	4.45	4.45
5	18	1	a	4.41	.	4.43	4.44	4.46	4.46	4.44
			b	4.39	.	4.41	4.43	4.41	4.37	4.37
		1	a	4.48	.	4.48	4.48	4.48	4.53	4.53
		reshaken	b	4.44	.	4.43	4.43	4.44	4.45	4.44
6	18	1	a	.	4.49	4.51	4.49	4.49	4.49	4.47
			b	.	4.52	4.52	4.52	4.52	4.52	4.51
		1	a	.	4.46	4.46	4.46	4.46	4.46	4.44
		reshaken	b	.	4.49	4.49	4.49	4.49	4.49	4.49
7	18	1	a	.	4.52	4.52	4.52	4.52	4.52	4.51
			b	.	4.52	4.52	4.51	4.51	4.51	4.51
		1	a	.	4.36	4.36	4.36	4.36	4.36	4.36
		reshaken	b	.	4.36	4.36	4.36	4.36	4.36	4.36

Table IV, 13

Soil sample: G. L. A. 2; sent in by Dr. Trénel, Berlin

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	2	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	—	4.60	4.51	4.45	4.25	—	—
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	—	3.95	3.90	3.90	3.90	—	—
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	—	—	—	—	4.20	—	—
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	—	—	—	—	3.85	—	—
2	20 to 22	2	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	3.90 4.00 3.98	3.97	3.97	3.97	3.95	3.93	—
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	3.97 3.98	3.98	3.99	3.99	3.92	3.89	—
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	3.90 3.90	3.89	3.88	3.88	—	—	—
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	3.85 3.85	3.85	3.85	3.85	—	—	—
3	19.5	2	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.87	3.85	3.80	3.78	3.61	3.61
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.87	3.85	3.82	3.80	3.59	3.61
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.87	3.87	3.85	3.81	3.80	3.75
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.87	3.87	3.86	3.82	3.80	3.78
4	22	2	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.93	3.93	3.93	3.93	3.91	3.89
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.89	3.89	3.89	3.89	3.87	3.87
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.81	3.81	3.79	3.79	3.79	3.79
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.86	3.86	3.86	3.86	3.84	3.84
5	18	2	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	3.94 .	3.92	3.92	3.92	3.91	3.89	3.87
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	3.96 .	3.94	3.94	3.94	3.92	3.91	3.89
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	3.85 .	3.86	3.86	3.86	3.86	3.87	3.87
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	3.87 .	3.87	3.87	3.88	3.90	3.88	3.88
6	18	2	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.99	3.97	3.97	3.95	3.95	3.85
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.94	3.94	3.94	3.94	3.90	3.83
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.90	3.90	3.90	3.88	3.87	3.85
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.88	3.87	3.87	3.87	3.87	3.87
7	18	2	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.97	3.95	3.94	3.94	3.94	3.94
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.97	3.97	3.97	3.95	3.94	3.94
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.85	3.85	3.85	3.85	3.85	3.85
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	.	3.85	3.85	3.85	3.85	3.85	3.85

Table IV, 14

Soil sample: G. L. A. 3; sent in by Dr. Trénel, Berlin

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	1/2 min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	3	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	—	4.40	4.41	4.42	4.40	—	—
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	—	4.41	4.40	4.40	4.35	—	—
		3 reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	—	—	—	—	4.39	—	—
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	—	—	—	—	4.34	—	—
2	20 to 22	3	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	4.17 4.10	4.17 4.12	4.17 4.11	4.16 4.11	4.15 4.11	4.15 4.10	4.12 4.06
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	—	—	—	—	—	—	—
		3 reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	4.03	4.00	4.00	4.02	4.04	—	—
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	—	—	—	—	—	—	—
3	19.5	3	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. .	4.03 4.03	4.03 4.02	4.00 4.00	4.02 4.00	3.96 3.98	3.91 3.96
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. .	3.98 3.99	3.93 3.96	3.93 3.93	3.91 3.91	3.92 3.91	3.91 3.89
		3 reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. .	3.98 3.99	3.93 3.96	3.93 3.93	3.91 3.91	3.92 3.91	3.91 3.89
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. .	3.98 3.99	3.93 3.96	3.93 3.93	3.91 3.91	3.92 3.91	3.91 3.89
4	22.5	3	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. .	4.03 4.05	4.03 4.05	4.03 4.03	4.01 4.01	3.99 3.99	3.94 3.96
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. .	3.96 3.94	3.96 3.94	3.94 3.93	3.94 3.91	3.91 3.89	3.89 3.89
		3 reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. .	3.96 3.94	3.96 3.94	3.94 3.93	3.94 3.91	3.91 3.89	3.89 3.89
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. .	3.96 3.94	3.96 3.94	3.94 3.93	3.94 3.91	3.91 3.89	3.89 3.89
5	18	3	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	4.28 4.30	. .	4.20 4.29	4.20 4.27	4.20 4.25	4.20 4.18	4.18 4.15
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	4.15 3.96	. .	4.13 3.94	4.13 3.94	4.13 3.94	4.11 3.94	4.11 3.92
		3 reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	4.15 3.96	. .	4.13 3.94	4.13 3.94	4.13 3.94	4.11 3.94	4.11 3.92
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	4.15 3.96	. .	4.13 3.94	4.13 3.94	4.13 3.94	4.11 3.94	4.11 3.92
6	18	3	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. .	4.14 4.23	4.14 4.21	4.16 4.20	4.16 4.18	4.16 4.18	4.11 4.14
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. .	4.07 4.09	4.07 4.07	4.06 4.07	4.06 4.06	4.06 4.06	4.04 4.06
		3 reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. .	4.07 4.09	4.07 4.07	4.06 4.07	4.06 4.06	4.06 4.06	4.04 4.06
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. .	4.07 4.09	4.07 4.07	4.06 4.07	4.06 4.06	4.06 4.06	4.04 4.06
7	18	3	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. .	4.14 4.16	4.13 4.14	4.13 4.13	4.13 4.13	4.11 4.13	4.11 4.13
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. .	4.08 4.02	4.06 4.04	4.06 4.04	4.06 4.04	4.06 4.02	4.04 4.02
		3 reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. .	4.08 4.02	4.06 4.04	4.06 4.04	4.06 4.04	4.06 4.02	4.04 4.02
			$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. .	4.08 4.02	4.06 4.04	4.06 4.04	4.06 4.04	4.06 4.02	4.04 4.02

