1977
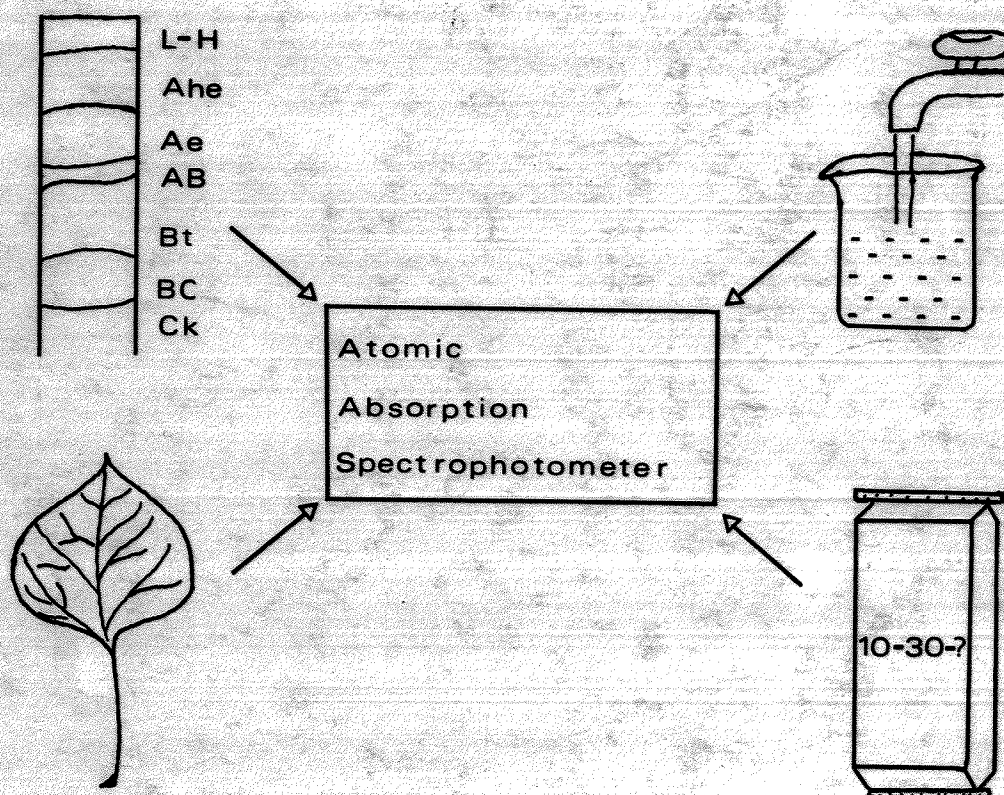
Applications of atomic absorption spectrophotometry in soil, plant, water, and fertilizer analysis: An annotated bibliography

Part 1: August 1958 – December 1971

by Y. P. Kalra

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March 1977

APPLICATIONS OF ATOMIC ABSORPTION SPECTROPHOTOMETRY

IN SOIL, PLANT, WATER, AND FERTILIZER ANALYSIS

AN ANNOTATED BIBLIOGRAPHY

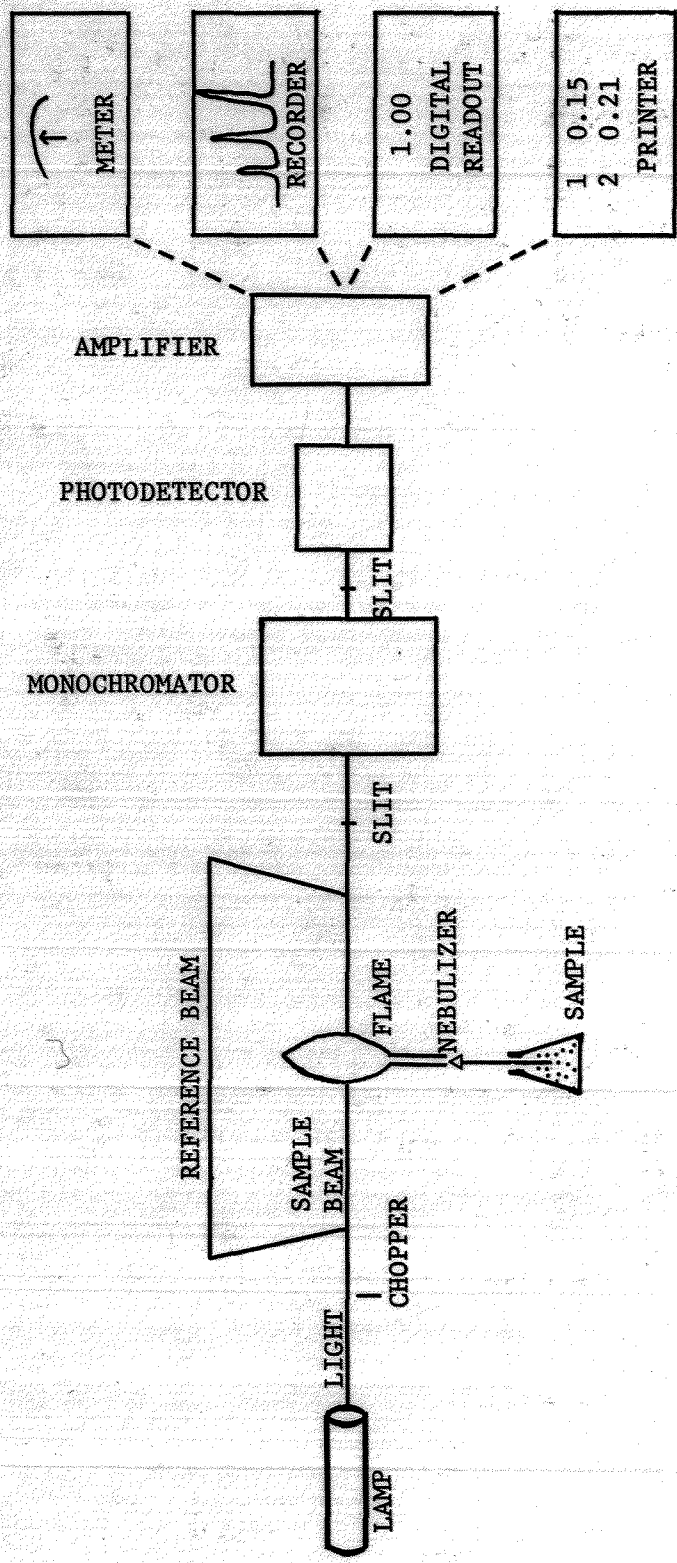PART 1: AUGUST 1958-DECEMBER 1971

BY

Y.P. KALRA

ABSTRACT

The bibliography contains 457 annotations on literature published from August 1958, when the first paper on the applications of atomic absorption spectrophotometry appeared, to December 1971. It is intended to provide a ready reference principally to those commencing work in the actual and potential applications of atomic absorption spectrophotometry in soil, plant, water, and fertilizer analysis.

CONTENTS

PREFACE

The effective potential of atomic absorption spectrophotometry (AAS) in analytical chemistry was first demonstrated in early 1955 by Walsh (432)*, a physicist at the Division of Chemical Physics of the Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia. AAS introduced new possibilities for high-speed, accurate analysis for several metals in such diverse fields as agronomy and food analysis, forestry, environmental analysis, biochemistry, medical research, petroleum and petroleum products, geochemistry and mining, metallurgy, textiles, plastics, and others. The first publication on the application of AAS dealt with agricultural materials. Allan (4) published a method in August 1958 for Mg determination that was successfully applied to the analysis of plant-ash extracts, soil extracts, and lysimeter and drainage waters. Since then, a large volume of scientific literature has developed. In the last 15 years or so AAS has become one of the most versatile analytical tools, complementing such other well-established techniques as flame photometry, emission spectroscopy, X-ray fluorescence, and neutron activation.

Although a large number of articles and chapters in books are available on the applications of AAS in soil, plant, water, and fertilizer analysis, a ready reference bibliography with annotations has not been. This bibliography has been compiled for that purpose. It is intended principally for those commencing work in AAS in the above-mentioned disciplines. It provides, in a readily available form, a quick reference for many of the methods used in AAS so that the analyst may ascertain

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* Citation Number

whether the element of interest has been previously determined in the type of sample he is working with.

The entries have been arranged alphabetically by author. Publications by the same author are listed chronologically. Each entry follows the same organization: author(s), year, title, journal, volume, pages, and number of references, tables, and figures. For ease of reference, the Subject Index is divided into four sections: Soil, Plant, Water, and Fertilizer. The indexes are arranged and cross-referenced so that if the reader knows the element, type of sample, or the author(s), he can find the cross-reference.

Part 1 covers literature from August 1958 through December 1971. References were drawn from the journals (listed on pp. 149-154) available at the libraries of the University of Alberta and Northern Forest Research Centre. References were selected on the basis of usefulness; originals of all the references were seen. Some papers may have been overlooked during the compilation process, and I will appreciate the users of the Bibliography bringing to my attention relevant publications that were inadvertently missed. Comments, if any, will be also appreciated; tear sheet for this purpose has been included on p. 195.

Many advances in methodology and equipment have been made since 1971, and a vast amount of literature on the subject has appeared due to the explosive growth of AAS. At a later date Part 2 will cover literature published since January 1972.

I wish to extend grateful acknowledgements to Dr. Keith D. Dodd and Mr. Darrell Robinson for assistance in the preparation of the manuscript, to Miss Brenda Gustafson for proofreading and to Dr. J.P. Tewari of the

LIST OF ABBREVIATIONS

AOAC	Association of Official Analytical Chemists
APDC	Ammonium pyrrolidinedithiocarbamate
CEC	Cation exchange capacity
DCR	Digital concentration readout
DDTC	Diethyldithiocarbamate
Dithizone	Diphenylthiocarbazone
DTPA	Diethylenetriaminepenta-acetic acid
EDTA	Ethylenediaminetetra-acetic acid
HEEDTA	Hydroxyethylenediaminetetra-acetic acid
HOAc	Acetic acid
MBT	2-mercaptobenzothiazole
MIAK	Methyl iso-amyl ketone
MIBK	Methyl iso-butyl ketone
NaOAc	Sodium acetate
NH_4OAc	Ammonium acetate
NTA	Nitrilotriacetic acid
S.D.	Standard deviation
STPB	Sodium tetraphenyl boron
TOTP	Tri-iso-octyl thiophosphate

ANNOTATED BIBLIOGRAPHY

1 Abaza, R.H., J.T. Blake, and E.J. Fisher. 1968. Oxalate determination:
       Analytical problems encountered with certain plant species.
       J. Assoc. Off. Anal. Chem. 51:963-967. 6 ref., 1 tab.

       Presence of large percentages of pectins and Fe^{++} gave

   inaccurate results for oxalate determination by the traditional   .

   $KMnO_4$ – oxalate reduction-oxidation method. The method was modified

   as follows: Acidity of the plant digest was increased, thereby

   eliminating pectin interference. The Fe^{++}-containing precipitate

   was eliminated by filtration. Oxalate in the Fe^{++}-containing

   precipitate was determined as Ca and Mg salts by AAS.

2 Adriano, D.C., G.M. Paulsen, and L.S. Murphy. 1971. Phosphorus-iron
       and phosphorus-zinc relationships in corn (Zea mays L.) seedlings
       as affected by mineral nutrition. Agron. J. 63:36-39. 27 ref.,
       3 tab., 4 fig.

       Corn shoots and roots were prepared for analysis by a wet

   oxidation procedure. A 0.5-g sample was digested with 25 ml

   $H_2O-HNO_3-HClO_4$ (1:1:1 v/v/v) in 250 ml beaker, residue treated

   with 10 ml 0.1N HCl, filtered and made up to 50 ml with 0.1N HCl.

   Fe and Zn were determined by AAS and P by colorimetric method.

3 Ajayi, O., D.N. Maynard, and A.V. Barker. 1970. The effects of
       potassium on ammonium nutrition of tomato (Lycopersicon
       esculentum Mill.). Agron. J. 62:818-821. 16 ref., 7 tab., 1 fig.

       Leaf samples collected on different dates were analyzed

   for K by AAS.

4 Allan, J.E. 1958. Atomic-absorption spectrophotometry with
      special reference to the determination of magnesium. Analyst
      83:466-471. 5 ref., 4 fig.

      Solutions containing 0.3, 1.0, 3.0, 6.0, and 10.0 ppm

Mg were analyzed 20 times over a period of 1 wk to test

reproducibility. Coefficients of variation were 3.0% for 10

ppm, 6% for 0.3 ppm and 1.7% for the middle of the range. No

interference was found due to Na (17,000 ppm), SO_4 (up to

$0.1\underline{N}$ H_2SO_4) OR PO_4 (up to a concentration of P=60 times the Mg

concentration). However, Al caused a depression in absorption

and must be removed if present in the sample at a concentration

comparable with Mg. These results have been successfully used

for the determination of Mg in agricultural samples such as

plant-ash solutions, soil extracts, lysimeter and drainage

waters. Prior concentration needed for the emission methods

is not required for Mg by AAS.

5 Allan, J.E. 1959. Application of analytical absorption
      spectroscopy to agricultural analyses. Paper presented at the
      Second Australian Spectroscopy Conference, Melbourne, Australia,
      June 1-3, 1959. Abstract in Spectrochim. Acta 15:784-785.

      Mg in soil extracts and plants can be readily determined

by AAS and Na, K, Ca, and Mg by flame-emission analyses. Fe,

Mn and Zn in plant ash solutions and soil extracts can be

determined by AAS but Cu could not be determined by the AA

equipment used. Plant and soil extracts would have to be

concentrated for Co, Mo, Ni and V analysis.

6 Allan, J.E. 1959. The determination of iron and manganese by
      atomic absorption. Spectrochim. Acta 15:800-806. 7 ref.,
      2 tab., 2 fig.

      Rye grass, white clover and paspalum were analyzed. 1 g

sample was digested with 20 ml of 60% $HClO_4$-HNO_3 (1:5), diluted to

20 ml, filtered and analyzed for Fe (248.33 nm) and Mn (279.48 nm).

7 Allan, J.E. 1961. The determination of copper by atomic absorption
       spectrophotometry. Spectrochim. Acta 17:459-466. 13 ref.,
       5 tab., 1 fig.

       Cu was determined in aqueous solution when the sensitivity

   was adequate or after extraction with APDC-MIBK. Hydrochloric

   acid extracts of the fertilizer, HNO_3-$HClO_4$ extracts of clay

   and sandy soils, $0.1\underline{N}$ HCl, 2.5% CH_3COOH and 1% Na_2EDTA extracts

   of soil, and plant samples digested with HNO_3-$HClO_4$ were

   analyzed for Cu. AAS was found to be accurate and free from

   interferences.

8 Allan, J.E. 1961. The determination of zinc in agricultural
       materials by atomic-absorption spectrophotometry. Analyst
       86:530-534. 10 ref., 3 tab., 1 fig.

       Fertilizer sample was boiled with $3\underline{N}$ HCl, the residue

   dissolved in $0.5\underline{N}$ HCl and diluted to 100 ml. Soils were

   digested with HNO_3-$HClO_4$, silica removed by HF, evaporated,

   residue dissolved in 5% $HClO_4$ and diluted to 50 ml. Peat (2 g)

   was shaken with 20 ml 1% Na_2EDTA for 2 h and filtered. Plant

   samples were digested with 20 ml HNO_3-$HClO_4$ (17 ml: 3 ml 72%).

   Zn was complexed with APDC and extracted with MIBK. With the

   apparatus used, sensitivity of 0.025 ppm Zn were obtained.

   Coefficient of variation was 2-3% in 0.3-8.0 ppm Zn range. Satis-

   factory recoveries of Zn were obtained.

9 Allan, J.E. 1962. A review of recent work in atomic absorption
       spectroscopy. Spectrochim. Acta 18:605-614. 42 ref.

       A review paper dealing with analytical methods (e.g.,

   agricultural materials), interference effects, instrumentation,

   etc.

10 Alloway, B.J. and B.E. Davies. 1971. Heavy metal content of
      plants growing on soils contaminated by lead mining. J. Agric.
      Sci., Camb. 76:321-323. 5 ref., 4 tab.