Table IV, 15

Soil sample: Sigmond A; sent in by Prof. Dr. v. Sigmond, Budapest

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	A	a	—	3.60	3.70	3.75	3.75	—	—
			b	—	3.75	3.75	3.75	3.75	—	—
		A reshaken	a	—	—	—	—	3.78	—	—
			b	—	—	—	—	3.78	—	—
2	20 to 22	A	a	3.93 3.93	3.93	3.92	3.91	3.90	3.88	3.88
			b	3.96 3.97 3.97	3.98	3.98	3.97	3.93	3.92	3.91
		A reshaken	a	3.88	3.88	3.88	3.87	—	—	—
			b	3.94	3.94	3.95	3.94	—	—	—
3	20	A	a	.	3.97	3.95	3.93	3.92	3.92	3.88
			b	.	3.94	3.94	3.92	3.92	3.89	3.88
		A reshaken	a	.	3.89	3.89	3.89	3.89	3.91	3.89
			b	.	3.90	3.90	3.91	3.91	3.84	3.84
4	23	A	a	.	3.94	3.87	3.85	3.84	3.84	3.83
			b	.	4.01	3.94	3.91	3.90	3.88	3.88
		A reshaken	a	.	3.87	3.85	3.85	3.85	3.85	3.85
			b	.	3.91	3.91	3.89	3.89	3.89	3.89
5	18	A	a	3.96	.	3.96	3.96	3.96	3.94	3.94
			b	4.04	.	4.04	4.04	4.04	4.03	4.01
		A reshaken	a	3.99	.	3.97	3.97	3.97	3.96	3.94
			b	3.99	.	3.99	3.99	3.99	3.99	3.96
6	18	A	a	.	4.04	3.97	3.95	3.94	3.92	3.90
			b	.	4.00	3.99	3.99	3.97	3.94	3.92
		A reshaken	a	.	3.95	3.95	3.94	3.94	3.92	3.92
			b	.	3.97	3.95	3.95	3.95	3.94	3.94
7	18	A	a	.	4.04	4.06	4.07	4.06	4.04	4.04
			b	.	4.04	4.06	4.07	4.06	4.04	4.02
		A reshaken	a	.	4.02	4.04	4.04	4.04	4.02	4.00
			b	.	4.02	4.02	4.02	4.02	4.00	4.00

Table IV, 16

Soil sample: Sigmond B; sent in by Prof. Dr. v. Sigmond, Budapest

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone							
				immediately (about 8—15 sec.)	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.	
				pH	pH	pH	pH	pH	pH	pH	
1	21	B	{ a b	—	5.50	5.60	5.62	5.65	—	—	
				—	5.55	5.58	5.59	5.58	—	—	
		reshaken	{ a b	—	—	—	—	5.65	—	—	
				—	—	—	—	5.51	—	—	
2	20 to 22	B	{ a b	6.00 6.00 6.04	6.14	6.17	6.19	6.25	6.28	6.31	
				6.17 6.17	6.17	6.17	6.17	6.19	6.22	6.24	
		reshaken	{ a b	5.80 5.95 5.99	6.00	6.03	6.03	—	—	—	
				6.37 6.37	6.37	6.37	6.37	—	—	—	
3	20	B	{ a b	. 6.09	6.09	6.07	6.06	6.04	6.12	6.14	
				. 6.09	6.08	6.06	6.04	6.04	6.14	6.14	
		reshaken	{ a b	. 6.09	6.09	6.00	5.91	6.00	6.12	6.12	
				. 6.09	6.09	6.00	5.91	5.98	6.09	6.12	
4	24	B	{ a b	. 5.87	5.87	5.87	5.90	5.93	6.04	6.09	
				. 5.93	5.97	5.99	5.99	6.04	6.10	6.15	
		reshaken	{ a b	. 6.15	6.13	6.13	6.15	6.13	6.13	6.13	
				. 6.21	6.21	6.21	6.19	6.19	6.21	6.21	
5	18	B	{ a b	5.85 .	5.85	5.85	5.85	5.85	5.85	5.85	
				5.92 .	5.90	5.88	5.88	5.88	5.88	5.88	
		reshaken	{ a b	6.05 .	6.03	6.03	6.03	6.03	6.01	6.01	
				6.09 .	6.09	6.09	6.09	6.09	6.07	6.05	
6	18	B	{ a b	. 5.94	5.91	5.89	5.89	5.88	5.89	5.91	
				. 5.93	5.93	5.91	5.93	5.94	5.94	5.96	
		reshaken	{ a b	. 6.07	6.05	6.03	6.01	6.01	6.01	6.01	
				. 6.15	6.13	6.13	6.12	6.10	6.12	6.12	
7	18	B	{ a b	. 5.89	5.89	5.93	5.91	5.91	5.91	5.91	
				. 5.89	5.93	5.93	5.91	5.91	5.89	5.89	
		reshaken	{ a b	. 6.01	6.03	6.01	6.01	6.01	6.01	6.01	
				. 6.01	6.01	6.01	5.99	5.96	5.94	5.94	

Table IV, 17

Soil sample: Sigmond G; sent in by Prof. Dr. v. Sigmond, Budapest

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	C	a	—	4.95	4.95	4.97	5.02	—	—
		C	b	—	4.95	4.97	4.98	—	—	—
		reshaken	a	—	—	—	—	5.00	—	—
		C	b	—	—	—	—	—	—	—
2	20 to 22	C	a	5.35	5.32	5.34	5.34	5.36	5.38	5.42
		C	b	5.32	5.33	5.33	5.35	5.35	5.36	5.38
		reshaken	a	5.52	5.52	5.50	5.50	5.51	—	—
		C	b	5.53	5.53	5.53	5.52	5.52	—	—
3	19	C	a	.	5.42	5.43	5.42	5.42	5.42	5.48
		C	b	.	5.44	5.44	5.44	5.44	5.42	5.45
		reshaken	a	.	5.46	5.43	5.46	5.48	5.49	5.49
		C	b	.	5.47	5.45	5.48	5.48	5.50	5.50
4	24.5	C	a	.	5.80	5.78	5.80	5.78	5.80	5.81
		C	b	.	5.83	5.80	5.83	5.84	5.85	5.87
		reshaken	a	.	5.86	5.87	5.87	5.87	5.87	5.89
		C	b	.	5.90	5.90	5.90	5.90	5.90	5.92
5	18	C	a	5.31	.	5.31	5.31	5.31	5.29	5.26
		C	b	5.24	.	5.26	5.26	5.26	5.26	5.24
		reshaken	a	5.45	.	5.45	5.44	5.43	5.41	5.41
		C	b	5.47	.	5.45	5.45	5.43	5.41	5.41
6	18	C	a	.	5.39	5.37	5.36	5.34	5.30	5.27
		C	b	.	5.47	5.44	5.42	5.41	5.41	5.36
		reshaken	a	.	5.49	5.49	5.49	5.48	5.48	5.47
		C	b	.	5.58	5.58	5.56	5.56	5.56	5.56
7	18	C	a	.	5.39	5.41	5.42	5.41	5.42	5.42
		C	b	.	5.39	5.39	5.41	5.41	5.41	5.43
		reshaken	a	.	5.58	5.58	5.58	—	5.58	5.58
		C	b	.	5.56	5.58	5.58	5.58	5.60	5.60

Table IV, 19

Soil sample: Sigmond E; sent in by Prof. Dr. v. Sigmond, Budapest

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	E	a	—	9.41	9.45	9.45	9.45	—	—
			b	—	9.52	9.55	9.50	9.55	—	—
		E reshaken	a	—	—	—	—	9.42	—	—
			b	—	—	—	—	9.55	—	—
2	20 to 22	E	a	9.57	9.54	9.53	9.53	9.53	9.54	9.56
			b	9.47	9.47	9.47	9.47	9.51	9.55	9.57
		E reshaken	a	9.55	9.54	9.53	9.53	9.53	—	—
			b	9.46	9.46	9.45	9.44	9.44	—	—
3	20	E	a	.	9.22	9.32	9.32	9.32	9.34	9.39
			b	.	9.25	9.29	9.29	9.29	9.34	9.38
		E reshaken	a	.	9.25	9.22	9.22	9.18	9.13	9.06
			b	.	9.22	9.22	9.22	9.17	9.13	9.06
4	24	E	a	.	9.36	9.09	9.07	9.07	9.07	9.05
			b	.	9.07	9.09	9.09	9.09	9.09	9.07
		E reshaken	a	.	8.99	8.97	8.97	8.97	8.97	8.95
			b	.	8.92	8.92	8.92	8.92	8.93	8.92
5	18	E	a	9.66	9.68	9.73	9.75	9.82	9.94	9.99
			b	9.59	9.57	9.61	9.63	9.70	9.76	9.82
		E reshaken	a	9.59	9.59	9.61	9.61	9.66	9.70	9.75
			b	9.56	9.57	9.56	9.56	9.57	9.59	9.64
6	18	E	a	.	9.61	9.71	9.73	9.74	9.81	9.86
			b	.	9.53	9.55	9.57	9.60	9.65	9.73
		E reshaken	a	.	9.71	9.73	9.73	9.74	9.80	9.86
			b	.	9.55	9.55	9.55	9.57	9.60	9.62
7	18	E	a	.	9.42	9.45	9.48	9.49	9.55	9.58
			b	.	9.42	9.46	9.49	9.53	9.62	9.63
		E reshaken	a	.	9.48	9.48	9.48	9.48	9.49	9.49
			b	.	9.46	9.46	9.46	9.46	9.49	9.53

Table IV, 20

Soil sample: Lyngby A; sent in by Dr. Tovborg Jensen, Lyngby

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	A	a	—	4.15	4.15	4.14	4.12	—	—
			b	—	4.13	4.12	4.10	4.09	—	—
		A reshaken	a	—	—	—	—	4.12	—	—
			b	—	—	—	—	4.08	—	—
2	20 to 22	A	a	4.65 4.72 4.73	4.76	4.78	4.79	4.79	4.79	—
			b	4.65 4.73 4.73	4.73	4.74	4.74	4.74	4.74	—
		A reshaken	a	4.74	4.74	4.74	4.72	—	—	—
			b	4.64	4.64	4.64	4.64	—	—	—
3	19.5	A	a	.	4.72	4.72	4.72	4.70	4.69	4.69
			b	.	4.72	4.72	4.72	4.70	4.69	4.72
		A reshaken	a	.	4.72	4.72	4.72	4.72	4.72	4.72
			b	.	4.72	4.72	4.72	4.72	4.72	4.72
4	19	A	a	.	4.86	4.84	4.84	4.82	4.78	4.76
			b	.	4.82	4.82	4.78	4.73	4.73	4.73
		A reshaken	a	.	4.62	4.64	4.64	4.64	4.64	4.64
			b	.	4.59	4.57	4.57	4.57	4.55	4.55
5	18	A	a	4.89	4.91	4.88	4.85	4.83	4.79	4.79
			b	4.95	4.91	4.89	4.89	4.88	4.86	4.86
		A reshaken	a	4.77	4.77	4.74	4.74	4.74	4.74	4.72
			b	4.83	4.83	4.83	4.83	4.83	4.83	4.83
6	18	A	a	.	4.78	4.77	4.77	4.75	4.73	4.73
			b	.	4.75	4.75	4.73	4.73	4.73	4.71
		A reshaken	a	.	4.71	4.71	4.71	4.71	4.70	4.70
			b	.	4.71	4.71	4.71	4.71	4.71	4.71
7	18	A	a	.	4.75	4.77	4.77	4.75	4.75	4.75
			b	.	4.79	4.79	4.79	4.80	4.79	4.75
		A reshaken	a	.	4.52	4.52	4.54	4.54	4.54	4.54
			b	.	4.52	4.54	4.54	4.54	4.54	4.54

Table IV, 22

Soil sample: Lyngby C; sent in by Dr. Tovborg Jensen, Lyngby

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	C	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	— —	7.24 7.55	7.28 7.55	7.35 7.55	7.42 7.55	— —	— —
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	— —	— —	— —	— —	7.40 7.50	— —	— —
2	20 to 22	C	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	7.25 7.63 7.63 7.3 7.55 7.56	7.63 7.59	7.65 7.64	7.68 7.68	7.73 7.70	7.75 7.71	7.75 —
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	7.75 7.75 7.67 7.67	7.75 7.67	7.74 7.67	7.71 7.67	— —	— —	— —
3	19.5	C	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 7.57 . 7.54	7.54 7.49	7.40 7.40	7.40 7.40	7.40 7.44	7.42 7.46	7.42 7.46
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 7.56 . 7.54	7.50 7.49	7.40 7.40	7.40 7.41	7.43 7.44	7.43 7.40	7.42 7.40
4	20	C	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 7.49 . 7.41	7.49 7.37	7.53 7.39	7.56 7.41	7.60 7.49	7.62 7.51	7.62 7.53
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 7.62 . 7.47	7.62 7.47	7.60 7.45	7.60 7.47	7.62 7.47	7.60 7.45	7.62 7.47
5	18	C	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	7.43 . 7.45 .	7.62 7.58	7.64 7.62	7.70 7.67	7.72 7.72	7.72 7.72	7.74 7.72
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	7.75 . 7.64 .	7.75 7.64	7.75 7.65	7.74 7.67	7.74 7.67	7.72 7.67	7.72 7.67
6	18	C	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 7.64 . 7.57	7.68 7.63	7.68 7.64	7.69 7.67	7.71 7.68	7.75 7.69	7.75 7.69
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 7.77 . 7.69	7.77 7.69	7.75 7.68	7.75 7.68	7.75 7.68	7.77 7.68	7.77 7.69
7	18	C	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 7.50 . 7.52	7.52 7.54	7.56 7.54	7.57 7.56	7.62 7.62	7.66 7.64	7.66 7.62
		reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 7.56 . 7.48	7.56 7.48	7.56 7.48	7.56 7.47	7.56 7.45	7.56 7.45	7.56 7.45