        Plant analyses were carried out to confirm the evidence

      from soil extraction (2.5% CH_3COOH) of contamination due to

      air-and water-borne heavy metals. Samples were washed, oven-

      dried at 100°C and dry-ashed at 430°C. The ash was taken up

      in $0.1\underline{N}$ HNO_3 and analyses performed by AAS. Whole radish

      plants and ryegrass were analyzed for Cd, Cu, Pb and Zn. Herbage

      samples (cocksfoot, meadow fescue, bent, timothy, sheep's fescue,

      sedges, and clover) were analyzed for Cu, Pb, and Zn. Herbage

      samples of Festuca and ryegrass were analyzed for Pb and Zn.

11 Alloway, B.J. and B.E. Davies. 1971. Trace element content of
      soils affected by base metal mining in Wales. Geoderma 5:197-208.
      15 ref., 10 tab.

        Residual influences of past contamination on soils were

      studied. Soils were dried (15°C), ground and passed through

      a nylon sieve (2 mm square aperture). "Available" metal contents

      (Pb, Zn, Cu, and Cd) were determined in filtrates obtained

      after extraction (45 min shaking) with 2.5% v/v CH_3COOH (soil:

      extracting solution 1:20). Total metal contents (Pb, Zn, Cu,

      Cd, Co, and Ag) were determined on digests obtained by HNO_3

      and aqua regia treatment. AAS was used.

12 Ambler, J.E. and J.C. Brown. 1969. Cause of differential suscep-
      tibility to zinc deficiency in two varieties of navy beans
      (Phaseolus vulgaris L.). Agron.J. 61:41-43. 7 ref., 3 tab., 4 fig.

        Navy beans were grown separately in soil, nutrient solution, and

      a split medium to show a Zn, P, Fe interaction as the factor causing

      the differential susceptibility to Zn deficiency. Plant tops and

      roots were analyzed for Fe and P colorimetrically and Zn by AAS.

13 American Public Health Association, American Water Works Association
        and Water Pollution Control Federation. 1968. Tentative method
        for metals in water. J. Am. Water Works Assoc. 60:739-742.
        4 ref., 2 tab.

        Three synthetic water samples were analyzed for Ag, Cd, Cr,

        Cu, Fe, Mg, Mn, Pb, and Zn, in 59 laboratories. On the basis

        of precision and accuracy, AAS method has been found acceptable.

        Effective July 1968, AAS has been adopted as "tentative" method.

14 Analytical Methods Committee. 1969. The determination of small
        amounts of cadmium in organic matter. Analyst 94:1153-1158.
        6 ref., 5 tab.

        AAS, colorimetric, and polarographic techniques were used

        for determining Cd in orange squash and lime juice. Samples

        are wet oxidized and diluted, and the diluted solution (containing

        1-4 ppm Cd) is aspirated in AAS equipment.

15 Andelman, J.B. 1970. A review of the 1969 literature on wastewater
        and water pollution control: Inorganics - Atomic spectrophotometric
        analysis and electrochemical techniques. J. Water Pollut. Control
        Fed. 42:888-895. 57 ref.

        Reviews AAS literature for 1969.

16 Andersen, A.J. 1971. Influence of phosphorus and nitrogen nutrition
        on uptake and distribution of strontium and calcium in oat
        plants. Soil Sci. Soc. Am. Proc. 35:108-111. 16 ref., 9 tab.,
        1 fig.

        Two pot experiments were conducted on a sandy clay loam

        and a sandy loam soil to study the uptake of Sr^{90}, Ca^{45}, and

        stable Ca by oats. Grain and straw samples dried at 80°C

        for 18 h were digested with HNO_3 and $HClO_4$. After proper

        dilution, Ca was determined by AAS.

17 Anderson, B.J. and E.A. Jenne. 1970. Free-iron and -manganese oxide content of reference clays. Soil Sci. 109:163-169. 18 ref., 1 tab., 4 fig.

Samples (montmorillonites-5, illites-2, kaolinites-2, vermiculite-1, "illite-vermiculite"-1) were ground to pass a 60-mesh sieve. Subsamples (3-6 g) were washed with a saturated NaCl solution and extracted with 40 ml of a solution which was $0.175\underline{M}$ with respect to sodium citrate and $0.025\underline{M}$ citric   acid and contained 2 g $Na_2S_2O_4$. After flocculating the clay with NaCl, the filtrate was diluted to 100 ml and analyzed for Fe and Mn by AAS (Perkin-Elmer model 303) with a three-slot Boling burner. Several determinations were made by the "method of additions" technique. Fe hollow cathode lamp was used at 36 ma and not 20 ma as recommended by the manufacturer. The approximate detection limits obtained for Fe and Mn were 0.05 and 0.005 mg/ℓ, respectively.

18 Anderson, J.M., N.K. Boardman, and D.J. David. 1964. Trace metal composition of fractions obtained by digitonin fragmentation of spinach chloroplasts. Biochem. Biophys. Res. Commun. 17:685-689. 9 ref., 1 tab.

Chloroplasts fractions (20-50 mg) of spinach were digested with 2 ml of H_2SO_4-$HClO_4$ (1 + 7) and 5 ml of HNO_3 and analyzed for Cu, Fe, Mn, and Mg with Perkin-Elmer model 303.

19. Ando, T., J.H. Baker, and M. Drake. 1969. Root CEC measurement by Li-exchange. Plant Soil 31:473-485. 29 ref., 3 tab., 4 fig.

CEC of fresh roots of barley was determined using $0.1\underline{N}$ LiCl as the exchange cation followed by rinsing with distilled water to remove occluded and diffusible portions of Li from the roots. Li content of roots was determined by AAS. Dry root samples were ashed at 500°C in a muffle furnace, ash dissolved in 1:1 HNO_3, and K, Ca, and Mg determined by Perkin-Elmer model 214.

20 Andrew, C.S. and M.F. Robins. 1969. The effect of potassium on
        the growth and chemical composition of some tropical and
        temperate pasture legumes. I. Growth and critical percentages
        of potassium. Aust. J. Agric. Res. 20:999-1007. 19 ref., 5 tab.

        Tops of tropical (Phaseolus lathyroides, Phaseolus

    atropurpurens, tick-clover, stylo, centro, Lotononis bainessii,

    Glycine javanica), and temperate (common alfalfa, barrel alfalfa,

    white clover, strawberry clover) pasture grasses were analyzed

    for Ca and Mg by AAS and N, P, K and Cl by a Technicon Auto-Analyzer.

21 Angino, E.E. and G.K. Billings. 1966. Lithium content of sea
        water by atomic absorption spectrometry. Geochim. Cosmochim.
        Acta 30:153-158. 10 ref., 3 tab., 1 fig.

        Li was determined in sea water (73 samples) without prior

    chemical separation. Samples were filtered through 0.45-μ

    filter and aspirated into Perkin-Elmer model 303 using air-C_2H_2

    flame (335.1 nm wavelength).

22 Angino, E.E. and G.K. Billings. 1967. Atomic Absorption
        Spectrometry in Geology. Elsevier Publ. Co. Amsterdam. 144 p.

        The second part of the book is devoted to methods and

    application in analysis of fresh water, sea water and other samples.

23 Angino, E.E., O.K. Galle, and T.C. Waugh. 1969. Fe, Mn, Ni, Co,
        Sr, Li, Zn, and SiO_2 in streams of the Lower Kansas River
        Basin. Water Resour. Res. 5:689-705. 18 ref., 3 tab., 2 fig.

        Background levels and seasonal variation in trace and

    minor elements in the major streams were determined. All

    samples were analyzed within 24 h after collection (filtered

    through 1.2 μ millipore filter). HCl (10 ml) was added to 500

    ml filtered sample and evaporated to about 10 ml, transferred

    to 50 ml flask and diluted. Analyzed by Jarrell-Ash 82-500

    series unit.

24 Anonymous. 1970. Mercury in the environment. Environ. Sci.
        Technol. 4:890-892. 2 tab., 1 fig.

        It is suggested that of the methods mentioned (emission spec-

        trography, mass spectroscopy, X-ray spectrophotometry, X-ray absorption,

        AAS, atomic fluorescent flame spectrometry, neutron activation,

        polarography, and radiometry) for the determination of Hg

        present in water and other environment, AAS and neutron

        activation are preferred.

25 Awada, M. and C. Long. 1971. The selection of the potassium index
        in papaya tissue analysis. J. Am. Soc. Hortic. Sci. 96:74-77. 13 ref.,
        7 tab., 2 fig.

        Leaves were separated into blades and petioles. Samples

        were saturated with C_2H_5OH containing 5% H_2SO_4, ignited and

        ashed overnight at 475°C. HCl extract was prepared and analyzed

        for K, Ca, and Mg by AAS and P by colorimetric method.

26 Baker, A.D. 1971. Determination of copper in alfalfa. J. Assoc.
        Off. Anal. Chem. 54:951-952. 5 ref., 2 tab.

        A 0.5-2 g sample was wet ashed with a HNO_3-HClO_4 mixture

        or dry ashed at 400-600°C. Air-C_2H_2 flame was used. Cu was

        determined at 324.8 nm with Perkin-Elmer model 290.

        Recovery of added Cu was 96-100%. Removal of SiO_2 by fuming

        with HF was not necessary.

27 Baker, J.H. and T. Greweling. 1967. Extraction procedure for
        quantitative determination of six elements in plant tissue.
        J. Agric. Food Chem. 15:340-344. 7 ref., 4 tab.

        Total Ca, Cu, K, Mg, Mn and Zn were extracted from the

        plant tissue (turnip greens, red pine needles, sorghum, corn

        grain, ladino clover, apple leaves, cherry leaves, citrus leaves,

        and peach leaves) with $0.1\underline{M}$ NH_4EDTA (0.25 g sample: 20 ml

        solution). The filtrate was analyzed without dilution by AAS

using Boling burner for Cu, Mn and Zn and standard burner

for Ca, Mg, and K. These results agreed with those obtained

after dry ashing the samples (500°C overnight). It appears

that the procedure is ideal for use in a "quick test" tissue

analysis laboratory. Perkin-Elmer model 214 and 303 were used.

28 Baril, R. and G. Bitton. 1969. Influence de la matière organique
      dans le dosage du fer, de l'aluminium et du manganèse dans les
      sols à l'aide du spectrophotomètre à absorption atomique
      (Influence of organic matter in the determination of iron,
      aluminum and manganese in soils using atomic absorption
      spectrophotometer). Nat. Can. (Que.) 96:725-729. 4 ref., 4 tab.

$Na_2S_2O_4-$ and acid NH_4 oxalate-extractable Fe, Al, and Mn

were determined with Perkin-Elmer model 303. There was no

interference due to organic matter.

29 Bar-On, P. and I. Shainberg. 1970. Hydrolysis and decomposition
      of Na-montmorillonite in distilled water. Soil Sci.
      109:241-246. 8 ref., 1 tab., 3 fig.

Na-saturated clay was leached with distilled water and

the filtrate analyzed for Na and Mg with a Unicam AAS, Al by

pyrocatechol violet method, SiO_2 colorimetrically and Cl with

a chloridometer.

30 Barrow, N.J. 1970. Comparison of the adsorption of molybdate,
      sulfate and phosphate by soils. Soil Sci. 109:282-288.
      19 ref., 2 tab., 7 fig.

Free Fe and Al in the soils were extracted with citrate-

dithionite solution. Fe was determined by AAS and Al

colorimetrically.

31 Bell, L.C. and C.A. Black. 1970. Crystalline phosphates produced
      by interaction of orthophosphate fertilizers with slightly
      acid and alkaline soils. Soil Sci. Soc. Am. Proc. 34:735-740.
      31 ref., 5 tab.

For soil characterization, exchangeable Ca and Mg in the

1N NaOAc extracts were determined by AAS.

32 Belling, P.J. 1969. Analysis of toxic metals in trade effluents
        by atomic absorption spectrophotometry. Effluent Water Treat.
        J. 9:314-318,332. 5 ref., 5 tab.

        Mn, Cr, Cu, Ni, and Zn in the effluents from the

        electroplating industry were determined. Addition of Sr and

        HCl (to give 1% w/v $SrCl_2 \cdot 6H_2O$ and 5% v/v HCl in the final

        solution) masked any interference observed in determining

        Cr and Ni. Perkin-Elmer model 303 was used.

33 Bentley, E.M. and G.F. Lee. 1967. Determination of calcium in
        natural water by atomic absorption spectrophotometry. Environ.
        Sci. Technol. 1:721-724. 12 ref., 3 tab., 5 fig.

        Ca determination in waters by AAS was found to be pH

        dependent. Observed values for Ca increased with decreasing

        pH from 7.0 to 3.8. It was constant in 3.8-1.8 pH range and

        decreased with decreasing pH below 1.8. However, addition of

        1% La or 50% EDTA (required to titrate the hardness of water)

        will eliminate pH dependence in Ca determination by AAS. Na,

        K, and Mg were also determined. Perkin-Elmer model 303 was

        used.

34 Bentley, L., P.C. De Kock, and R.H.E. Inkson. 1970. An
        investigation into the effect of varied phosphorus and iron
        concentrations in the nutrient medium on the cation and
        anion contents of oats. Plant Soil 32:271-281. 21 ref.,
        4 tab.

        Oats were grown in nutrient solution (pH 5.5). Plant

        tops were dried at 85°C for 48 h, ashed in a muffle furnace

        at 550°C and ash taken up in HCl. K, Ca, Mg, and Na were

        analyzed spectrophotometrically and Fe, P, Mn, and Cu

        colorimetrically. Total S and inorganic SO_4 were determined

        turbidimetrically.

35 Berglind, L. and A. Henriksen. 1970. Automatic sampler for
        atomic absorption and automatic colorimetric analysis.
        Lab. Pract. 19:918, 920. 2 fig,

        Perkin-Elmer model 303 equipped with a DCR-1 is used

        in this chemical routine laboratory. An automatic sample

        changer enabling the use of glass vials as sample cups for

        direct presentation to the instrument is described.

36 Bernier, B. and J.L. Carrier. 1968. Étude sur l'extraction du
        fer et de l'aluminium libres dans les sols podzolisés (study
        on the extraction of free iron and aluminum in podzolized
        soils). Nat. Can. (Que.) 95:247-257. 15 ref., 2 tab., 3 fig.

        Free Fe and Al were extracted from strongly podzolized

        soils by ammonium oxalate (4 different procedures) hydrosulfite -

        tartarate and hydrosulfite-EDTA. In general, AAS (Perkin-Elmer

        model 303) was used. Some Fe and Al determinations were also

        done by colorimetry.

37 Berry, W.L. and C.M. Johnson. 1966. Determination of calcium and
        magnesium in plant material and culture solutions, using
        atomic-absorption spectroscopy. Appl. Spectrosc. 20:209-211.
        5 ref., 1 tab.

        Interferences for Ca and Mg determination were eliminated

        by adding Sr (500 ppm as $SrCl_2$) and $HClO_4$ (0.1$\underline{N}$). The method

        is suitable for large number of samples containing interfering

        ions. Complete recoveries of Ca and Mg were obtained.

38 Berry, W.L. and A. Ulrich. 1970. Calcium nutrition of sugar
        beets as affected by potassium. Soil Sci. 110:389-394.
        12 ref., 2 tab., 5 fig.

        Ca-K interaction in sugar beet nutrition was studied

        with culture solutions. Ca in the plants was determined by

        AAS and K and Na by flame emission. Culture solutions were

        analyzed for K and Na by flame emission.

39 Betzer, P.R. and M.E.Q. Pilson. 1970. The Nansen bottle – a
      major contributor to reported concentrations of particulate
      iron in sea water. Deep-Sea Res. 17:671-674. 8 ref., 1 tabl.,
      1 fig.

        Concentrations of particulate Fe in approx. 300 seawater

      samples collected in Teflon coated Nansen bottles and Niskin

      bottles were determined to investigate contamination of Fe from

      the former. Perkin-Elmer model 303 with a laminar flow

      Boling burner head and an air-C_2H_2 flame was used.

40 Biechler, D.G. 1965. Determination of trace copper, lead, zinc,
      cadmium, nickel and iron in industrial waste waters by atomic
      absorption spectrometry after ion exchange concentration on
      Dowex A-1. Anal. Chem. 37:1054-1055. 6 ref., 2 tab.