Table IV, 23

Soil sample: Lyngby D; sent in by Dr. Tovborg Jensen, Lyngby

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	1/2 min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	D	a	—	7.25	7.29	7.30	7.32	—	—
		D	b	—	7.40	7.45	7.40	7.45	—	—
		reshaken	a	—	—	—	—	7.25	—	—
		reshaken	b	—	—	—	—	7.35	—	—
2	20 to 22	D	a	7.00 7.25 7.39	7.43	7.43	7.43	7.44	7.39	7.39
		D	b	7.00 7.37 7.39	7.39	7.39	7.39	7.40	7.37	—
		reshaken	a	7.33	7.33	7.33	7.32	7.32	—	—
		reshaken	b	7.29	7.29	7.29	7.29	7.29	—	—
3	19.5	D	a	. 7.30	7.30	7.25	7.24	7.23	7.21	7.21
		D	b	. 7.33	7.33	7.25	7.24	7.23	7.21	7.21
		reshaken	a	. 7.30	7.25	7.23	7.15	7.09	7.08	7.06
		reshaken	b	. 7.30	7.23	7.21	7.16	7.11	7.08	7.08
4	20.5	D	a	. 7.25	7.25	7.25	7.25	7.23	7.25	7.25
		D	b	. 7.31	7.31	7.27	7.25	7.25	7.25	7.25
		reshaken	a	. 7.23	7.25	7.25	7.25	7.25	7.25	7.25
		reshaken	b	. 7.25	7.25	7.23	7.23	7.23	7.21	7.21
5	18	D	a	7.32	7.43	7.41	7.43	7.43	7.43	7.43
		D	b	7.26	7.43	7.44	7.46	7.44	7.43	7.43
		reshaken	a	7.44	7.44	7.44	7.44	7.43	7.43	7.41
		reshaken	b	7.44	7.44	7.44	7.44	7.43	7.41	7.39
6	18	D	a	. 7.41	7.41	7.43	7.43	7.43	7.43	7.43
		D	b	. 7.38	7.38	7.38	7.38	7.38	7.38	7.38
		reshaken	a	. 7.37	7.37	7.37	7.37	7.37	7.35	7.35
		reshaken	b	. 7.33	7.33	7.33	7.33	7.33	7.33	7.31
7	18	D	a	. —	7.37	7.39	7.39	7.37	7.33	7.31
		D	b	. 7.31	7.31	7.33	7.33	7.31	7.30	7.23
		reshaken	a	. 7.12	7.12	7.12	7.12	7.09	7.09	7.09
		reshaken	b	. 7.16	7.14	7.12	7.10	7.10	7.09	7.09

Table IV, 25

Soil sample: Scherf A; sent in by Dr. Scherf, Budapest

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	A	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	— —	7.20 7.40	7.42 7.70	7.65 7.75	7.82 7.85	— —	— —
		A reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	— —	— —	— —	— —	7.76 7.82	— —	— —
2	20 to 22	A	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	7.00 7.51 7.55 7.20 7.63 7.80	7.78 8.01	7.92 8.16	7.97 8.26	7.95 8.27	7.90 8.18	— 8.12
		A reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	7.83 7.86 <8.00 8.00	7.88 8.03	7.87 8.05	7.87 8.06	— —	— —	— —
3	19.0	A	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 7.62 . 7.62	7.62 7.62	7.67 7.71	7.78 7.79	7.87 7.88	7.87 7.88	7.85 7.86
		A reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 7.58 . 7.60	7.60 7.60	7.70 7.70	7.78 7.78	7.73 7.78	7.73 7.73	7.66 7.66
4	20	A	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 7.63 . 7.63	7.78 7.82	7.84 7.90	7.92 7.88	7.90 7.88	7.90 7.88	7.90 7.88
		A reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 7.85 . 7.88	7.85 7.88	7.85 7.88	7.85 7.88	7.85 7.85	7.85 7.85	7.85 7.85
5	18	A	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	7.46 7.44	7.84 7.89	7.98 8.01	8.17 8.17	8.33 8.29	8.33 8.33	8.31 8.33
		A reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	8.07 8.01	8.15 8.17	8.19 8.17	8.19 8.19	8.19 8.19	8.19 8.19	8.19 8.19
6	18	A	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 8.04 . 8.14	8.18 8.25	8.21 8.28	8.25 8.32	8.30 8.37	8.11 8.35	8.13 8.28
		A reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 8.11 . 8.18	8.13 8.18	8.13 8.18	8.13 8.20	8.13 8.20	8.13 8.18	8.13 8.18
7	18	A	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 7.59 . 7.40	7.92 7.54	8.02 7.81	8.07 7.95	8.16 8.02	8.16 8.06	8.16 8.02
		A reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right.$	. 7.85 . 7.76	7.88 7.78	7.87 7.78	7.87 7.78	7.88 7.78	7.90 7.78	7.90 7.74

Table IV, 26

Soil sample: Scherf B; sent in by Dr. Scherf, Budapest

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	B	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	— —	8.60 8.55	8.76 8.80	8.91 8.92	8.95 8.90	— —	— —
		B reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	— —	— —	— —	— —	8.90 8.92	— —	— —
2	20 to 22	B	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	8.08 8.30 8.43 8.20 8.32 8.42	8.65 8.67	8.79 8.79	8.82 8.82	8.83 8.82	8.85 8.82	8.84 —
		B reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	8.81 8.75 8.75	8.82 8.75	8.79 8.74	8.77 8.74	8.72 8.74	— —	— —
3	19.0	B	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. 8.31 . 8.31	8.35 8.38	8.53 8.49	8.63 8.65	8.63 8.65	8.63 8.70	8.65 8.70
		B reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. 8.28 . 8.31	8.38 8.38	8.53 8.51	8.63 8.63	8.63 8.64	8.59 8.58	8.42 8.41
4	21	B	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. 8.65 . 8.58	8.72 8.63	8.77 8.66	8.79 8.72	8.80 8.75	8.82 8.79	8.87 8.80
		B reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. 8.68 . 8.65	8.68 8.62	8.66 8.60	8.66 8.60	8.68 8.60	8.68 8.62	8.68 8.63
5	18	B	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	8.26 . 8.26 .	8.62 8.60	8.83 8.88	8.86 8.90	8.81 8.88	8.85 8.90	8.85 8.91
		B reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	8.93 . 8.88 .	8.90 8.86	8.88 8.85	8.85 8.85	8.85 8.85	8.86 8.85	8.88 8.85
6	18	B	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. 8.87 . 8.92	8.92 8.91	8.92 8.92	8.92 8.94	8.96 8.94	8.94 8.96	8.96 8.98
		B reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. 8.94 . 8.92	8.92 8.92	8.92 8.89	8.92 8.87	8.92 8.87	8.92 8.91	8.92 8.92
7	18	B	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. 8.54 . 8.58	8.82 8.75	8.89 8.85	8.90 8.87	8.92 8.87	8.96 8.87	8.96 8.83
		B reshaken	$\left\{ \begin{array}{l} a \\ b \end{array} \right\}$	. 8.76 . 8.83	8.76 8.83	8.78 8.82	8.78 8.82	8.78 8.82	8.80 8.82	8.80 8.82