        Since heavy metals in industrial waste waters often need

      to be determined at concentrations lower than the limits of

      sensitivity of AAS, an ion exchange concentration step was

      devised. Water samples are buffered (with NH_4OAc buffer, pH 5.5)

      and passed rapidly through a column of Dowex A-1 resin. The

      evaporated metals are stripped from the column with $8\underline{N}$ HNO_3,

      concentrated to a small volume and analyzed for Cu, Pb, Zn,

      Cd, Ni and Fe by AAS. Jarrell-Ash model 82-363 was used.

41 Bishop, R.F. and C.R. MacEachern. 1971. Response of spring wheat
      and barley to nitrogen, phosphorus and potassium. Can. J.
      Soil Sci. 51:1-11. 20 ref., 7 tab.

        In fertilizer trials, straw, grain and tissue samples of

      wheat and barley were dry-ashed at 550°C., taken up in HCl, P

      determined colorimetrically and Ca, K and Mg by AAS.

42 Blair, G.J., C.P. Mamaril, and M.H. Miller. 1971. Influence of
      nitrogen source on phosphorus uptake by corn from soils differing
      in pH. Agron. J. 63:235-238. 14 ref., 3 tab., 2 fig.

A greenhouse study was conducted on soils (pH 4.2 to 8.2)

from southern Ontario. Tops and roots were analyzed for N and

P, by the method of Thomas et al. (Agron. J. 59:240-243, 1967)

and Ca was determined on the same digest by AAS.

43 Blair, G.J., M.H. Miller, and W.A. Mitchell. 1970. Nitrate and
ammonium as sources of nitrogen for corn and their influence on
the uptake of other ions. Agron. J. 62:530-532. 20 ref.,
4 tab.

Tops and roots of corn grown in nutrient solution (pH 6.8)

were frozen immediately after harvest, freeze dried and ground

to pass 20-mesh sieve. H_2SO_4-H_2O_2 extract was analyzed for Na,

Ca, and Mg by AAS.

44 Blakemore, L.C. 1968. Determination of iron and aluminum in Tamm's
soil extracts. N. Z. J. Agric. Res. 11:515-520. 9 ref.,
1 tab., 2 fig.

Two rapid methods (AAS and ferron colorimetric methods)

are described for Fe and Al determination in Tamm's

oxalate soil extracts. Both methods are accurate. However,

interferences due to high contents of Ni, Cu, and Zn were

observed in colorimetric method. A 3-g soil sample was shaken

with 100 ml extracting solution (pH 3.25) for 1 h and made

up to 250 ml in Tamm's reagent. In order to avoid precipitation

of oxalate, 2.5 ml HCl was added to 20 ml aliquot and made up

to 25 ml with Tamm's solution. For Fe, N_2O - C_2H_2 flame or

air-C_2H_2 flame (using $SrCl_3$) was used. For Al, N_2O-C_2H_2 was used.

45 Blatt, C.R. 1971. Effect of dolomitic limestone applications
on the strawberry cultivar "Acadia". Can. J. Plant Sci.
51:167-169. 8 ref., 2 tab.

Ca and Mg in soils (exchangeable), leaf samples, and

dry-ashed (550°C) fruit samples were determined by AAS.

46 Boawn, L.C. and P.E. Rasmussen. 1971. Crop response to excessive
        zinc fertilization of alkaline soil. Agron. J. 63:874-876.
        6 ref., 4 tab., 1 fig.

        The tolerance of 15 field crops and three vegetable crop species

        to excessive levels of available Zn in the soil was evaluated

        in a growth chamber. Zn in the tops of the following crops was

        determined by AAS after digesting in HNO_3 and $HClO_4$: field corn,

        sweet corn, sorghum, barley, wheat, field beans, snap beans,

        alfalfa, clover, peas, lettuce, spinach, potatoes, sugarbeet,

        and tomato.

47 Boawn, L.C., P.E. Rasmussen, and J.W. Brown. 1969. Relationship
        between tissue zinc levels and maturity period of field beans.
        Agron. J. 61:49-51. 5 ref., 1 tab., 4 fig.

        Field beans were grown in field experiments in two geo-

        graphical areas. Leaf samples and total tops of plants were

        sampled and dried at 65°C. Zn was determined on HNO_3-$HClO_4$

        digests by AAS.

48 Boettner, E.A. and F.I. Grunder. 1968. Water analysis by atomic
        absorption and flame emission spectroscopy. 9 ref., 2 tab.,
        9 fig. pp. 236 - 246. In R.A. Baker (ed), Trace inorganics in
        water. Advances in Chemistry Series No. 73. Am. Chem. Soc.,
        Washington, DC.

        Ca, Cu, Fe, Mg, Mn, Ni, Pb, and Zn are determined routinely

        in water samples by AAS, and Na and K by flame emission. Details

        of these methods are described. Jarrell-Ash model 32-360 was used.

49 Boström, K. 1970. Deposition of manganese rich sediments during
        glacial deposits. Nature 226:629-630. 11 ref., 1 tab., 1 fig.

        Sediments were analyzed for Fe and Mn by AAS and emission

        spectroscopy. Cu, Y, La, and Co were determined by emission

        spectroscopy.

50 Bowen, H.J.M. 1967. Comparative elemental analyses of a standard
        plant material. Analyst 92:124-131. 6 ref., 1 tab., 1 fig.

        In an inter-laboratory comparison a standard kale powder

was analyzed by 29 laboratories for 40 elements. Several

techniques were used. Some elements were analyzed by AAS as

well as other techniques. The following elements were determined

by AAS: Ca, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Sr, and Zn.

51 Bradfield, E.G. 1964. Leaf analysis as a guide to the nutrition
        of fruit crops. IV.-Scheme for the rapid determination of
        copper, iron, manganese and zinc in plant material. J. Sci.
        Food Agric. 15:469-473. 5 ref., 3 tab., 1 fig.

        1.0 g samples (leaves of strawberry, black currant, apple,

plum and raspberry) were ashed in pyrex 50 ml conical flasks

(450°C overnight), treated with HNO_3:$HClO_4$ mixture and digested

on a hot plate. After further treatment, Zn was determined by

AAS (Hilger and Watts Uvispek with atomic absorption burner

unit, at 213.8 nm) and Fe, Cu, and Mn by other methods.

52 Bradfield, E.G. and D. Spincer. 1965. Leaf analysis as a guide to
        the nutrition of fruit crops. VI.-Determination of magnesium,
        zinc and copper by atomic absorption spectroscopy. J. Sci.
        Food Agric. 16:33-38. 17 ref., 5 tab., 1 fig.

        Leaves of strawberry, apple, black currant, raspberry and

plum were analyzed for Mg (285.2 nm) by dry-ashing using C_2H_2/air

flame (1000 μg/ml Sr added) and coal gas/air flame. It was also

determined after wet digestion with Na_2SO_4/Se/H_2SO_4 using C_2H_2/

air flame (2000 μg/ml La added). Leaves of strawberry and black

currant were also analyzed for Zn and Cu at 213.8 and 324.7 nm.

Magnesium, Zn, and Cu in solutions can be determined by AAS at

0.01-2.0, 0.02-4, and 0.1-15.0 μg/ml, respectively.

53 Bradford, R.R. and D.E. Baker. 1969. Variable selectivity for Sr by
    corn hybrids which accumulate different concentrations of Sr, Ca,
    Mg and K. Agron J. 61:766-768. 15 ref., 6 tab.

       Four single-cross corn hybrids were grown in greenhouse in

    a silt loam soil. Six weeks after emergence the above-ground

    portions were harvested, dried at 40.2°C and analyzed for Sr, Ca,

    Mg and K as given in Agron. J. 56:133-136. Soil extracts (0.002$\underline{N}$

    HCl; $1\underline{N}$ NH$_4$OAc) were analyzed for Sr, Ca, Mg, and K by Perkin-

    Elmer model 303.

54 Brech, F. 1968. Comparison of optical emission and atomic absorption
    methods for the analyses of plant tissues. J. Assoc. Off. Anal.
    Chem. 51:132-136. 6 ref., 2 tab., 5 fig.

       Aluminum, Si and Mo can now be measured in plant tissues by

    AAS. Advantages and limitations of optical emission spectroscopy

    and AAS are discussed.

55 Bremner, I. and A.H. Knight. 1970. The complexes of zinc, copper and
    manganese present in ryegrass. Br. J. Nutr. 24:279-289. 19 ref.,
    6 fig., 1 plate.

       Dilute aqueous solutions were aspirated directly while all

    other samples were digested with mineral acids for the determina-

    tion of Cu, Mn, and Zn by AAS.

56 Brewer, P.G., D.W. Spencer, and C.L. Smith. 1969. Determination of
    trace metals in seawater by atomic absorption spectrophotometry.
    9 ref., 2 tab., 3 fig. pp. 70-77. $\underline{In}$ Atomic Absorption
    Spectroscopy, ASTM STP 443, Am. Soc. Test. Mat.

       Co, Cu, Fe, Ni, Pb, and Zn were extracted by APDC-MIBK

    technique and determined directly by AAS (Perkin-Elmer model 303).

    The method had sufficient sensitivity and accuracy for Cu, Ni,

    and Zn, but Co, Fe, and Pb were below the limit of detection

    in most of their oceanic samples.

57 Brooks, R.R., B.J. Presley, and I.R. Kaplan. 1967. APDC-MIBK
     extraction system for the determination of trace elements in
     saline waters by atomic absorption spectrophotometry. Talanta
     14:809-816. 5 ref., 2 tab., 4 fig.

         "Soluble" Co, Cu, Fe, Ni, Pb, and Zn were determined in

     saline waters by extracting their complexes with APDC into

     MIBK. The advantages of the technique are its simplicity,

     speed, relatively good precision, relative freedom from con-

     tamination effects, high sensitivity and self-compensation for

     any incomplete extraction of the complexes. Detection limits

     in salines ranged from 0.05 ppb for Zn to 0.2 ppb for Pb in

     MIBK with Perkin-Elmer model 303.

58 Brooks, R.R, B.J. Presley, and I.R. Kaplan. 1967. Determination
     of copper in saline waters by atomic absorption spectrophotometry
     combined with APDC-MIBK extraction. Anal. Chim. Acta 38:
     321-326. 7 ref., 1 tab., 1 fig.

         Cu in saline water samples (sea water, lake water and inter-

     stitial samples) was determined by AAS after extracting its

     complex with APDC into MIBK. With a 15:510 solvent-aqueous phase

     ratio, a sensitivity of 0.2 ppb was achieved.

59 Brooks, R.R., B.J. Presley, and I.R. Kaplan. 1968. Trace elements
     in the interstitial waters of marine sediments. Geochim. Cosmochim.
     Acta 32:397-414. 33 ref., 6 tab., 7 fig.

         PO_4 and 11 elements were determined in the interstitial

     waters: P colorimetrically, Ca, Mg, K, Na, and Sr by direct

     aspiration AAS, and Cd, Co, Cu, Ni, Fe, and Zn after APDC-MIBK

     extraction and AAS. Perkin-Elmer model 303 with scale expansion

     of 10 was used. Detection limits were <0.2 ppb for most elements

     and the coefficients of variation for replicate analyses were <10%

     except for Co (15%).

60 Browman, M.G., G. Chesters, and H.B. Pionke. 1969. Evaluation of
        tests for predicting the availability of soil manganese to plants.
        J. Agric. Sci., Camb. 72:335-340. 22 ref., 4 tab.

        In a greenhouse experiment, corn was harvested after 6-wk

        cropping. The top portions (60 mesh; 110°C) were ashed at 580°C

        and analyzed for Mn by AAS. Soil extracts -- NH_4OAc (1.0$\underline{N}$, pH 7.0),

        0.1$\underline{N}$ H_3PO_4 and 0.01$\underline{M}$ EDTA in 1$\underline{M}$ $(NH_4)_2CO_3$ -- were analyzed for Mn

        by AAS. Other soil extracts were analyzed for Mn by colorimetric

        methods.

61 Brown, A.L., J. Quick, and J.L. Eddings. 1971. A comparison of
        analytical methods for soil zinc. Soil Sci. Soc. Am. Proc. 35:
        105-107. 11 ref., 1 tab., 4 fig.

        Soils from 92 fields were analyzed for extractable Zn by 4

        methods: 1. NH_4OAc - dithizone method: colorimetrically

        2. 0.1$\underline{N}$ HCl 3. DTPA 4. Zn with 1% Na_2EDTA solution and

        Zn determined by AAS. Total Zn was determined by X-ray

        fluorescence.

62 Brownell, P. 1959. The estimation of sodium by atomic absorption.
        Paper presented at the second Australian Spectroscopy Conference,
        Melbourne, Australia, June 1-3, 1959. Abstract in Spectrochim.
        Acta 15:785-786.

        "Si-ro-spec" AAS instrument was used to determine minute

        quantities of Na in highly concentrated culture solutions, boiling

        water, and acid digestion extracts of bladder saltbush.

63 Brunelle, R.L., C.M. Hoffman, K.B. Snow, and M.J. Pro. 1969. Neutron
        activation and atomic absorption analyses of chemical elements in
        soil. J. Assoc. Off. Anal. Chem. 52:911-914. 6 ref., 7 tab.

Soil samples were prepared by Na_2CO_3 fusion method (Pt crucibles; 1000°C for 1 h) or acid digestion method (HF; HNO_3-$HClO_4$ treatment). Total Al, Ca, Cr, Cu, Fe, Li, Mg, Mn, Na, Ni, K, Sr, Rb, and Zn were determined by AAS. A Jarrell-Ash model 82-500 AA unit equipped with a Hetco total consumption burner using H_2-air fuel mixture was used. For Al, a tri-flame laminar flow burner with a N_2O-C_2H_2 fuel mixture was employed. Ru is also measurable by AAS.

64 Buchanan, J.R. and T.T. Muraoka. 1964. Determination of zinc and manganese in tree leaves by atomic absorption spectroscopy. Atom. Absorp. Newsl. 3:79-83. 6 ref., 3 tab.

Leaf samples of deciduous fruit trees (Mn-70 samples, Zn-46 samples) were ashed at 550°C for 2-3 h and HCl-HNO_3 extracts were prepared. Perkin-Elmer model 303 was used. Extracts were used for Mn and Zn by AAS and Mn by permanganate method. Zn by X-ray flourescence was analyzed on ground plant samples. AAS results agreed very well with permanganate and X-ray flourescence methods.

65 Burelli, F.P. and F. Ecrement. 1969. La détermination du chrome dans les eaux par spectrophotométric d'absorption atomique: Application aux mesures des débits de cours d'eau. (The determination of chromium in water by atomic absorption spectrophotometry: Application in the measurement of water course flows). Chim. Analyt. 51:561-566. 7 ref., 2 tab., 7 fig.

$Na_2Cr_2O_7$ can serve as an excellent tracer in evaluating the flow of water courses. To find its dilution, Cr is determined in water by colorimetric and AAS, the latter being more rapid and highly specific. Higler and Watts model AA2 unit was used (N_2O-C_2H_2 flame).

66 Burke, K.E. and C.H. Albright. 1970. Atomic absorption spectrometric
    determination of copper and nickel in tea. J. Assoc. Off. Anal.
    Chem. 53:531-533. 5 ref., 6 tab.

        Organic matter in tea samples was decomposed by oxidation

    with HNO_3 and $HClO_4$ or by dry ashing. An average matrix composi-

    tion was determined and synthetic standards prepared. AAS results

    were compared with chemical, X-ray and optical emission spectro-

    scopy methods. An average of 50 determinations gave a mean of

    11 ppm Ni and 32 ppm Cu with standard deviations of 1.6 and 1.8,

    respectively. Perkin-Elmer model 303 equipped with a premix

    chamber and a three-slot Boling burner head was used.

67 Burke, K.E. and C.H. Albright. 1971. Atomic absorption spectroscopy
    for determination of ppm quantities of copper and nickel in tea.
    J. Assoc. Off. Anal. Chem. 54:658-662. 3 ref., 4 tab.

        Five-100 ppm Cu (at 324.7 nm) and Ni (at 232.0 nm) in both

    made and instant tea can be determined by the reported AAS method.

    Samples are wet ashed and after dilution are aspirated into air-

    C_2H_2 flame. Results from 7 collaborators are presented. The

    procedure has been adopted as official "first action".

68 Burling, E. and W.T. Jackson. 1965. Changes in calcium levels in
    cell walls during elongation of oat coleoptile sections. Plant
    Physiol. 40:138-141. 12 ref., 1 tab., 2 fig.