Table IV, 27

Soil sample: Scherf C; sent in by Dr. Scherf, Budapest

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone						
				immediately (about 8—15 sec.)	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.
				pH	pH	pH	pH	pH	pH	pH
1	21	C	a	—	8.02	8.15	8.28	8.35	—	—
			b	—	7.95	8.14	8.28	8.30	—	—
		C	a	—	—	—	—	8.30	—	—
		reshaken	b	—	—	—	—	8.20	—	—
2	20 to 22	C	a	7.55 7.75 7.78	7.98	8.14	8.18	8.20	8.23	8.23
			b	7.65 7.80 7.92	8.11	8.18	8.20	8.23	8.26	—
		C	a	8.24	8.24	8.24	8.25	8.26	8.28	8.30
		reshaken	b	8.25	8.25	8.25	8.25	—	—	—
3	19	C	a	.	7.75	7.86	7.92	8.01	8.03	8.10
			b	.	7.75	7.87	7.87	7.99	7.99	8.07
		C	a	.	7.73	7.87	7.94	8.01	8.03	8.02
		reshaken	b	.	7.73	7.85	7.94	7.99	8.03	8.02
4	21	C	a	.	7.89	8.05	8.15	8.17	8.21	8.27
			b	.	7.83	8.02	8.07	8.12	8.15	8.23
		C	a	.	8.21	8.24	8.24	8.24	8.26	8.29
		reshaken	b	.	8.19	8.17	8.17	8.19	8.21	8.24
5	18	C	a	7.67	8.01	8.14	8.21	8.27	8.27	8.29
			b	7.67	8.09	8.17	8.19	8.20	8.22	8.24
		C	a	8.27	8.27	8.24	8.24	8.24	8.26	8.27
		reshaken	b	8.26	8.27	8.29	8.29	8.29	8.33	8.34
6	18	C	a	.	8.14	8.16	8.14	8.14	8.13	8.13
			b	.	8.23	8.25	8.25	8.25	8.25	8.28
		C	a	.	8.33	8.33	8.33	8.33	8.33	8.37
		reshaken	b	.	8.35	8.35	8.35	8.35	8.35	8.39
7	18	C	a	.	8.00	8.16	8.25	8.27	8.28	8.28
			b	.	7.92	8.09	8.20	8.21	8.23	8.23
		C	a	.	8.32	8.32	8.32	8.34	8.35	8.35
		reshaken	b	.	8.32	8.30	8.30	8.30	8.32	8.32

Table IV, 29

Soil sample: Scherf E; sent in by Dr. Scherf, Budapest

Number Institute	Temperature	Soil marked	Electrode or duplicate	Measurements at different times after addition of Quinhydrone							
				immediately (about 8—15 sec.)	½ min.	1 min.	2 min.	5 min.	10 min.	15 min.	
				pH	pH	pH	pH	pH	pH	pH	
1	21	E	a	—	4.47	4.45	4.44	4.35	—	—	
			b	—	4.46	4.45	4.44	4.35	—	—	
		reshaken	a	—	—	—	4.35	—	—		
			b	—	—	—	4.33	—	—		
2	20 to 22	E	a	4.25 4.29 4.31	4.32	4.33	4.34	4.34	4.34	—	
			b	4.34 4.34 4.34	4.36	4.36	4.33	4.31	4.26	—	
		reshaken	a	4.32 4.32	4.32	4.31	4.31	—	—	—	
			b	4.27 4.27	4.27	4.27	4.27	—	—	—	
3	21	E	a	. 4.31	4.38	4.34	4.34	4.34	4.34	4.34	
			b	. 4.27	4.31	4.25	4.22	4.20	4.17	4.15	
		reshaken	a	. 4.27	4.27	4.27	4.27	4.29	4.27	4.29	
			b	. 4.27	4.27	4.28	4.28	4.31	4.31	4.31	
4	21.5	E	a	. 4.39	4.39	4.37	4.36	4.34	4.33	4.33	
			b	. 4.36	4.36	4.33	4.31	4.31	4.29	4.29	
		reshaken	a	. 4.36	4.34	4.34	4.34	4.34	4.33	4.34	
			b	. 4.27	4.27	4.27	4.27	4.27	4.26	4.26	
5	18	E	a	4.46 .	4.53	4.53	4.49	4.46	4.43	4.41	
			b	4.49 .	4.53	4.53	4.49	4.43	4.39	4.37	
		reshaken	a	4.48 .	4.48	4.48	4.46	4.43	4.41	4.41	
			b	4.49 .	4.49	4.49	4.48	4.46	4.44	4.44	
6	18	E	a	. 4.68	4.59	4.58	4.57	4.46	4.40	4.39	
			b	. 4.59	4.58	4.58	4.54	4.51	4.46	4.42	
		reshaken	a	. 4.57	4.54	4.52	4.51	4.47	4.46	4.44	
			b	. 4.54	4.51	4.51	4.51	4.47	4.46	4.46	
7	18	E	a	. 4.40	4.40	4.40	4.38	4.35	4.26	4.23	
			b	. 4.44	4.44	4.42	4.38	4.35	4.26	4.23	
		reshaken	a	. 4.23	4.20	4.20	4.20	4.18	4.16	4.13	
			b	. 4.23	4.23	4.22	4.20	4.18	4.16	4.13	

Table Va

Soil sample marked	Hydrogen-Electrode				
	Institute 2	Inst. 4	Inst. 5	Institute 6	Inst. 7
	temp. 20—22°	temp. 25°	temp. 18°	temp. 18°	temp. 18°
Gron. A	5.85	5.79	5.92; 5.88	5.65; 5.68; 5.49; 5.68	5.72
" B	7.25	7.88	7.30; 7.34	7.10; 7.06	7.30
" C	7.25; 7.25; 7.30; 7.25	6.85	7.11; 7.09	6.78; 6.74; 6.88	7.08
" D	4.89	4.83	4.88; 4.91	4.80; 4.76; 4.80	4.87
" E	3.94	3.93	3.94; 3.92	3.92; 3.92; 3.95; 3.95	3.98
" F	5.45	5.47	5.50; 5.55	5.49; 5.53; 5.49	5.41
Rothamsted, R I	5.97; 6.00	7.36	5.98; 5.98	5.91; 5.84; 5.89; 5.84	5.96
" R II	4.95	5.12	5.12; 4.96	4.89; 4.86; 4.82; 4.92	4.96
" R III	7.92; 8.00	8.87	7.60; 7.70	7.90; 7.90; 7.83	7.90
" R IV	6.06; 6.00	6.85	6.00; 6.02	6.00; 5.73; 5.73	6.31
" R V	5.30	5.30	5.10; 5.12	5.29; 5.29	5.15
Berlin, G.L.A. I	4.45	4.54	4.34; 4.34	4.46; 4.48	4.53
" G.L.A. II	3.95	3.90	3.83; 3.77	3.76; 3.85; 3.84	3.93
" G.L.A. III	4.05	3.95	4.20; 4.20	4.04; 4.00	4.08
Sigmond A	3.79	3.82	3.91; 3.85	3.85; 3.87; 3.91; 3.85	4.01
" B	6.07	6.12	5.80; 5.85	5.84; 5.77; 5.84; 5.80	6.00
" C	4.97; 4.90	5.85	5.31; 5.26	5.25; 5.22	5.62
" D	8.20	8.05	8.10; 8.05	8.16; 8.21; 8.20; 8.26	8.18
" E	—	9.72	10.24; 10.23	9.90; 10.06; 10.12; 10.04; 10.12	10.04
Lyngby A	4.72	4.73	4.82; 4.90	4.65; 4.65	4.71
" B	6.10	6.11	6.22; 6.22	5.96; 5.88	6.03
" C	7.47	7.50	7.51; 7.50	7.47; 7.25	7.79
" D	7.28	7.23	7.20; 7.20	7.13	7.37
" E	4.70	4.80	4.79; 4.81	4.70	4.84
Scherf A	7.65; 7.60; 7.65	7.82	7.64; 7.67	7.23; 7.31; 7.31; 7.38; 7.41	7.71
" B	8.28; 7.95; 8.30	8.75	8.38; 8.38	8.33; 8.26; 8.38; 8.30	8.35
" C	7.47; 7.57	8.22	7.82; 7.84	7.61; 7.77; 7.63; 7.75	7.94
" D	5.90; 5.90	6.70	5.98; 5.97	5.84; 5.67	5.96
" A	4.25	4.34	4.44; 4.44	4.46; 4.46	4.19

Table Vb

Soil sample marked	Antimony Electrode		
	Institute 5		Inst. 4
	temp. 18°		temp. 20°
Gron. A	5.95;	5.91	5.92
„ B	7.16;	7.16	7.80
„ C	7.10;	7.05	6.90
„ D	4.93;	4.95	4.90
„ E	3.97;	3.95	4.05
„ F	5.56;	5.58	5.35
Rothamsted, R I	5.84;	5.82	7.35
„ R II	5.10;	5.11	5.05
„ R III	7.48;	7.48	8.35
„ R IV	6.07;	6.04	6.75
„ R V	5.20;	5.21	5.25
Berlin, G.L.A. I	4.35;	4.33	4.50
„ G.L.A. II	3.85;	3.87	3.85
„ G.L.A. III	4.22;	4.28	4.05
Sigmond A	4.03;	4.06	3.90
„ B	5.75;	5.82	5.95
„ C	5.19;	5.27	6.05
„ D	8.02;	7.97	8.20
„ E	10.20;	10.22	9.65
Lyngby A	4.75;	4.73	4.65
„ B	6.33;	6.33	6.15
„ C	7.37;	7.33	7.55
„ D	7.15;	7.15	7.15
„ E	4.73;	4.75	4.85
Scherf A	7.68;	7.65	7.90
„ B	8.00;	8.22	8.50
„ C	7.26;	7.33	8.05
„ D	6.08;	6.06	6.60
„ E	4.47;	4.50	4.30

Table Vc

Soil sample marked	Colorimetric according to Kühn's method (Institutes			
	Institute 2		Institute 3	Institute 4
	temperature 20 to 22°		temperature 20°	20 to 25°
Gron. A	5.7 M.R.;	5.9 K.I.	6.0	6.2
" B	6.9 B.T.B.;	6.8 K.I.	7.0	7.0
" C	6.9 B.T.B.;	6.9 K.I.	6.8	7.0
" D	4.9 B.K.G.;	5.1 K.I.	4.5	5.2
" E	4.0 K.I.;	4.1 B.K.G.	4.0	4.8
" F	5.4 M.R.;	5.5 K.I.	5.5	5.5
Rothamsted, R I	5.9 M.R.;	5.9 K.I.	6.8	6.2
" R II	5.1 M.R.;	5.1 K.I.	5.0	5.0
" R III	7.6 B.T.B.;	7.5 K.I.	8.0	8.0; 7.4
" R IV	6.3 B.T.B.;	6.2 K.I.	6.4	6.4
" R V	5.0 B.K.G.;	4.9 K.I.	5.3	5.3
Berlin, G.L.A. I	4.2 B.K.G.;	4.2 K.I.	4.7	4.7
" G.L.A. II	3.9 B.K.G.;	3.9 K.I.	4.0	4.5
" G.L.A. III	4.0 B.K.G.;	4.0 K.I.	4.0	4.5
Sigmond A	3.8 K.I.;	3.9 B.K.G.	?	5.4
" B	6.0 K.I.;	6.0 B.T.B.	6.0	6.4
" C	5.2 M.R.;	5.2 K.I.	5.5	6.2
" D	8.0 α -N.;	8.1 K.I.	8.5	8.6
" E	9.9 T.P.;	10.2 K.	9.7	10.0
Lyngby A	4.6 B.K.G.;	4.6 K.I.	5.0	4.5
" B	5.8 M.R.;	5.9 K.I.	6.0	6.2
" C	7.3 B.T.B.;	7.3 K.I.	7.4	8.2
" D	7.0 B.T.B.;	7.0 K.I.	7.1	7.0
" E	4.3 K.I.;	4.4 B.K.G.	5.0	5.0
Scherf A	7.1 B.T.B.;	7.2 K.I.	8.0	7.0
" B	8.0 α -N.;	8.1 K.I.	8.5	8.2
" C	7.5 P.R.;	7.6 α -N.	8.0	8.6
" D	6.0 B.T.B.;	6.0 K.I.	6.0	6.2
" E	4.1 B.K.G.;	4.2 K.I.	5.5	5.6

P.R. = Phenol Red; B.K.G. = Brom Cresol Green; B.T.B. = Brom Thymol Blue; T.P. = Thymol Phtaleine; α -N. = α -Naphtolphtaleine; M.R. = Methyl Red; K. = komplex-indicator; K.I. = a new indicator-mixture not yet published, by St. Kühn and E. Scherf.

Table Vc

2, 3, 4, 5 and 7) or another method (Institute 6)

Institute 5	Institute 6	Institute 7
temperature 18°	temperature 18°	temperature 18°
>5.2 B.K.G.; <6.0 B.T.B.; ? M.R. (35)	5.8; 5.8	5.7
7.0 B.T.B.; 7.2 B.T.B.	6.8; 6.8	6.8
7.0 B.T.B.; 7.0 B.T.B.	6.8; 6.8	6.8
5.0 B.K.G.; 5.0 B.K.G.	<5.0	5.0
4.0 B.K.G. (14); 3.8 B.K.G. (14)	<5.0	4.3
5.5 M.R.; 5.5 M.R.	5.5; 5.5	5.3; 5.4
6.2 B.T.B. (14); 6.2 B.T.B. (14)	6.6; 6.6	5.8
5.0 B.K.G.; 4.8 B.K.G.	5.6; 5.5	4.8
7.6 B.T.B.; 7.6 B.T.B.	7.4; 7.4	7.7
6.2 B.T.B.; 6.2 B.T.B.	6.4; 6.4	6.1
5.0 B.K.G.; 5.0 B.K.G.	5.3; 5.3	5.0
4.2 B.K.G.; 4.4 B.K.G.	<5.0	4.4; 4.5
3.6 B.K.G.; 4.0 B.K.G.	<5.0	4.0
3.6 B.K.G.; 4.2 B.K.G.; 4.0 B.K.G.	<5.0	4.2
3.8 B.K.G. (14); 3.8 B.K.G. (14)	<5.0	4.1
>5.2 B.K.G.; <6.0 B.T.M.; ? M.R.	6.2; 6.2	5.9
>5.2 B.K.G.; <6.0 B.T.M.; ? M.R. (21)	5.8; 5.8	5.7
8.5 K.; 8.5 K.	7.6; 7.6	7.8
10.5 K.; ? (not clear)	—	10.0 K
4.6 B.K.G.; 4.4 B.K.G.	<5.0	4.6
6.4 B.T.B.; 6.2 B.T.B.	6.1; 6.2	5.8
8.2 K.; >7.6 B.T.B.	7.2; 7.2; 7.1	7.4
7.0 B.T.B.; 8.0 K.; 7.4 B.T.B.	6.7; 7.0; 7.0	7.1
5.2 B.K.G.; 4.6 B.K.G.	<5.0	4.7
7.4 B.T.B.; 8.0 K.	7.2; 7.2	6.9
8.5 K.; 8.5 K.	7.8; 7.8	8.4
8.2 K.; 8.0 K.	7.3; 7.3	7.7
5.7 M.R. (21); 6.0 B.T.B.	6.2; 6.2	5.8
4.4 B.K.G.; 4.4 B.K.G.	<5.0	4.4