        To determine the relation between the absolute Ca levels in

    cell walls and cell elongation, coleoptile sections from oat were

    obtained and the cell walls were separated. Intact sections

    and cell walls were dried at 60°C for 8 h and ashed at 550-600°C

    for at least 12 h.   The ash was dissolved in a solution of 6$\underline{N}$ HCl

    and 5% La (La_2O_3) and diluted to obtain a final concentration of

    1% La. Ca was determined by Perkin-Elmer model 303.

69 Burrell,D.C. 1965. The determination of nickel and cobalt in
        natural waters by atomic absorption spectrophotometry: A pre-
        liminary study. Atom. Absorp. Newsl. 4:309-311. 10 ref.,
        3 tab., 2 fig.

        A procedure utilizing simple preconcentration techniques

    for determining trace metals in river and ocean waters is

    described. Perkin-Elmer model 303 was used for this two-stage

    technique which consisted of first $Fe(OH)_3$ coprecipitation and

    then chelation with APDC and extraction into MIBK. Detection

    limits for Co (240.7 nm) and Ni (232.0 nm) were 0.15 and 0.3 ppb,

    respectively.

70 Burrell,D.C. 1967. Trace elements in marine waters by atomic absorp-
        tion spectrophotometry. Anal. Chim. Acta 38:447-455. 26
        ref., 5 tab.

        Li, Rb, and Sr were determined in sea water by Perkin-Elmer

    model 303. Problems in the determination of transition elements

    (Fe, Mn, Cu, and Zn) are discussed. Cu, Fe, Mn, and Zn were

    determined in tap water to study the feasibility of application

    of AAS in continuous stream analysis. Preconcentration is essen-

    tial in the case of transition elements because of significantly

    lower concentrations in sea water.

71 Burrell, D.C. 1968. Atomic absorption spectrophotometry in the field
        of marine research. Atom. Absorp. Newsl. 7:65-68. 36 ref.,
        2 tab.

        A review of various applications of AAS in oceanographic

    sciences.

72 Burrell, D.C. and G.G. Wood. 1969. Direct determination of zinc
        in sea water by atomic absorption spectrophotometry. Anal.
        Chim. Acta 48:45-49. 22 ref., 1 tab.

        Total Zn was determined (0.25 ml sample) directly with the

    use of a tantalum "sampling boat" accessory. The detection

    limit in a sea water matrix was $2 \cdot 10^{-7}$ mg Zn. Precision of $\pm$

    0.04 and 0.15 µg Zn/ℓ is reported for Zn standards in double

    distilled water and in sea water, respectively. The procedure

    is simple and rapid. Perkin-Elmer model 303 was used.

73 Butler, L.R.P. and P.M. Mathews. 1966. The determination of trace
        quantities of molybdenum by atomic absorption spectroscopy.
        Anal. Chim. Acta 36:319-327. 10 ref., 8 tab., 3 fig.

        Water samples were prepared by evaporating 500 ml

    sample to about 40 ml, adding 2 ml HCl to dissolve any precipitate

    formed, adding 5 ml 10% solution of citric acid to complex Fe and

    adjusting pH to 2.0. Plant samples were prepared by ashing

    5-10 g sample at 500°C, dissolving ash in HCl, diluting to 40 ml

    and treating as water samples.

        Mo was complexed with APDC or 8 - hydroxyquinoline,

    extracted into n-amyl methyl ketone and determined at 313.3 nm

    by AAS. Detection limits of 0.002 ppm for water and 0.1 ppm

    for plant samples (peach leaves, beetroot leaves and lucerne)

    were obtained. Results of plant analysis were less precise than

    water analysis, possibly due to non-homogeneity of the former

    samples. A Zeiss PMQ II spectrophotometer with self-built AA

    attachment and later a Perkin-Elmer model 303 were used.

74 Carr, R.A. 1969. Determination of silver in sea water matrix by
        atomic absorption spectrophotometry. Atom. Absorp. Newsl.
        8:69. 1 ref., 2 fig.

Describes a method to determine trace amounts of

Ag freshly introduced (Ag that leached from Ag membrane filters,

0.45 μ pore size, during removal of particulates) into a sea

water matrix. Perkin-Elmer model 303 was used. Analyses should

be performed within 1 h of sample preparation.

75 Carr, R.A. 1970. Salinity effects on the determination of strontium
       in sea water by atomic absorption spectrophotometry. Limnol.
       Oceanogr. 15:318-320. 6 ref., 2 tab.

Differences in the salinity of samples and standards may

be a source of error in the determination of Sr in sea water.

Perkin-Elmer model 303 equipped with a Boling burner and connected

to a digital concentration readout with a recorder (Texas Instru-

ments) was used. Sensitivity of Sr determination varied inversely

with salinity. Absorbance of 7.5 ppm Sr in NaCl solution gave

absorbance of 0.195 to 0.150 when salinity was increased from

15% to 40%.

76 Chao, T.T. 1969. Determination of gold in waters in the nanogram
       range by anion exchange and atomic absorption spectrophotometry.
       Econ. Geol. 64:287-290, 7 ref., 1 tab., 4 fig.

The method involves the determination of optimum conditions

for the complete recovery of Au from water with an anion exchange

resin, quantitative elusion of Au from resin, MIBK extraction

and determination by AAS. Between 20 and 50 ng Au/ℓ can be

accurately determined. Perkin-Elmer 303 was used.

77 Chao, T.T. and J.W. Ball. 1971. Determination of nanogram levels
    of silver in suspended materials of streams retained by a
    membrane filter with the "sampling-boat" technique. Anal.
    Chim. Acta 54:166-168. 7 ref., 2 fig.

The samples of stream water were filtered through a 4-in.

Gelman membrane filter (0.45 μm pore size) under a N_2 pressure

of 40 psi. The membrane filter with suspended materials was

dried. Then the procedure consisted of dry ashing at 450°C,

digestion of residue with HNO_3, extraction with TOTP

-MIBK, stripping of Ag back into 0.3$\underline{M}$ HCl and deter-

mining by AAS using "sampling boat". Perkin-Elmer 303

with model 165 Perkin-Elmer recorder was used. Relative S.D.

was found to be 3-5% of the amount present from a fraction of

1 ng to 10 ng.

78 Chao, T.T., J.W. Ball, and H.M. Nakagawa. 1971. Determination of
    silver in soils, sediments, rocks by organic-chelate extraction
    and atomic absorption spectrophotometry. Anal. Chim. Acta
    54:77-81. 6 ref., 2 tab., 2 fig.

Soils and other samples (<100 mesh) were digested with

HNO_3 and the digest diluted to about 6$\underline{M}$. Ag was extracted

with TOTP in MIBK. The Ag complex is stable and remains

in the organic phase for several days. Ag was analyzed

by AAS using Perkin-Elmer model 303. As little as 0.05 ppm

Ag in samples can be detected by the method described.

79 Chao, T.T., M.J. Fishman, and J.W. Ball. 1969. Determination of traces
    of silver in waters by anion exchange and atomic absorption
    spectrophotometry. Anal. Chim. Acta 47:189-195. 11 ref.,
    1 tab., 4 fig.

A method for an accurate determination of 0.1-1 μg Ag/ℓ

water has been developed. Ag is recovered from water with an

anion exchange column, eluted from the resin and determined by

AAS after chelation with APDC and extraction with MIBK. However,

Ag in 1-10 μg/ℓ range can be determined by MIBK extraction with-

out prior concentration on resin.

80 Chau, Y.K. and K. Lum-Shue-Chan. 1969. Atomic absorption determina-
    tion of microgram quantities of molybdenum in lake waters.
    Anal. Chim. Acta 48:205-212. 16 ref., 4 tab., 1 fig.

    Mo is extracted from water by oxine (1% in MIBK) and deter-

    mined by AAS. Spiked and natural lake waters were analyzed.

    The sensitivity of the method was found to be 1 ppb. A Jarrell-

    Ash model 82-528 was used.

81 Chau, Y.K. and K. Lum-Shue-Chan. 1970. Complex extraction of
    vanadium for atomic absorption spectroscopy. Anal. Chim.
    Acta 50:201-207. 18 ref., 2 tab.

    A number of chelating agents were studied for their suit-

    ability for extraction of vanadium for AAS analysis.

    Dichloro-oxine was able to extract vanadium (IV), vanadium

    (V) and 90% of vanadium (III), forming a very stable com-

    plex. The method described here combines extraction and AAS

    for determining vanadium (at 318.4 nm) in lake water with a

    sensitivity of 0.3 ppb. A Jarrell-Ash AA spectrophotometer

    (model 820-528) with a N_2O burner and a Coleman-Hitachi recorder

    (model 165) were used. Recovery of added vanadium was 98-102%.

82 Chau, Y.K. and H. Saitoh. 1970. Determination of submicrogram
    quantities of mercury in lake waters. Environ. Sci. Technol.
    4:839-841. 12 ref., 1 tab., 2 fig.

Hg is extracted by dithizone, back extracted by HCl and
then converted to vapor by a reduction-aeration reaction. A
sensitivity of 0.008 ppb was achieved for water analysis. Jar-
rell-Ash model 820-528 was used.

83   Chau, Y.K. and H. Saitoh. 1971. Determination of submicrogram
     quantities of mercury in lake waters. Effluent Water Treat.
     J. 11:135-138. 12 ref., 1 tab., 2 fig.

     Reprint of ref. 82.

84   Chau, Y.K., S.S. Sim, and Y.H. Wong. 1968. Determination of chromium
     by atomic absorption spectrophotometry of chromium acetylacetonate:
     Determination of chromium in sea water. Anal. Chim. Acta
     43:13-18. 10 ref., 2 tab., 1 fig.

     Cr at a level of about 1.6 μg/ℓ can be determined in sea

     waters. Cr (II) is converted to its acetylacetone complex and

     extracted into MIBK for AAS determination. A Techtron model

     A.A. 4 was used.

85   Chau, Y.K. and P.Y. Wong. 1968. Determination of scandium in sea
     water by atomic absorption spectroscopy. Talanta 15:867-870.
     7 ref., 2 tab.

     To determine Sc in sea water in the submicro-

     gram level, it is co-precipitated with $Fe(OH)_3$ at pH 8-9 and

     then separated from Fe by ion-exchange. Sc is then extracted

     into a solution of oxine in butanol and determined at 391.35 nm

     by AAS using N_2O flame. Techtron A.A. 4 was used.

86   Chaudhry, F.M. and J.F. Loneragan. 1970. Effects of nitrogen, copper,
     and zinc fertilizers on the copper and zinc nutrition of wheat
     plants. Aust. J. Agric. Res. 21:865-879. 34 ref., 5 tab.,
     3 fig.

Wheat was grown in pots in an acid loamy sand (pH 4.7)

from Badgingarra, Western Australia. Harvesting was done at

20, 44, 60 days and at maturity (162 days). Tops and roots

were dried at 70°C and digested in a HNO_3-$HClO_4$ mixture. Cu

was complexed at pH 3-4 by cupferron (nitrosophenylhydroxylamine),

extracted into amyl alcohol and determined by AAS. The digest

was diluted and Zn determined by AAS.

87 Cheng, B.T. and G.J. Ouellette. 1968. Effect of various anions on
     manganese toxicity in Solanum tuberosum. Can. J. Soil Sci.
     48:109-115. 18 ref., 3 tab.

Potatoes were grown in a soil (pH 4.5) and in sand cultures.

Exchangeable K and Mn in soil and total K and Mn in leaves

collected at the early and late blooming stages and the rest

of the leaves, stems and tubers at harvesting were determined

by AAS.

88 Cheng, B.T. and G.J. Ouellette. 1970. Effects of steam steriliza-
     tion and organic amendments on the manganese status and associ-
     ated characteristics of acid soils. Soil Sci. 110:383-388.
     19 ref., 9 tab.

Soils (gravelly loam, clay loam and organic soil) and

organic amendments (compost and peat moss) were used. Samples

were extracted with $1\underline{N}$ NH_4OAc (pH 7.0) for exchangeable Fe and

Mn and $1\underline{N}$ NH_4OAc containing 0.2% hydroquinone for easily

reducible Mn. Extracts were analyzed by AAS.

89 Cheng, B.T. and G.J. Ouellette. 1971. Effects of organic amendments
     on manganese toxicity in potatoes as measured by sand and soil
     culture studies. Plant Soil 34:165-181. 26 ref., 12 tab.

Potato leaves and petioles were collected at the early

blooming stage and at the time of harvesting. After oven-drying

at 70°C for 8 h the plant material was ground with a Wiley mill

to pass a 60-mesh screen. $HClO_4$-HNO_3 digests were analyzed for

Ca, Fe, and Mn by AAS and flame emission spectroscopy.

90 Christian, G.D. and F.J. Feldman. 1970. Atomic Absorption Spectro-
        scopy: Applications in agriculture, biology, and medicine.
        John Wiley & Sons, Inc. New York, NY. 490 pp.

        The book is divided into two essentially independent parts:

        (1) Principles and theory (2) Applications. It is a com-

        prehensive monograph on applications (soil, plant, fertilizer

        and other type of samples) and contains literature that appeared

        up to mid-1969.

91 Christman, R.F., M. Ghassemi, R.K. Ham, E.R. Lynd, S.E. Smith, and
        G.R. Webster. 1967. A review of the literature of 1966 on
        waste-water and water pollution control--analytical methods.
        J. Water Pollut. Control Fed. 39:689-703. 112 ref.

        Reviews 1966 literature on AAS and other techniques.

92 Clement, C.R. and M.J. Hopper. 1970. Nutrient levels in the soil
        and the yield of potatoes following cut grass, grazed grass and
        arable cropping. J. Sci. Food Agric. 21:601-606. 18 ref.,
        6 tab.

        Leaflets and petioles of potatoes, grown in an arable

        rotation and after cut or grazed grass, were analyzed for K, Na,

        Mg, and Ca by emission and AAS. Exchangeable K and the K, Ca, Na,

        and Mg in the aqueous soil extracts were analyzed by flame

        photometry.

93 Clinton, O.E. 1967. A three channel flame photometer for soil analysis. N.Z. J. Sci. 10:1069-1075. 2 ref., 4 fig.

The flame photometer described here enables simultaneous determination of K and Ca by flame emission and Mg by AAS in the NH_4OAc extracts of soils.

94 Cochran, P.H., G.M. Marion, and A.L. Leaf. 1970. Variations in tension lysimeter leachate volumes. Soil Sci. Soc. Am. Proc. 34:309-311. 5 ref., 4 tab., 2 fig.

Stacks of plate- or sideless-tension lysimeters were installed in the sides of pits at soil depths of 15, 61, and 152 cm in the approximate center of eight 0.08 ha plots supporting a 40 yr old red pine plantation. A 1-liter aliquot of the lysimeter plate leachate was evaporated on a hot plate (95°C) to dryness, taken up in 10 ml of 30% H_2O_2, evaporated to dryness, taken up in 100 ml of 0.6$\underline{N}$ HCl and filtered. The filtrate was analyzed for Ca and Mg by AAS, Na and K by flame photometer, and P colorimetrically.

95 Collins, H.A. and H.E. Burch. 1970. Accumulation of strontium and other cations by plant species grown on two soil types. Crop Sci. 10:312-314. 14 ref., 1 tab.

Shoot tissues of 22 plant species were dry-ashed in silica crucibles. La (as oxide) in a final concentration of 1% was added to the ash extracts and Ca, Mg, K, and Sr determined by Perkin-Elmer model 303 equipped with a Boling burner head. The following species were included: mustard, crotalaria, white clover, velvet bean, sickle-pod, red clover, garden pea, Hubam clover, alfalfa, lupine, sunflower, vetch, coffee senna, big

bluestem, kidney beans, kudzu, Italian ryegrass, dock,

morning glory, sweet corn, Johnsongrass, and sorghum.

96 Colwell, J.D. 1970. A statistical-chemical characterization of
        four Great Soil Groups in southern New South Wales based on
        orthogonal polynomials. Aust. J. Soil Res. 8:221-238. 10
        ref., 4 tab., 9 fig.

    Soils were collected at sites 0.4 ha in area located within

wheat paddocks in the southern New South Wales. At each site

core samples of 5 cm diam were taken to a depth of 1 m (0-10,

10-20, ..., 90-100 cm). For the determination of exchangeable

cations, $1\underline{N}$ NH_4Cl (pH 7) extracts were prepared (5 g soil + 100

ml extractant). Ca and Mg were determined by AAS and Na and K

by flame photometry.

97 Coonley, L.S., Jr., E.B. Baker, and H.D. Holland. 1971. Iron in
        the Mullica River and in Great Bay, New Jersey. Chem. Geol.
        7:51-63. 9 ref., 4 tab., 3 fig.

    Fe content of samples of river water was determined by

Perkin-Elmer model 303.

98 Cotter, D.J. and U.N. Mishra. 1968. The role of organic matter in
        soil manganese equilibrium. Plant Soil 29:439-448. 18 ref.,
        5 tab., 1 fig.

    Exchangeable Mn was extracted with $1\underline{N}$ NH_4OAc. Easily

reducible Mn was extracted with $1\underline{N}$ NH_4OAc containing 0.2% hydro-

quinone or $Na_2S_2O_4$ at 0.2% or 0.4%. The Mn concentration in

the extracts was determined by AAS.

99 Courtot-Coupez, J. and A. Le Bihan. 1969. Dosage des detergents
        anioniques dans l'eau de mer. Generalisation de la methode aux
        eaux douces et a la determination des detergents cationiques.
        (Determination of anionic detergents in sea water: Application
        of the method to fresh water and to cationic detergents.)
        Anal. Lett. 2:211-219. 14 ref., 4 tab., 2 fig.

For the determination of anionic surfactants in sea water

(10–500 µg/ℓ) an ion-pair is formed between orthopheranthroline-

Cu (II) cationic and anionic surfactant and extracted by MIBK.

Cu is determined in the solvent by AAS. Method is applicable

for determining anionic surfactant in fresh water and also

cationic surfactants.

100 Creger, C.R., E.C. Holt, and D.A.Lovelace. 1970. Calcium and strontium
     relationship in various commercially important plants. Agron.
     J. 62:297–299. 21 ref., 1 tab., 3 fig.

     Bean, cotton, and sorghum were grown in a sand-culture

     experiment. Tops and roots, collected 14 days after planting,

     were dry ashed at 580°C for 24 h. ash dissolved in 0.5 ml HCl

     and diluted with 24.5 ml water. The digest was analyzed for

     Ca and Sr by AAS.

101 Cundiff, R.H. and J.T. Dobbins, Jr. 1966. Determination of potassium
     and calcium in tobacco. J. Assoc. Off. Anal. Chem. 49:521–525.
     5 ref., 5 tab.

     Ca was determined by AAS, EDTA titration and flame photometry

     while K was determined by flame photometry only. For

     the determination of Ca, AAS offers considerable promise

     in eliminating many of the problems experienced with flame

     photometry. La is preferred to Sr as a releasing agent.

102 Dagnall, R.M., G.F. Kirkbright, T.S. West, and R. Wood. 1971.
     Multichannel atomic fluorescence and flame photometric determina-
     tion of calcium, copper, magnesium, manganese, potassium, and
     zinc in soil extracts. Anal. Chem. 43:1765–1769. 17 ref., 8 tab.

     Exchangeable Ca, Cu, Mg, Mn, K, and Zn in soils ($1\underline{N}$ NH_4OAc,

     2.5% HOAc or 0.05$\underline{M}$ EDTA extracts) determined by atomic fluorescence

     compare favorably with AAS (Perkin-Elmer model 303) results.

103 David, D.J. 1958. Determination of zinc and other elements in
        plants by atomic absorption spectroscopy. Analyst 83:655-661.
        9 ref., 5 tab., 1 fig.

        Plant material (1-2 g) was digested with 4 ml H_2SO_4-$HClO_4$

        mixture (1:7) and about 15 ml HNO_3. Zn (213.9 nm), Mg (285.2 nm),

        Cu (324.7 nm) and Fe (375.8 nm) were determined by AAS. Repro-

        ductibility test gave these results: Zn gave 58.56 ± 1.07% absorp-

        tion at 10 ppm Zn and 7.26 ± 0.94% absorption at 1 ppm Zn. Mg

        gave 10.37 ± 0.33% absorption at 0.5 ppm Mg and 43.15 ± 1.01%

        absorption at 5 ppm Mg. Zn results for stem, leaf, and petiole

        samples of clover were compared with polarographic method.

104 David, D.J. 1959. The application of atomic absorption spectropho-
        tometry to plant and soil analysis. Paper presented at the
        Second Australian Spectroscopy Conference, Melbourne, Australia,
        June 1-3, 1959. Abstract in Spectrochim. Acta 15:785.

        In plant analysis no serious interference was observed

        for Zn, Fe, Cu, and Mg determination by extraneous elements.

        However, PO_4, Al and Si interferred in Ca analysis. Na

        and K enhanced Ca absorption. In soil analysis NH_4Cl in the

        extract suppressed interference in Ca determination up to

        20 ppm Si but had little effect on the interference due to Al,

        PO_4, and SO_4. Sr (1500 ppm) was better than La in suppressing

        these interferences.

105 David, D.J. 1959. Determination of calcium in plant material by
        atomic absorption spectrophotometry. Analyst 84:536-545. 9
        ref., 11 tab., 3 fig.

        Dry matter (0.3-0.5 g) was ashed with 1.25 ml H_2SO_4 + 3.75

        ml $HClO_4$ and about 15 ml HNO_3 was added. After ashing and filtra-

        tion the volume was made up to 50 ml. In the determination of Ca

(422.67 nm) interferences due to Al, P, and Si were eliminated

by adding 6000 ppm Mg and 2% v/v H_2SO_4, and those due to K and

Na were eliminated by adding these elements in excess (200 ppm

Na, 1500 ppm K) to samples and standards. The procedure does not

need such time-consuming operations as precipitation, ion-exchange

or extraction to remove interfering elements. Recoveries obtained

were 92.6-104.5% of added Ca. AAS results are compared with

those obtained by flame photometry and by titration of the oxalate

with permanganate.

106 David, D.J. 1960. The application of atomic absorption to chemical
analysis: A review. Analyst 85:779-791. 45 ref., 1 tab.

Discusses the theory and instrumentation and compares

sensitivity, precision and accuracy with other analytical methods

in soil and plant analysis.

107 David, D.J. 1960. Atomic absorption spectrophotometric determination
of molybdenum and strontium. Nature 187:1109. 7 ref., 1 tab.

Despite the use of reducing flame, the presence of an oxi-

dizing agent (HNO_3) in the solution did not interfere seriously

in the determination of Mo (313.2 nm) in superphosphate. Sr

was determined at 460.7 nm.

108 David, D.J. 1960. The determination of exchangeable sodium, potas-
sium, calcium and magnesium in soils by atomic absorption spec-
trophotometry. Analyst 85:495-503. 12 ref., 7 tab., 1 fig.

Addition of 1500 ppm Sr was better than La in suppressing

Al, PO_4, Si, and SO_4 interferences, in 1$\underline{N}$ NH_4Cl soil extracts,

for Ca and Mg. No interference was found in Na or K determina-

tion. 10 g soil extracted with 200 ml solution can be analyzed

without preliminary concentration. However, dilution is neces-

sary. AAS results were compared with gravimetric, volumetric

and flame-photometric emission methods.

109 David, D.J. 1961. The determination of molybdenum by atomic-absorp-
tion spectrophotometry. Analyst 86:730-740. 15 ref., 6 tab.,
3 fig.

In a reducing flame, Ca, Sr, Mn, Fe, and SO_4 ions reduced

Mo absorption but this interference was suppressed by the addi-

tion of $AlCl_3$. AAS results for Mo determination in superphos-

phate were compared with colorimetric methods.

110 David, D.J. 1962. Atomic absorption spectrochemical analysis of
plant materials with particular reference to manganese and iron.
Atom. Absorp. Newsl. 1:45-50. 7 ref., 2 tab., 1 fig.

For the determination of Na, K, Mg, Mn, Fe, Zn, and Ca,

2 g plant sample was ashed with 4 ml 7:1 v/v $HClO_4$-H_2SO_4 and

15 ml HNO_3 and the digest was made to 50 ml after filtration.

For the first 6 elements, standards were prepared in 1% v/v

H_2SO_4 to give concentration equal to that present in the residual

digestion reagents in the sample solution. For Ca determination,

Mg, S, K, and Na were added to samples and standards. For Sr,

the dry-ashed sample was extracted with 0.1N HCl and P removed

by anion-exchange column before determination.

111 David, D.J. 1962. Determination of strontium in biological materials
and exchangeable strontium in soils by atomic-absorption spectro-
photometry. Analyst 87:576-585. 14 ref., 4 tab., 3 fig.

Ca and P together seriously depress absorption of Sr

(460.7 nm) but Ca or P alone does not produce serious

depression. Although Al seriously depresses Sr absorption,

this interference is eliminated by excess Ca, as found in most

of the soil solutions. It is recommended that PO_4 from plant

ash be removed by De-Acidite FF ion exchange resin. For soils,

$1\underline{N}$ NH_4Cl was used. In some acid soils Ca was added to suppress

Al interference.)

112 David, D.J. 1962. Emission and atomic absorption spectrochemical
      methods. 33 ref., 7 tab., 7 fig. pp. 1-25. $\underline{In}$ H.F. Linskens
      and M.V. Tracey (ed). Moderne methoden der pflanzenanalyse
      (Modern methods of plant analysis). Spinger-Verlag, Berlin,
      Vol. 5.

A review of use of AAS in plant analysis, essentially

based on the work carried out by Allan (1958, 1959) and David

(1958, 1959 and unpublished data).

113 David, D.J. 1964. An ion-exchange column for use with atomic-ab-
      sorption analysis. Analyst 89:747-748. 2 ref., 1 tab., 1 fig.

For Sr determination in plant material, phosphate is

removed by means of an anion-exchange column whose design

and operation are discussed. Plant ash is dissolved

in $0.02\underline{N}$ HCl and passed through this column. The use of

the acetate form of De-Acidite FF is effective

in removing phosphate to prevent interference in Ca and Sr

determinations by AAS.

114 David, D.J. 1964. Recent developments in atomic absorption anaysis.
      Spectrochim. Acta 20:1185-1195. 83 ref.

A review dealing with, among other topics, scope of AAS

in the analysis of sea water, agriculture, etc.

115 David, D.J. 1969. Atomic-absorption determination of strontium in
a standard plant material: Comment on results of inter-labora-
tory comparison. Analyst 94:884-885. 4 ref., 1 tab.

The standard kale sample received from Dr. Bowen

was dry ashed, dissolved in HCl, passed through De-Acidite FF

(acetate form) anion-exchange column and Sr determined by AAS

in the column effluent.

116 Day, J.A., T.C. Wirt, and R.D. Mortensen. 1971. Atomic absorption
spectrophotometric analysis of the calcium ion gradient in
gladiolus. Bot. Gaz. 132:62-65. 7 ref., 1 tab.

Ca content in the gynoecial tissue of gladiolus flowers

was determined by AAS (Perkin-Elmer model 303). Samples were

wet ashed by the method suggested by David (105) and Perkin-

Elmer Corporation (327).

117 De Kimpe, C. 1970. Chemical, physical and mineralogical properties
of a podzol soil with fragipan derived from glacial till in the
province of Quebec. Can. J. Soil Sci. 50:317-330. 34 ref.,
4 tab., 5 fig.

Exchangeable cations were extracted with 2$\underline{N}$ NaCl. Elemental

analysis was carried out by AAS. Free Fe and Al were extracted

and determined in oxalate and dithionite-citrate-bicarbonate

solutions. Al and Fe were also extracted from interlayer posi-

tions.

118 Dobbins, D.A., P.C. Ragland, and J.D. Johnson. 1970. Water-clay
interactions in North Carolina's Pamlico estuary. Environ.
Sci. Technol. 4:743-748. 22 ref., 5 tab., 6 fig.

The bore to bottom water ratio of cationic equivalents was

measured. Na, K, and Mg were determined by Perkin-Elmer model 303.

All analyses were checked for interference by the addition

method. No interferences were observed.

119 Doherty, P.E. and R.S. Dorsett. 1971. Determination of trace
concentrations of mercury in environmental water samples. Anal.
Chem. 43:1887-1888. 4 ref., 1 tab.

Hg was electrodeposited onto a Cu cathode and then deter-

mined by flameless AAS with a Hg discharge lamp. Four Federal

Water Quality Administration samples were analyzed.

120 Draycott, A.P. and M.J. Durrant. 1969. The effects of magnesium
fertilizers on yield and chemical composition of sugar beet.
J. Agric. Sci., Camb. 72:319-324. 8 ref., 5 tab., 2 fig.

Field experiments were conducted between 1964 and 1967.

Leaves, petioles, and roots of sugar beets were analyzed for K

by flame emission and Ca, Mg, and Na by AAS.

121 Dudas, M.J. and M.E. Harward. 1971. Effect of dissolution treat-
ment on standard and soil clays. Soil Sci. Soc. Am. Proc.
35:134-140. 18 ref., 5 tab., 4 fig.

Clay samples were extracted alternatively with $Na_2S_2O_4$-

citrate-bicarbonate (3 times) and boiling $0.5\underline{N}$ NaOH or KOH (2

times). Samples were also extracted alternatively with acid

ammonium oxalate and $0.5\underline{N}$ NaOH or KOH. Fe in the $Na_2S_2O_4$-

citrate-bicarbonate extract was determined by AAS. Si and Al

in the $Na_2S_2O_4$-citrate-HCO_3, KOH, and NaOH extracts were deter-

mined colorimetrically. For CEC determination, Ca saturation

was done with $1\underline{N}$ $CaCl_2$ washed till Cl-free, Ca replaced by $1\underline{N}$

KCl and determined by Perkin-Elmer model 303.

122 Durie, R.A. 1961. Third Australian Spectroscopy Conference. Nature
192:927-929.

B.G. Davey described the applications of AAS to the analysis

of agricultural materials. D.J. David discussed the determina-

tion of Mo. J.E. Allan indicated that the determination of Co

and Ni in agricultural materials had been studied in detail and

procedures established for the analysis of fertilizers.

123 Dvořák, J. 1967. Stanovení hořčíku v rostlinném materiálu absorpčni
     plamenovou spektrofotometrií (Determination of magnesium in
     plant materials by means of absorption flame spectrophotometry).
     Chem. Listy 61:390-394. 4 ref., 1 tab., 7 fig.

     Sample (0.5-5 g) was ashed with H_2SO_4 and HNO_3. $La(NO_3)_3$

was added (20 mg La/100 ml solution) to eliminate interferences

by Al, P, H_2SO_4, Ca, and Na. Mg determination was carried out

in a C_3H_8-air flame using a Hilger Uvispek spectrophotometer.

Maximum error was 2.57%. Wheat, straw, hay, tobacco, and flour

were analyzed.

124 Eaton, G.W. and M.K. John. 1971. Effect of lime and manganese upon
     growth and mineral composition of pea cv. "Dark Skin Perfection".
     Agron. J. 63:219-221. 10 ref., 5 tab.

     Soil experiment and solution culture experiment were con-

ducted in greenhouse in 1969. Plants were separated into leaves,

pods, stems, and roots. Samples were digested with $HClO_4$-HNO_3

mixture. P was analyzed colorimetrically and Al, Ca, Cu, Fe, K,

Mg, Mn, Na, and Zn by AAS.

125 Elliot, J.M. 1969. Effect of applied manganese, sulfur, and phos-
     phorus on the manganese content of oats and flue-cured tobacco.
     Can. J. Soil Sci. 49:277-285. 27 ref., 3 tab.

     Field and greenhouse experiments were conducted on a sandy

loam soil. Moist soil was extracted for exchangeable and easily

reducible Mn and $NaHCO_3$-extractable P which were analyzed by AAS

and colorimetrically, respectively. The tobacco samples

(green and cured leaves and stalks) were wet ashed and oat

plant material dry ashed. Cu, Fe, and Mn were determined by

AAS.

126 El-Sayed, M.H., R.G. Burau, and K.L. Babcock. 1970. Thermodynamics
of copper (II)-Calcium exchange on bentonite clay. Soil Sci.
Soc. Am. Proc. 34:397-400. 12 ref., 4 tab., 3 fig.