Method	MnO ₂ content in %	Quinhydrone, immediately (from about 8—15 sec.)						Quinhydrone;			
Number Institute	5	2	3	4	5	6	7	1	2	3	4
Gron. A	0.1—0.01	5.78	5.85	6.00	5.92	5.95	5.86	5.92	5.90	5.82	5.88
„ B	0.1	7.08	7.48	7.85	7.20	7.97	<u>7.64</u>	7.74	7.90	7.62	7.89
„ C	—	6.86	6.74	6.91	7.00	6.94	<u>6.73</u>	6.90*	6.90	6.71	6.91
„ D	—	4.87	4.79	4.89	4.95	4.89	<u>4.93</u>	4.80*	4.88	4.78	4.87
„ E	—	3.97	3.91	3.95	4.00	4.00	<u>4.05</u>	3.90	3.97	3.89	3.95
„ F	—	5.39	5.37	5.48	5.57	5.49	<u>5.42</u>	5.44	5.38	5.29	5.45
Rothamsted, R I	0.01	6.20	6.92	7.26	6.04	7.32	<u>6.94</u>	7.20*	7.31	7.13	7.27
„ R II	—	5.14	4.95	5.12	5.13	5.20	5.08	5.20	5.14	5.00	5.11
„ R III	0.001	7.72	7.90	8.20	7.71	8.52	8.12	8.60	8.69	8.23	8.49
„ R IV	0.0001	6.19	6.37	6.62	6.14	6.96	6.49	7.02	6.91	6.53	6.71
„ R V	—	5.07	5.51	5.28	5.24	5.34	5.23	5.32	5.20	5.31	5.24
Berlin, G.L.A. I	—	4.35	4.69	4.57	4.40	4.50	4.52	5.30*	4.44	4.65	4.50
„ G.L.A. II	—	3.93	3.87	3.91	3.95	3.96	3.97	3.95*	3.98	3.81	3.91
„ G.L.A. III	—	4.13	4.03	4.04	4.29	4.18	4.15	4.40	4.13	4.00	4.03
Sigmond A . . .	—	3.94	3.95	3.97	4.00	4.02	4.04	3.72	3.95	3.92	3.88
„ B . . .	—	6.08	6.09	5.90	5.88	5.93	5.89	5.59	6.17	6.06	5.93
„ C . . .	0.01—0.001	5.33	5.43	5.81	5.27	5.43	5.39	4.96	5.34	5.43	5.81
„ D . . .	0.0001	7.98	7.76	7.97	8.06	8.20	8.00	7.88	8.17	7.83	7.98
„ E . . .	0.0001	9.52	9.23	9.21	9.62	9.63	9.42	9.50	9.50	9.30	9.08
Lyngby A	—	4.65	4.72	4.84	4.92	4.76	4.77	4.13	4.76	4.72	4.81
„ B	—	6.01	6.06	6.11	6.31	6.17	6.12	6.40*	6.15	6.06	6.08
„ C	—	7.27	7.55	7.45	7.44	7.60	7.51	7.41	7.64	7.40	7.46
„ D	—	7.00	7.31	7.28	7.29	7.39	7.31	7.37	7.41	7.25	7.26
„ E	—	4.55	5.01	4.86	4.76	4.81	4.79	4.73	4.74	4.87	4.80
Scherf A	0.001	7.10	7.62	7.63	7.45	8.09	7.50	7.56	8.04	7.69	7.87
„ B	0.001—0.0001	8.14	8.31	8.61	8.26	8.89	8.56	8.78	8.79	8.51	8.71
„ C	0.001	7.60	7.75	7.86	7.67	8.18	7.96	8.14	8.16	7.89	8.11
„ D	0.001—0.0001	6.00	6.29	6.58	5.99	6.87	6.54	6.83	6.55	6.47	6.65
„ E	0.0001	4.29	4.29	4.37	4.47	4.63	4.42	4.45	4.34	4.29	4.35

Die mit einem * versehenen Zahlen sind keine Mittelwerte.