Wyoming bentonite was converted to homoionic-calcium clay

by the exchange resin technique. The resulting clay suspension

as well as its equilibrium extract were analyzed chelometrically

for Ca. Ca clay suspensions and cupric nitrate solutions were

shaken for 1 h in a waterbath and centrifuged. Ca and Cu

were determined in the supernatants by AAS.

127 Elwell, W.T. and J.A.F. Gidley. 1966. Atomic-Absorption Spectro-
photometry. 2nd (rev) ed. Pergamon Press, London, England.
140 pp. Vol. 6 of the International Series of Monographs in
Analytical Chemistry (R. Belcher and L. Gordon, eds.).

Provides necessary background information on AAS. Limita-

tions of the technique are also discussed. Chapter 7 on

applications gives references for detailed information in such

fields as plant materials, fertilizers, effluents, etc. at end

of each section listed by element.

128. Elzam, O.E. and E. Epstein. 1969. Salt relations of two grass
species differing in salt tolerance. I.-Growth and salt content
at different salt concentrations. Agrochimica 13:187-195. 14
ref., 3 tab., 2 fig.

In a greenhouse experiment two species of wheatgrass (A.

elongatum and A. intermedium) were grown. Tops and roots were

oven dried at 70°C (72 h), wet ashed and anlyzed for Na and K

(flame photometrically), Ca (AAS), and chloride (potentiometrically).

129 Emmermann, R. and W. Luecke. 1969. Atomabsorptionsspektrometrische
    Bestimmung sehr geringer Gehalte an Blei, Zink und Silber in
    Bodenproben mit einer Tantal-Verdampfungsrinne. (Determination
    of trace amounts of lead, zinc and silver in soil samples by
    atomic absorption spectrometry using a Tantalum sampling-boat).
    Z. Analyt. Chem. 248:325-329. 7 ref., 3 tab., 2 fig.

    Traces of Pb, Zn and Ag can be rapidly determined by AAS

    using a heat-resisting evaporation boat made of Ta metal.

    Detection limits for Ag, Pb and Zn are 0.2, 2 and 0.05 ppb,

    respectively. Perkin-Elmer model 303 was used.

130 Evans, C.E. and E.J. Kamprath. 1970. Lime response as related to
    percent Al saturation, solution Al, and organic matter content.
    Soil Sci. Soc. Am. Proc. 34:893-896. 16 ref., 7 tab., 4 fig.

    Exchangeable Ca, Mg, Al, and H were extracted from organic

    and mineral soils with unbuffered 1$\underline{N}$ KCl solution. Ca and Mg

    were analyzed by AAS and H and Al by titration with 0.1$\underline{N}$ NaOH

    using methyl orange and phenolphthalein indicators. Soil solu-

    tion Ca and Mg were determined by AAS and Al colorimetrically

    by the Alizarin Red-S method.

131 Evans Electroselenium Limited. 1966. Atomic Absorption Analytical
    Methods. Vol. 1. Ref. No. 14097006A. Loose leaf manual.
    Evans Electroselenium Limited, Essex, England.

    This volume is a guide for using the Evans Electro-

    selenium Limited AA model 140. The methods have been grouped

    alphabetically by the element for applications in soils, fertili-

    zers, plant, water etc.

132 Fabricand, B.P., E.S. Imbimbo, and M.E. Brey. 1967. Atomic absorption analyses for Ca, Li, Mg, K, Rb, and Sr at two Atlantic Ocean stations. Deep-Sea Res. 14:785-789. 18 ref., 3 tab., 1 fig.

   K, Ca, Mg, Sr, Li, and Rb, as functions of depth, are reported

for widely separated localities in the Atlantic ocean. Samples

were stored in polyethylene containers and refrigerated until they

could be analyzed at the laboratory. Two AA units were used:

(a) National Instrument Laboratories Atabel instrument and (b)

The one described by Fabricand et al. (134). Sr, Li, and Rb

were determined without filtering or dilution. For Mg, samples

were diluted 1:1000, for K and Ca 1:100. Calibration standards

were made up with artificial sea water minus element of

interest.

133 Fabricand, B.P., E.S. Imbimbo, M.E. Brey, and J.A. Weston. 1966. Atomic absorption analyses for Li, Mg, K, Rb, and Sr in ocean waters. J. Geophys. Res. 71:3917-3921. 18 ref., 3 tab., 1 fig.

   Samples for AAS analysis (Li, Mg, K, Rb, and Sr) were

stored in polyethylene containers and refrigerated until they

could be analyzed. Artificial sea water was mixed with the

standard solutions to give a solution with salinity about equal

to that in ocean water.

134 Fabricand, B.P., R.R. Sawyer, S.G. Ungar, and S. Adler. 1962. Trace metal concentrations in the ocean by atomic absorption spectroscopy. Geochim. Cosmochim. Acta 26:1023-1027. 5 ref., 1 tab., 2 fig.

   Cu, Fe, Mn, Ni, and Zn in concentrations of one part in 10

billion and less can be measured using less than 1 ml of ocean

water by aspirating directly in the flame. The following con-

centrations were found in oceans (μg-atom/ℓ): Cu, 0.018-0.035;

Fe, 0.01-0.13; Mn, 0.054-0.080; Ni, 0.0022-0.0063; Zn 0.0091-0.011. Perkin-Elmer I.R. spectrophotometer modified for use as an AA spectrometer was used.

135 Facteau, T.J. and P. Eck. 1970. Effects of base saturation and cation level of a sand-clay substrate upon growth and composition of highbush blueberry. Soil Sci. 110:244-252. 17 ref., 2 tab., 7 fig.

The study was conducted to test the hypothesis that blueberry growth is favored by low cation levels and to evaluate its response to a substrate in which the cation exchange complex consisted of a montmorillonite type clay. Root, stem and leaf tissue samples were wet ashed with HNO_3-$HClO_4$. Magnesium was determined by AAS and Ca and K by flame emission.

136 Fardeau, J.C. and J.P. Michel. 1969. Extraction et dosage des ions-phosphate des solutions de sol. (Extraction and determination of phosphate ions in soil solution). Ann. Agron. 20:645-648. 9 ref.

For the determination of intensity of isotopic exchanges, specific activity of phosphate ions in soil solutions is measured. In the proposed method, after complexing with acid NH_4 molybdate, the phosphomolybdic complex is extracted with isobutanol and then Mo determined by AAS.

137 Farrow, R.P., J.H. Johnson, W.A. Gould, and J.E. Charbonneau. 1971. Detinning in canned tomatoes caused by accumulations of nitrate in the fruit. J. Food Sci. 36:341-345. 7 ref., 9 fig.

Tinned tomatoes were analyzed for NO_3 (m-xylenol procedure), Sn (polarographically) and mineral analysis (AAS using a Jarrell-Ash spectrophotometer).

Note – There are no data as to what mineral analysis was carried out.

138 Fassbender, H.W. Von and E. Piñeres. 1971. Effect of liming on the
     exchangeable cation composition and availability of six Costa
     Rican soils. Z. Pflanzenernaehr. Bodenkd. 130:124-135. 19 ref.,
     4 tab., 3 fig.

     Surface horizons of six soils of the Central Plateau of

     Costa Rica were incubated for 5 mo with increasing rates of

     lime. After incubation, the air-dried samples were analyzed for,

     among other characteristics, exchange capacity and exchangeable

     Ca, Mg, and K with $BaCl_2$ and triethanolamine and AAS. Ammonium

     acetate (1$\underline{N}$, pH4.8) extracts were prepared. Aluminum was deter-

     mined with aluminon.

139 Fernandez, F.J. and D.C. Manning. 1971. Atomic absorption analyses
     of metal pollutants in water using a heated graphite atomizer.
     Atom. Absorp. Newsl. 10:65-69. 16 ref., 4 tab., 8 fig.

     Perkin-Elmer model 403 equipped with a model HGA-70 heated

     graphite atomizer was used. Detection limits for Al, As, Cd,

     Co, Cr, Cu, Fe, Mn, Ni, Pb, Sn, and Zn were found to be 10-

     100 times better than those obtained by nebulizer flame method.

     Precisions, expressed as repeatability, of 3-8% coefficient of

     variation were obtained.

140 Fishman, M.J. 1966. The use of atomic absorption for analysis of
     natural waters. Atom. Absorp. Newsl. 5:102-106. 1 ref., 10
     tab., 2 fig.

     Ca, Cu, K, Li, Mg, Mn, Na, Sr, and Zn were determined in

     natural waters. In general, detection limits found by AAS were

     as low as or lower than those obtained by other methods.

141 Fishman, M.J. 1970. Determination of mercury in water. Anal. Chem. 42:1462-1463. 3 ref., 2 tab.

Hg in several natural waters was determined by AAS at 253.7 nm. In this procedure Hg was collected from an acidified sample by amalgamation on a Ag wire which was then electrically heated in an absorption cell placed in the light beam of an AA unit. The Hg vapors are drawn through the cell with a water aspirator. Samples containing at least 0.1 µg Hg/l can be analyzed; those containing more than 1.5 µg/l must be diluted prior to aspiration. Recovery of added Hg ranged from 80 to 128%. Perkin-Elmer model 303 was used.

142 Fishman, M.J. and S.C. Downs. 1966. Methods for analysis of selected metals in water by atomic absorption. Geol. Surv. Water-Supp. Pap. 1540-C. 45 p., 2 ref., 4 fig.

This is a manual of procedures for the determination of Ca, Cu, K, Li, Mg, Mn, Na, Sr and Zn in atomospheric precipitation, fresh waters, and brines by AAS. Calculations, preparation of reagents, accuracy, precision and sensitivity etc. are provided. Most of the methods are adapted from the Perkin-Elmer instruction manual (327).

143 Fishman, M.J. and E.C. Mallory, Jr. 1968. Determination of molybdenum in fresh waters - a comparison of methods. J. Water Pollut. Control Fed. 40:R67-R71. 8 ref., 1 tab.

Four methods were compared for Mo determination in natural water: (a) Thiocyanate, using ion exchange, (b) Dithiol - colorimetric, using direct extraction, (c) Dithiol - AAS (313.3 nm), using direct extraction, and (d) Spectrographic, using precipitation. The four methods gave essentially comparable values.

144 Fishman, M.J. and M.R. Midgett. 1968. Extraction techniques for
        the determination of cobalt, nickel, and lead in fresh water
        by atomic absorption. 6 ref., 5 tab. pp. 230-235. <u>In</u> R.A. Baker
        (ed.),Trace inorganics in water. Advances in chemistry series
        No. 73. Am. Chem. Soc. Washington, DC.

        Co, Ni, and Pb were chelated with APDC at a pH of 2.8,

        extracted with MIBK and the ketone layer aspirated. AAS

        results were in good agreement with spectrographic analysis.

        As little as 1 µg/l of the element can be determined.

145 Fishman, M.J. and B.P. Robinson. 1969. Water analysis. Anal. Chem.
        41:323R-360R. 664 ref.

        A review with 664 references dealing with the use of AAS

        and other methods for water analysis.

146 Fiskell, J.G.A. 1970. Cation exchange capacity and component varia-
        tions of soils of southeastern USA. Soil Sci. Soc. Am. Proc.
        34:723-727. 41 ref., 2 tab.

        For CEC determination in the first set of 19 soils, cation

        saturation was made by six methods (with Na, K, NH_4, and Ca salts).

        For the second set of 28 soils, cation saturation was made with five

        methods   (with Na, NH_4, and Ca salts). Cation replacement was

        made with NH_4 salts after Ca or Na saturation and with $Ca(CH_3COO)_2$

        after K or NH_4 saturation. Exchangeable bases were determined

        after NH_4 saturation (acid soils) or Na saturation (calcareous

        soils). Replaced K and Na were determined by flame photometer.

        On the first set, Ca was estimated by EDTA and Mg colorimetrically

        as the thiazole-yellow complex. On the second set, Ca and Mg

        were determined, after proper dilution and La addition, by AAS.

147 Flannery, R.L. and D.K. Markus. 1969. Simultaneous determinations of phosphorus, potassium, calcium, and magnesium in soil extracts by AutoAnalyzer. Adv. Aut. Anal., Technicon Int. Congr. June 4-6, Chicago, IL.29-37. 11 ref., 7 tab., 13 fig.

This paper compares AutoAnalyzer (Ca and K by flame photometer; Mg colorimetrically) and AAS results for K, Ca, and Mg in (a) $1\underline{N}$ (pH 7.0) NH_4OAc and (b) North Carolina extracts (mixture of $0.05\underline{N}$ HCl and $0.025\underline{N}$ H_2SO_4) of soils. For all practical purposes, AAS results compared favorably with Auto-Analyzer methods.

148 Flannery, R.L. and D.K. Markus. 1971. Determination of phosphorus, potassium, calcium and magnesium simultaneously in North Carolina, ammonium acetate, and Bray P_1 soil extracts by AutoAnalyzer. 5 ref., 7 tab., 13 fig. pp. 97-112. In L.M. Walsh (ed.), Instrumental methods for analysis of soils and plant tissue. Soil Sci. Soc. Am. Inc., Madison, WI.

Abstract same as Ref. 147.

149 Fletcher, K. 1971. Direct determination of lead in plant materials by atomic absorption spectrophotometry. J. Sci. Food Agric. 22:260-261. 10 ref., 2 tab.

Pb content of edible parts of corn, carrot, bean, cabbage, chard, tomato, beet, cucumber, and lettuce was determined by AAS (air-C_2H_2 flame, 217.0 nm) and colorimetrically. Sample (2-5 g) was ashed at 500°C for 12 h. Ash was digested with 2 ml of $3\underline{N}$ HCl, evaporated to dryness and made to 30 ml with $1.5\underline{N}$ HCl. Background absorption was found to result in high values in the determination of Pb content of plant digests by AAS. However, by measuring the absorbance of a spectral continuum in the region of absorption line, a correction could be applied.

The corrected values were in reasonable agreement with the

values obtained colorimetrically (dithizone method). Techtron

model AA-4 was used.

150 Follett, R.H. and W.L. Lindsay. 1971. Changes in DTPA-extractable
     zinc, iron, manganese, and copper in soils following fertilization.
     Soil Sci. Soc. Am. Proc. 35:600-602. 7 ref., 3 tab., 1 fig.

Colorado soils (pH of saturated paste 5.4 - 7.9) were

cropped first with oats for 6 wk and then with single cross

hybrid corn for 6 wk in a greenhouse. Soils were extracted

before and after cropping with a solution (pH 7.30) that consisted

of 0.005$\underline{M}$ DTPA, 0.01$\underline{M}$ CaCl$_2$ and 0.1$\underline{M}$ triethanolamine (soil 10 g:

solution 20 ml, shaking time 2 h). Fe, Mn, Cu, and Zn con-

tent of the above-ground portions of plants and the soil extracts

were analyzed by AAS.

151 Fresenius, W. and W. Schneider. 1966. Über den Einfluß von Phosphat,
     Sulfat, und Nitrat auf die Magnesiumbestimmung in Mineralwässern
     nach dem Atomabsorptionsverfahren. (Effect of phosphate, sulfate,
     and nitrate on the magnesium determination in mineral waters by
     atomic absorption. Z. Anal. Chem. 223:181-182. 4 ref.,
     1 tab.

Mg in 51 samples of mineral water was determined by AAS,

gravimetrically and complexometrically. NO$_3$ had no effect, while

SO$_4$ and PO$_4$ interfered in AAS. A Zeiss spectrophotometer PMQ 11

with flame attachment was used.

152 Fuehring, H.D. 1969. Irrigated wheat on a calcareous soil as affected
     by application of nitrogen, phosphorus, potassium, and zinc: I.
     Yield, composition, and number of heads. Agron. J. 61:591-594.
     7 ref., 4 tab.

An irrigated field experiment was conducted on a calcareous

soil (15% $CaCO_3$) with a Mexican semi-dwarf wheat. HNO_3-$HClO_4$ digests

of the grain were analyzed for K, Ca, Mg, Mn, Cu, and Zn by AAS

and P by molybdovanadate method.

153 Fuehring, H.D. 1969. Irrigated wheat on a calcareous soil as affected
by application of nitrogen, phosphorus, potassium, and zinc: II.
Analysis of the young plant in relation to yield. Agron. J. 61:
594-596. 9 ref., 2 tab.

Mexican semi-dwarf wheat was tested in a field experiment.

Stems were divided at the base of the lowest leaf into the base

portion of the plant and the upper portion. The base portions

were dried (70°C), ground and analyzed for phosphate-P colorimetric-

ally and soluble-K, Zn, and Mn by AAS (on 2% HOAc extracts).

154 Fuller, W.H. and J.E. Hardcastle. 1967. Relative absorption of
strontium and calcium by certain algae. Soil Sci. Soc. Am. Proc.
31:772-774. 16 ref., 2 tab., 2 fig.

Different species of fresh-water and desert algae (A.

falcolus, Scenedesmus sp., Pediastrum sp., Sphaerocytis sp.,

Phormidium sp., Nostoc sp., and Anabaena sp.) were used to study

interrelation of Ca and Sr uptake and radiostrontium uptake.

After test growth, the algal mats were oxidized with HNO_3 and

H_2O_2, the residue taken up in 0.1N HCl, and Ca and Sr determined

by AAS.

155 Galindo, G.G., H. Appelt, and E.B. Schalscha. 1969. Sulfur deter-
mination in soil extracts by an indirect atomic absorption
spectrophotometric method. Soil Sci. Soc. Am. Proc. 33:974-975.
7 ref., 2 tab.

Volcanic-ash derived soils were extracted with a 500 ppm

PO_4 solution (KH_2PO_4). S was converted to SO_4. Organic matter

was destroyed by 30% H_2O_2 in a water bath at 60°C. A 15% $BaCl_2$

solution was used to precipitate SO_4. The $BaSO_4$ precipitate was

dissolved in 1% $(NH_4)_2$EDTA. Ba was determined with an air-C_2H_2

burner by Perkin-Elmer model 303 after adding 1500 ppm Na to

eliminate possible interferences by ionization. Destruction of

organic matter did not affect the results. SO_4 recovery was good.

Sensitivity of 0.8 ppm S was found (with scale 2).

156 Gast, P.W. and N.J. Hubbard. 1970. Abundance of alkali metals, alkaline
     and rare earths, and strontium-87/strontium-86 ratios in lunar
     samples. Science 167:485-487. 10 ref. and notes, 1 tab., 2 fig.

K, Rb, Cs, Sr, Ba, La, Ce, Nd, Sm, Eu, Gd, Dy, Er, Yb, and Lu

were determined by mass spectrometry, Ni by X-ray fluorescence,

and Zn in the separated fraction by AAS.

157 Geering, H.R., J.F. Hodgson, and C. Sdano. 1969. Micronutrient cation
     complexes in soil solution: IV. The chemical state of manganese
     in soil solution. Soil Sci. Soc. Am. Proc. 33:81-85. 26 ref.,
     1 tab., 2 fig.

Soil solutions of 28 soils (A and/or B horizons) were collected

by displacement with a salt solution. Total Mn was determined by

AAS. The percentage of the total Mn that was complexed in the soil

solutions was analyzed by ion-exchange technique using ^{54}MnCl$_2$.

Oxidation states were determined by spectrophotometric and polaro-

graphic methods.

158 Gehrke, C.W. and J.P. Ussary. 1965. Fertilizers. Anal. Chem.
     37(II):67R-70R. 62 ref.

         The review deals with analytical problems in the determin-

     ation of K, Ca, Mg, Cu, etc. by AAS and other techniques.

159 Gheesling, R.H. and H.F. Perkins. 1970. Critical levels of manganese
     and magnesium in cotton at different stages of growth. Agron J.
     62:29-32. 11 ref., 3 fig.

         Cotton was grown in a greenhouse for 105 days in sand culture

     experiments. Tissue samples were collected at 34, 48, 62, 83,

     and 105 days after seeding. Leaf blades, leaf petioles and stems

     were dried in a forced-draft oven at 70°C and ground to pass 40-

     mesh stainless steel screen. HNO_3-H_2SO_4-$HClO_4$ extract was

     analyzed for Mg and Mn by AAS.

160 Giordano, P.M. and J.J. Mortvedt. 1969. Phosphorus availability to
     corn as affected by granulating manganese with ortho- and pyro-
     phosphate fertilizers. Soil Sci. Soc. Am. Proc. 33:460-463.
     9 ref., 3 tab., 5 fig.

         $MnSO_4 \cdot H_2O$ was pressure granulated with monoammounium phos-

     phate, triammonium pyrophosphate and ammonium polyphosphate.

     They were applied to a soil (pH 6.4) for a pot experiment with

     corn. The forage (50 day-old-plant) was analyzed for P and Mn.

     P-Mn fertilizers were extracted with H_2O, 0.01$\underline{N}$ HCl, 0.1$\underline{N}$ HCl

     and 0.01$\underline{M}$ Na_2EDTA, and Mn was determined by AAS. Solubility of P in

     H_2O and 1$\underline{N}$ ammonium citrate (pH 7) was determined colorimetrically.

161 Giordano, P.M., E.C. Sample, and J.J. Mortvedt. 1971. Effect of
     ammonium ortho- and pyrophosphate on Zn and P in soil solution.
     Soil Sci. 111:101-106. 17 ref., 1 tab., 4 fig.

Soil solution, obtained from incubated soils placed in a heavy-walled lucite pressure cell, was passed through Whatman 41 filter paper using N_2 gas at a pressure of 7 kg/cm^2. Solutions were analyzed for total Zn by AAS and complexed Zn by a more sensitive tracer technique. P was determined colorimetrically.

162 Gjems, O. 1970. Mineralogical composition and pedogenic weathering of the clay fraction in podzol soil profiles in Zalesine, Yugoslavia. Soil Sci. 110:237-243. 29 ref., 3 tab. 3 fig.

Samples were collected from the different soil-profile layers in podzols along a forest road-cut in an area covered with a forest vegetation of Norway spruce, silver fir, European beech, and some European mountain ash. $NH_4OAc(1\underline{N})$ extracts were analyzed for exchangeable Na and K by flame photometry and exchangeable Ca and Mg by AAS. Buffered dithionite-citrate, sodium citrate and $5\underline{N}$ HCl extractable Fe and Al were determined colorimetrically.

163 Goulden, P.D. and B.K. Afghan. 1970. An automated method for determining mercury in water. Can. Dep. Energy Mines Resour., Inl. Waters Br. Tech. Bull. 27. 21 p. 5 ref., 3 tab., 13 fig.

Hg as low as 0.05 µg/l can be determined in water samples by the proposed method. Ten samples/h can be analyzed for the 0.05-1.0 µg/l range and 20 samples/h for the 1.0-32 µg/l range. The technique has been applied to samples containing both organic and inorganic Hg compounds. Perkin-Elmer model 403 equipped with Perkin-Elmer model 165 recorder was used.

164 Green, J.L., C.V. Cole, and W.D. Holley. 1971. Ionic balance and growth of carnations. Soil Sci. 111:138-145. 19 ref., 5 tab., 2 fig.

Carnation plant tissue was analyzed for P (colorimetrically) on a HNO_3-$HClO_4$ digest. Perchloric acid digest was analyzed for Ca and Mg by AAS and K and Na by flame photometry. Cl was determined volumetrically and SO_4 gravimetrically.

165. Griffin, G.F. 1968. Automated determination of magnesium in soil extracts by atomic absorption spectrophotometry. Soil Sci. Soc. Am. Proc. 32:803-805. 5 ref., 2 tab., 2 fig.

Soils were extracted with a modified Morgan solution of pH 4.8 (0.625$\underline{N}$ NH_4OH + 1.25$\underline{N}$ CH_3COOH). Extracts analyzed by the proposed automated method on Perkin-Elmer model 290 gave results which were not different from those by manual procedure. Sr was not required to eliminate interference due to Al, Si, and P.

166. Grimme, H. Von. 1968. Die Adsorption von Mn, Co, Cu and Zn durch Goethit aus verdünnten Lösungen (Adsorption of Mn, Co, Cu and Zn by Goethite from dilute solutions). Z. Pflanzenernaehr. Bodenkd. 121:58-65. 9 ref., 4 fig.

An investigation was carried out on the adsorption of Co, Cu, Mn, and Zn from solutions on synthetic crystalline goethite. The adsorbed concentrations were calculated from the decreased amounts in the solution. Cu, Mn, and Zn were determined by AAS and Co colorimetrically.

167 Grunder, F.I. and E.A. Boettner, 1967. Water analysis by atomic absorption and flame emission spectroscopy. Am. Ind. Hyg. Assoc. J. 28:391-394. 2 ref., 4 tab., 4 fig.

Ca, Mg, Fe, Mn, Cu, Zn, and Pb were determined in water samples (softened and unsoftened well water and city water) by AAS. La

addition was necessary for Ca and Mg analysis. Jarrell-Ash
multipass AAS equipped with a Beckman total-consumption 3-burner
set and Westinghouse single-element hollow cathode lamps were
used. Na and K were determined by flame emission spectroscopy.

168 Gupta, U.C. 1968. Studies on the O-phenantroline method for deter-
    mining iron in plant materials. Plant Soil 28:298-305. 11 ref.,
    4 tab., 1 fig.

   Plant tissue (alfalfa, broccoli, barley, spinach, timothy)
and peat samples (2-4 g) were ashed for 4 (3 + 1) h by double-
dry ashing. The ash was digested with 10 ml $6\underline{N}$ HCl + 1.5 ml H_2O_2
for 30 min on a hot plate. After filtration and making the
volume up to 100 ml, Fe was determined by o-phenanthroline and
AAS (Perkin-Elmer model 303 using a DCR-1 concentration readout).
Results obtained by colorimetric method were very similar to the
values obtained by AAS.

169 Halim, A.H., C.E. Wassom, and R. Ellis, Jr. 1968. Zinc deficiency
    symptoms and zinc and phosphorus interactions in several strains
    of corn (Zea mays L.). Agron. J. 60:267-271. 12 ref., 4 tab.

   Ten hybrids and 24 single crosses were grown in sand culture
and 26 single crosses and 6 double crosses were grown in the field.
Leaf samples and seeds from the same sources used for the experi-
ment were dry ashed by increasing the temperature from 200 to 400
to 600°C in 2-h steps. Ash was dissolved in $0.1\underline{N}$ HCl and made
up to 25 ml (using 1 g sample) with $0.1\underline{N}$ HCl after filtration.
P was determined colorimetrically and Zn by Perkin-Elmer model
303.

170 Hallock, D.L., D.C. Martens, and M.W. Alexander. 1971. Distribution of P, K, Ca, Mg, B, Cu, Mn, and Zn in peanut lines near maturity. Agron. J. 63:251-256. 12 ref., 2 tab., 2 fig.

A field experiment was conducted in 1967 on a Woodstown loamy fine sand with 15 cultivars of peanuts. Plants were segmented into hypocotyl, first lateral branch leaves, upper central stem leaves, and fruits. Sample (1 g) was dry-ashed at 450°C for 2 h, ash shaken for 1 h with 15 ml 6$\underline{N}$ HCl, filtered, filtrate dried and residue dissolved in 15 ml 0.5 $\underline{N}$ HCl. Cu, Zn, and Mn were determined by AAS. Total B in the dry tissue was estimated by curcumin procedure. An HNO_3 extract of the dry-ashed sample was used for K, Ca, and Mg by flame emission and P by colorimetric procedure.

171 Halstead, E.H., S.A. Barber, D.D. Warncke, and J.B. Bole. 1968. Supply of Ca, Sr, Mn, and Zn to plant roots growing in soil. Soil Sci. Soc. Am. Proc. 32:69-72. 10 ref., 6 tab., 4 fig.

Lettuce, wheat, tomato, and soybean were grown on four soils in growth chambers by holding the relative humidity at 80-100% and 20%. The elements were determined on plant samples digested with HNO_3-$HClO_4$-H_2SO_4 acid mixture and in NH_4OAc extracts of soils after the addition of $LaCl_3$ to minimize possible interferences.

172 Halstead, R.L. 1968. Effect of different amendments on yield and composition of oats grown on a soil derived from serpentine material. Can. J. Soil Sci. 48:301-305. 8 ref., 4 tab., 1 fig.

Oats were grown in pots in soils from Guatemala, Central America and a podzol soil from New Brunswick. Plant samples (tops and roots) were ashed (500°C) and taken up in 0.2 $\underline{N}$ HCl.

Soils were extracted for exchangeable cations by $1\underline{N}$ NH_4OAc. Plant and soil extracts were analyzed for Ca, Fe, K, Mg, Mn and Ni by AAS.

173 Halstead, R.L., B.J. Finn, and A.J. MacLean. 1969 Extractability of nickel added to soils and its concentration in plants. Can. J. Soil Sci. 49:335-342. 15 ref., 6 tab.

Oats and alfalfa were grown in pots in four soils. Ni in the $0.1\underline{N}$ NH_4OAc and in $0.1\underline{M}$ $CaCl_2$ extracts of soils was determined without further preparation by AAS (Techtron AA-3). Plant material was ashed overnight at 500°C, treated twice with hot $3\underline{N}$ HCl and Ni determined by AAS and P by vanadate.

174 Ham, N.S. 1959. Second Australian Spectroscopy Conference. Nature 184:1195-1197.

Discusses papers on AAS and other topics presented at the 2nd Australian Spectroscopy Conference held at the University of Melbourne June 1-3, 1959. Papers on the use of AAS in plant and soil analysis by Allan and David are discussed.

175 Hammar, H.E. and N.R. Page. 1967. Micronutrient analysis of fertilizers with special reference to frits. Atom. Absorp. Newsl. 6:33-34. 3 ref., 2 tab.

In a collaborative study, 17 fertilizer samples--to 15 of which micronutrients were added as soluble salts or frits--from five suppliers were analyzed. Sample (1 g) was digested in 10 ml HCl. After evaporation, 20 ml $0.5\underline{N}$ HCl was added, boiled and the volume made to 100 ml. Perkin-Elmer model 303 was used for Cu, Fe, Mn, and Zn. Electrometric titration was used for B.

176 Harrison, M. and C. Andre. 1969. Digestion of sugar beet leaves for
     atomic absorption spectroscopy. Appl. Spectrosc. 23:354-357.
     13 ref., 1 tab., 3 fig.

Digestion mixture consisted of 75 ml HNO_3, 17.5 ml 70% $HClO_4$,

5 ml H_2SO_4 and 5 ml of a 2% w/v/ $Na_2MoO_4 \cdot 2H_2O$ (catalyst).

Sugarbeet leaves were digested using this procedure and

analyzed for Ca by AAS. La was used as a releasing agent for Ca

and Mg analyses. Sensitivity for Cu is increased by adding

methanol. Perkin-Elmer model 290 was used. Co was determined

at 240.7 nm. The digestion procedure is suitable for many other

cations.

177 Hatch, W.R. and W.L. Ott. 1968. Determination of sub-microgram
     quantities of mercury by atomic absorption spectrophotometry.
     Anal. Chem. 40:2085-2087. 5 ref., 3 tab., 1 fig.

The sample was treated with an oxidizing agent and then a

reduction-aeration procedure was employed. For this purpose, Hg

was reduced ($SnSO_4$ as reducing agent in NaCl--hydroxylamine sul-

fate medium) to the elemental state and aerated from solution

in a closed system. The absorption of the 253.7 nm line was

measured after passing the Hg vapor through a quartz-windowed

absorption cell of an AA unit. The method is extremely sensitive

and accurate for as low as 1.0 ppb Hg in solution. Organic mat-

ter and other volatile constituents of the sample do not inter-

fere. However, large quantities of easily reducible elements

must be absent from the solution. Soils containing organic

matter, rocks and Co and Ni metals were analyzed using a Perkin-

Elmer model 303 equipped with an Automatic Null Recorder Readout.

178 Heckman, M. 1967. Minerals in feeds by atomic absorption spectro-
        photometry. J. Assoc. Off. Anal. Chem. 50:45-50. 4 tab.

        In a collaborative study, Ca, Cu, Fe, Mg, Mn and Zn were

        determined by 17 laboratories. Six feeds and one mineral mixture,

        prepared by dry-ashing (550°C, 4 h) wet digestion were analyzed

        by AAS. It was recommended that the AAS method for Ca and Mg

        in feeds be adopted as official "first action". Further work

        is needed on the analysis for Cu, Fe, Mn and Zn. Instruments

        used were Perkin-Elmer models 303 and 214, Jarrell-Ash models

        82-360 and 82-375, and Techtron AA-3.

179 Heckman, M. 1968. Collaborative study of minerals in feeds by atomic
        absorption spectrophotometry. J. Assoc. Off. Anal. Chem. 51:
        776-779. 3 tab.