Table A

1 minute			Quinhydrone; 15 minutes						Quinhydrone; 8—15 sec. after re-shaken					
5	6	7	2	3	4	5	6	7	2	3	4	5	6	7
5.93	5.89	5.88	—	5.84	5.80	5.70	5.64	5.65	5.90	5.82	5.87	5.93	5.88	5.62
7.92	7.94	7.99	—	7.59	7.83	7.96	7.76	7.91	7.92	7.48	7.90	7.99	8.04	7.96
6.93	6.93	6.79	—	6.65	6.88	6.87	6.89	6.83	6.86	6.74	6.92	6.88	6.86	6.71
4.94	4.85	4.94	4.88	4.69	4.82	4.87	4.79	4.94	4.87	4.79	4.86	4.94	4.88	4.92
3.97	3.98	4.06	—	3.84	3.93	3.89	3.90	3.94	3.97	3.90	3.94	3.99	4.00	4.01
5.54	5.50	5.49	—	4.95	5.44	5.50	5.44	5.44	5.34	5.37	5.42	5.56	5.48	5.38
7.18	7.32	7.44	7.28	7.12	7.21	7.06	6.99	7.36	7.23	6.90	7.20	7.29	7.29	7.30
5.14	5.18	5.17	5.20	5.07	5.08	5.08	5.11	5.14	5.05	4.95	5.04	5.15	5.10	5.09
8.39	8.56	8.67	8.92	8.64	8.73	8.57	8.54	8.92	8.85	7.90	8.67	8.78	8.79	8.81
6.61	6.96	6.91	7.08	6.60	6.86	?	6.84	6.96	7.03	6.37	6.92	7.01	7.08	6.98
5.23	5.33	5.30	5.19	5.12	5.21	5.10	5.25	5.28	5.19	5.51	5.16	5.27	5.32	5.14
4.43	4.50	4.51	4.51	4.50	4.50	4.40	4.48	4.49	4.45	4.67	4.45	4.46	4.47	4.36
3.93	3.95	3.95	—	3.61	3.88	3.88	3.84	3.94	3.87	3.87	3.83	3.86	3.89	3.85
4.23	4.18	4.13	4.07	3.98	3.94	4.12	4.10	4.11	4.03	3.98	3.95	4.05	4.08	4.05
4.00	3.97	4.07	3.89	3.87	3.85	3.95	3.88	4.02	3.91	3.89	3.89	3.99	3.96	4.02
5.86	5.90	5.93	6.27	6.14	6.12	5.86	5.93	5.90	?	6.09	6.18	6.07	6.11	6.01
5.28	5.39	5.41	5.40	5.47	5.85	5.22	5.29	5.43	5.52	5.46	5.88	5.46	5.53	5.57
8.16	8.21	8.17	8.27	7.96	8.10	8.11	8.12	8.19	8.22	7.76	8.06	8.27	8.33	8.21
9.67	9.65	9.48	9.58	9.44	9.05	9.90	9.85	9.63	9.50	9.23	8.95	9.57	9.63	9.47
4.88	4.75	4.78	—	4.70	4.74	4.82	4.72	4.75	4.69	4.72	4.60	4.80	4.71	4.52
6.30	6.17	6.11	6.11	5.99	6.07	6.21	6.09	6.11	5.95	6.05	6.07	6.27	6.09	5.66
7.63	7.66	7.55	7.75	7.44	7.57	7.73	7.72	7.64	7.71	7.55	7.54	7.69	7.73	7.51
7.42	7.40	7.36	7.39	7.21	7.25	7.43	7.40	7.27	7.31	7.30	7.24	7.44	7.35	7.14
4.82	4.81	4.79	—	4.63	4.79	4.82	4.81	4.80	4.74	5.01	4.77	4.90	4.82	4.76
7.99	8.24	7.91	8.12	7.85	7.89	8.32	8.20	8.09	7.91	7.59	7.86	8.04	8.14	7.80
8.85	8.92	8.87	8.84	8.67	8.83	8.88	8.97	8.89	8.78	8.29	8.66	8.90	8.93	8.79
8.15	8.19	8.22	8.23	8.08	8.25	8.26	8.20	8.25	8.24	7.73	8.20	8.26	8.34	8.32
6.74	6.90	6.88	6.62	6.56	6.71	6.80	6.84	6.96	6.58	6.30	6.68	6.80	6.85	6.77
4.53	4.58	4.41	—	4.24	4.31	4.39	4.40	4.23	4.29	4.27	4.31	4.47	4.55	4.23

Method		Hydrogen				
Number Institute		2	4	5	6	7
Gron. A		5.85	5.79	5.90	5.63	5.72
" B		7.25	7.88	7.32	7.08	7.30
" C		7.26	6.85	7.10	6.87	7.08
" D		4.89	4.83	4.89	4.79	4.87
" E		3.94	3.93	3.93	3.93	3.98
" F		5.45	5.47	5.52	5.50	5.41
Rothamsted, R I		5.98	7.36	5.98	5.87	5.96
" R II		4.95	5.12	5.04	4.87	4.96
" R III		7.96	8.87	7.65	7.87	7.90
" R IV		6.03	6.85	6.01	5.82	6.31
" R V		5.30	5.30	5.11	5.29	5.15
Berlin, G.L.A. I		4.45	4.54	4.34	4.47	4.53
" G.L.A. II		3.95	3.90	3.80	3.82	3.93
" G.L.A. III		4.05	3.95	4.20	4.02	4.08
Sigmond A		3.79	3.82	3.87	3.87	4.01
" B		6.07	6.12	5.82	5.81	6.00
" C		4.93	5.85	5.28	5.23	5.62
" D		8.20	8.05	8.07	8.21	8.18
" E		?	9.72	10.23	10.06	10.04
Lyngby A		4.72	4.73	4.86	4.65	4.71
" B		6.10	6.11	6.22	5.92	6.03
" C		7.47	7.50	7.50	7.36	7.79
" D		7.28	7.23	7.20	7.13	7.37
" E		4.70	4.80	4.80	4.70	4.84
Scherf A		7.63	7.82	7.65	7.33	7.71
" B		8.18	8.75	8.38	8.32	8.35
" C		7.52	8.20	7.83	7.69	7.94
" D		5.90	6.70	5.97	5.75	5.96
" E		4.25	4.34	4.44	4.46	4.19

Table B

Antimony		Colorimetric, Kühn					
4	5	2	3	4	5	6 (x)	7
5.92	5.93	5.8	6.0	6.2	>5.2 <6.0	5.8	5.7
7.80	7.16	6.85	7.0	7.0	7.1	6.8	6.8
6.90	7.07	6.9	6.8	7.0	7.0	6.8	6.8
4.90	4.94	5.0	4.5	5.2	5.0	<5.0	5.0
4.05	3.96	4.05	4.0	4.8	3.9	<5.0	4.3
5.35	5.57	5.45	5.5	5.5	5.5	5.5	5.35
7.35	5.83	5.9	6.8	6.2	6.2	6.6	5.8
5.05	5.10	5.1	5.0	5.0	4.9	5.55	4.8
8.35	7.48	7.55	8.0	7.7?	7.6	7.4	7.7
6.75	6.05	6.25	6.4	6.4	6.2	6.4	6.1
5.25	5.20	4.95	5.3	5.3	5.0	5.3	5.0
4.50	4.34	4.2	4.7	4.7	4.3	<5.0	4.45
3.85	3.86	3.9	4.0	4.5	3.8	<5.0	4.0
4.05	4.25	4.0	4.0	4.5	?	<5.0	4.2
3.90	4.04	3.85	—	5.4	3.8	<5.0	4.1
5.95	5.78	6.0	6.0	6.4	>5.2 <6.0	6.2	5.9
6.05	5.23	5.2	5.5	6.2	>5.2 <6.0	5.8	5.7
8.20	8.00	8.05	8.5	8.6	8.5	7.6	7.8
9.65	10.21	10.05	9.7	10.0	10.5	—	10.0
4.65	4.74	4.6	5.0	4.5	4.5	<5.0	4.6
6.15	6.33	5.85	6.0	6.2	6.3	6.15	5.8
7.55	7.35	7.3	7.4	8.2	8.2	7.2	7.4
7.15	7.15	7.0	7.1	7.0	7.5?	6.8	7.1
4.85	4.74	4.35	5.0	5.0	4.9?	<5.0	4.7
7.90	7.66	7.15	8.0	7.0	7.7?	7.2	6.9
8.50	8.11	8.05	8.5	8.2	8.5	7.8	8.4
8.05	7.29	7.55	8.0	8.6	8.1	7.3	7.7
6.60	6.07	6.0	6.0	6.2	5.85	6.2	5.8
4.30	4.48	4.15	5.5	5.6	4.4	<5.0	4.4