        Feeds and mineral mixture were analyzed by 11 laboratories

        for Cu, Fe, Mn, and Zn by AAS. It is recommended that the method

        for AA analysis for Fe, Mn and Zn be adopted as official "first

        action". Further work is needed for Cu. The following instru-

        ments were used: Perkin-Elmer 214 and 303, Techtron AA-3, Jarrell-

        Ash 82-360, Unicam SP90 and Beckman 1301.

180 Heckman, M. 1970. Collaborative study of copper, sodium, and
        potassium in feeds by atomic absorption spectrophotometry and
        sodium and potassium by flame emission spectrophotometry. J.
        Assoc. Off. Anal. Chem. 53:923-925. 2 tab.

        Twelve laboratories collaborated in a study involving feed

        analysis, on 5 samples, for Cu, Na, and K by AAS and Na and K by

        flame emission. It was concluded that AAS is suitable for Cu, but

        further work is required for K and Na. Instruments used

        were Perkin-Elmer 303, 290 and 214, Jarrell-Ash 82-360

and 82-350, and Beckman 1301 and DU with flame attachment.

181 Heckman, M. 1971. Collaborative study of copper in feeds by atomic absorption spectrophotometry. J. Assoc. Off. Anal. Chem. 54: 666-668. 2 tab.

In a collaborative study by 11 laboratories feeds were analyzed by AAS. Five dry-ashing procedures and one of the two wet digestion methods were used for sample preparation by all the collaborators. The method by either dry-ashing the feed samples at 500 or 550°C or wet ashing has been adopted for Cu as official "first action".

182 Hensler, R.F., R.J. Olsen, and O.J. Attoe. 1970. Effect of soil pH and application rate of dairy cattle manure on yield and recovery of twelve plant nutrients by corn. Agron. J. 62:828-830. 16 ref., 2 tab.

The tissue samples were analyzed for Cu, Fe, Mn, and Zn by a Jarrell-Ash AA-flame emission unit and N, P, K, Ca, Mg, S, B, and Mo by other suitable methods. For AAS, tissue samples were ashed at 550°C, residue taken up in 2.75$\underline{N}$ HCl and diluted with 0.025$\underline{M}$ CaCl$_2$.

183 Herrmann, R. and W. Neu. 1965. Der Magnesium und der Zinkgehalt von Chloroplasten (The magnesium and zinc contents of chloroplasts). Experientia 21:436-437. 3 ref., 1 tab.

Zn and Mg content in chloroplasts isolated with a dry method were determined by AAS.

184 Hinson, W.H. 1962. An ion exchange treatment of plant ash extracts for removal of interfering anions in the determination of calcium by atomic absorption. Spectrochim. Acta 18:427-429. 6 ref., 1 fig., 1 plate.

Column of anion exchange resin in acetate form was used to

remove interferring anions in the plant ash extracts before

determining Ca by AAS.

185 Hinson, W.H. and R. Kitching. 1964. A double beam atomic absorption
spectrophotometer. Spectrochim. Acta 20:245-247. 5 ref., 3 fig.

A double beam AA unit used for the analysis of plant and

soil materials is described.

186 Hoeft, R.G. and L.M. Walsh. 1971. Effectiveness of Zn frits for corn
(Zea mays L.) as influenced by Zn concentration, granule size and
method of application. Agron. J. 63:84-86. 7 ref., 4 tab.

Plant material was ashed at 600°C, dissolved in 0.46$\underline{N}$ HCl

and analyzed by AAS. Water-soluble Zn and Zn soluble in a solu-

tion of 0.01$\underline{M}$ K_2SO_4; 0.01$\underline{M}$ $KHSO_4$ (pH 1.7) were also determined by

AAS in various Zn fertilizers and Zn frit carriers.

187 Hoover, W.L. and S.C. Duren. 1967. Determination of molybdenum in
fertilizers by atomic absorption spectrophotometry. J. Assoc.
Off. Anal. Chem. 50:1269-1273. 9 ref., 6 tab.

An AA method is proposed by which low levels (as low as 2.5

ppm) of Mo in fertilizers can be determined. With KCNS as com-

plexing agent, Mo is extracted in an isoamyl alchohol fraction.

The water- and acid-soluble salts that would interfere with AA

determination are eliminated by this extraction procedure.

However, the proposed method can not be used with samples that

are high in Fe. Techtron AA-3 was used.

188   Hoover, W.L., J.R. Melton, and P.A. Howard. 1971. Determination
        of trace amounts of mercury in foods by flameless atomic absorp-
        tion. J. Assoc. Off. Anal. Chem. 54:860-865. 7 ref., 1 tab.,
        4 fig.

        A rapid and accurate method is proposed whereby levels as

        low as 0.01 µg Hg can be determined by flameless AA (253.65 nm).

        Samples are digested with HNO_3. Recoveries of organic and inor-

        ganic mercury in samples (alfalfa meal and other foods) ranged

        from 95 to 102%. The vaporization system can be easily constructed.

189   Hoover, W.L. and J.C. Reagor. 1968. Interferences encountered in
        determining potassium in fertilizers by atomic absorption spectro-
        photometry. J. Assoc. Off. Anal. Chem. 51:211-216. 12 ref.,
        4 tab.

        At 766.49 nm, several materials interfered with K determina-

        tion by AAS. This interference was eliminated by the use of

        404.41 nm. But high P content interfered at 404.41 nm, the

        extent of interference depending on the presence of other ions.

        K analyses by AAS at the proposed 404.41 nm compared favorably

        with STPB and other procedures used by commercial laboratories.

190   Hoover, W.L., J.C. Reagor, and J.C. Garner. 1969. Extraction and
        atomic absorption analysis of lead in plant and animal products.
        J. Assoc. Off. Anal. Chem. 52:708-714. 11 ref., 5 tab.

        Plant samples (e.g., dried apples, Bermuda grass) were

        digested, after adding Sr as a trapping agent, in a ternary acid

        mixture (HNO_3, H_2SO_4 and $HClO_4$). Pb co-precipitates with $SrSO_4$.

        The precipitate was separated and converted from predominantly

        sulfate salt to a predominately carbonate precipitate, which in

        turn was dissolved in 1N HNO_3 and Pb was determined by AAS at 283.306 nm.

Samples containing 0.5 ppm to 1% Pb can be routinely analyzed.
Interference due to Ca, when present in high concentration (>1%),
can be avoided by removing it from the digest. Moderate quantities
of Al, Fe, P, Sn, Ca, Bi, and Tl do not interfere.

191 Horwitz, W., (ed.). 1970. Official methods of analysis of the
     Association of Official Analytical Chemists. Assoc. Off. Anal.
     Chem., Washington DC 11th ed. 1015 pp.

AAS is the official "final action" for minor elements in
fertilizers (Ca, Cu, Fe, Mg, Mn, and Zn) and feeds (Ca, Fe, Mg,
Mn, and Zn). Methods of sample preparation are presented.

192 Hossner, L.R. and E.C. Doll. 1970. Magnesium fertilization of potatoes
     as related to liming and potassium. Soil Sci. Soc. Am. Proc.
     34:772-774. 6 ref., 2 tab., 2 fig.

In field experiments, petiole samples (fourth petiole from
growing tip) of potato plants were collected at 6 and 16 wk from the
date of planting. Samples were digested in $HClO_4$ and the residues
taken up in 0.1$\underline{N}$ HCl. Ca and K were analyzed by flame photometer
and Mg by AAS. In soils, 1$\underline{N}$ NH_4OAc extractable Ca and K were
determined by flame photometer and Mg by AAS.

193 Hossner, L.R. and L.W. Ferrara. 1967. Soil manganese by atomic absorp-
     tion spectroscopy. Atom. Absorp. Newsl. 6:71-72. 3 ref.,
     2 tab.

Easily reducible and exchangeable Mn (NH_4OAc + hydroquinone)
and total Mn (a. Perchloric acid digest b. $HF-HClO_4$ digest) were
determined on soils with Perkin-Elmer model 303. The method
was accurate to ± 3.6 µg Mn at the 150 µg level. Results were
compared with colorimetric (periodate) method.

194 Hullin, R.P., M. Kapel, and J.A. Drinkall. 1969. The lithium contents of some consumable items. J. Food Technol. 4:235-240. 20 ref., 1 tab.

Tobacco ash, tap waters of various origins, salt, lettuce, and potato were analyzed for Li. C_3H_8-air flame on a Unicam SP90 was used.

195 Humphrey, B.A. and J.M. Vincent. 1966. Strontium as a substituted structural element in cell walls of Rhizobium. Nature 212:212-213. 3 ref., 1 tab.

Ca, Mg, and Sr were determined by AAS in the whole cells and cell walls of Rhizobium trifolium. Sr (1500 ppm) was used as a releasing agent in the determination of Ca and Mg (to prevent phosphate interference). To remove phosphate interference in Sr analysis, the solutions were treated with "permutite decacidite - FF" resin (acetate form) moistened with 0.1$\underline{N}$ HOAc. (Method of sample preparation and ashing of sample is given by Humphrey and Vincent in J. Gen. Microbiology 29:557, 1962.)

196 Hunsaker, V.E. and P.F. Pratt. 1970. The solubility of mixed magnesium-aluminum hydroxide in various aqueous solutions. Soil Sci. Soc. Am. Proc. 34:823-825. 6 ref., 3 tab., 2 fig.

The release of Mg to water and 1$\underline{N}$ solutions of NaCl, NH_4NO_3, and NH_4OAc by synthetic crystalline Mg-Al hydroxide and the same material freshly precipitated on hydroxy Al- montmorillonite was studied. Mg in the extracts was determined by AAS. Mg was also determined on leachates collected from leaching columns. Soils in lysimeters were analyzed for exchangeable Mg by extracting with NH_4NO_3 and NaCl solutions. Water-soluble Mg was also determined to apply necessary correction.

197 Hunsaker, V.E. and P.F. Pratt. 1971. Calcium magnesium exchange
         equilibria in soils. Soil Sci. Soc. Am. Proc. 35:151-152.
         12 ref., 1 tab., 2 fig.

         A sample of montmorillonite and the same montmorillonite

     coated with hydroxy-Al and soils with organic materials, allophane

     and kaolinite plus oxides of Fe and Al were equilibrated with

     solution 0.04$\underline{N}$ in chloride with Ca:Mg between 10:90 and 95:5.

     After centrifuging the soils were washed three times with 25 ml 1$\underline{N}$

     NH_4NO_3. Ca and Mg were determined in the extracting and equilib-

     rating solutions by AAS.

198 Husler, J. 1970. Atomic absorption determination of bismuth in soils,
         rocks, and ores. Atom. Absorp. Newsl. 9:31-32. 5 ref., 2 tab.

         Soil sample (0.5 - 0.1 g, 200 mesh) was digested with 20 ml

     1:1 HNO_3 for 20-30 min and diluted to 100 ml for Bi determination.

199 Hylton, L.O., A. Ulrich, and D.R. Cornelius. 1967. Potassium and
         sodium interrelations in growth and mineral content of Italian
         ryegrass. Agron. J. 59:311-314. 14 ref., 5 tab., 3 fig.

         Plants of Italian ryegrass were segregated into blade, tiller,

     roots, etc. Samples (40 mesh) were dry-ashed. K and Na were

     determined by flame photometry and Ca and Mg by AAS.

200 Isaac, R.A. and J.D. Kerber. 1971. Atomic absorption and flame
         photometry: Techniques and uses in soil, plant, and water
         analysis. 13 ref., 6 tab., 5 fig. pp. 17-37. In L.M. Walsh
         (ed.) Instrumental methods for analysis of soils and plant tissue.
         Soil Sci. Soc. Am., Inc., Madison, WI.

         Discusses AAS analyses of (a) Dry and wet-ashed plant samples

     (b) Soil extracts (i) 1$\underline{N}$ NH_4OAc (ii) 0.05 $\underline{N}$ HCl and 0.025 $\underline{N}$ HCl

     (iii) HF-HCl digests and (c) Water samples of streams, ponds,

     lakes and other forms of water.

201 Islam, A. and J. Bolton. 1970. The effect of soil pH on potassium
        intensity and release of non-exchangeable potassium to ryegrass.
        J. Agric. Sci., Camb. 75:571-576. 14 ref., 2 tab., 3 fig.

        For the determination of exchange isotherms subsamples of

two air-dried soils were shaken with 0.01 $\underline{M}$ $CaCl_2$ containing

different amounts of KCl. The suspension was centrifuged and the

supernatant analyzed for K by flame photometry and Ca and Mg by

EDTA titration. Exchangeable K, Ca, and Mg were determined before

and after growing ryegrass, by leaching $1\underline{N}$ NH_4OAc. K in the

extract was determined by flame and Ca and Mg by using a Unicam

SP900 flame photometer in the emission and AA modes, respectively.

Plant digests were analyzed for K, Ca and Mg by flame photometry.

202 Jago, J., P.E. Wilson, and B.M. Lee. 1971. Determination of sub-
        microgram amounts of cobalt in plants and animal tissues by
        extraction and atomic-absorption spectroscopy. Analyst 96: 349-
        353. 13 ref., 4 tab.

        Co in the acidic solution of the plant ash (HNO_3-$HClO_4$-H_2SO_4)

was extracted with 1-nitroso-2-naphthol complex. The solvent was

evaporated and the complex dissolved in ethyl methyl ketone for

aspiration. This method is more sensitive than colorimetric

method (using nitroso-R salt). Using a 5 g sample, 0.01-0.2 ppm

Co can be determined. Techtron model AA-3 was used. Clover,

lucerne, lupin, grass, weeds, etc. were analyzed.

203 Jeffus, M.T., J.S. Elkins, and C.T. Kenner. 1970. Determination of
        mercury in biological materials. J. Assoc. Off. Anal. Chem.
        53:1172-1175. 8 ref., 2 tab., 2 fig.

Wheat and other biological samples were digested in HNO_3-H_2SO_4 (1+1) and permanganate at elevated termperature. Hg was determined, after reduction and aeration, by AAS. The procedure is simple and requires about 4 h for completion. Perkin-Elmer model 303 was used.

204 Johanson, L. and H.E. Joham. 1971. The influence of calcium absorption and accumulation on the growth of excised cotton roots. Plant Soil 34:331-339. 8 ref., 2 tab., 3 fig.

Cotton seeds were used to study the Ca nutrition of excised roots. Roots were rinsed in deionized water. The dried samples were ashed in a muffle furnace at 550° (overnight) and ash was treated with 10 ml 1% HCl (v/v) containing 1625 mg/ℓ lanthanum chloride. Ca was determined by AAS.

205 John, M.K. 1971. Lead contamination of some agricultural soils in Western Canada. Environ. Sci. Technol. 5:1199-1203. 19 ref., 4 tab., 1 fig.

Soils were incubated at field capacity after addition of $Pb(NO_3)_2$. Pb was extracted with 1$\underline{N}$ NH_4OAc (pH 7), 1$\underline{N}$ NH_4OAc (pH 4.8) and 1$\underline{N}$ HNO_3. Satisfactory recovery of added Pb was obtained when 2 g soil was extracted with 10 ml 1$\underline{N}$ HNO_3 and 30 min shaking. Pb in 700 farmland soils (mostly British Columbia, some from other parts of Canada, New Zealand and USA) was extracted with 1$\underline{N}$ HNO_3. Total Pb in about 200 soils was determined with HNO_3. HNO_3 (1$\underline{N}$) extractable Pb near a battery smelter was also determined. The analyses were conducted by AAS at 283.3 nm.

206 Jones, C.E. and L.E. Pracht. 1971. Collaborative study of a zincon ion exchange method for the quantitative determination of zinc in fertilizers. J. Assoc. Off. Anal. Chem. 54:790-795. 9 ref., 7 tab.

Commercial fertilizer samples were analyzed by 5 collaborators for Zn. Samples were analyzed by the colorimetric zincon ion exchange method and an additional method (e.g., offical wet method, AAS, or gravimetric method). The zincon method gave poorer precision compared to AAS.

207 Jones, J.B., Jr. 1969. Elemental analyses of plant leaf tissue by several laboratories. J. Assoc. Off. Anal. Chem. 52:900-903. 6 ref., 4 tab.

For a collaborative study, tissue samples (enough for 9-15 kg dried tissue) were dried at least 24 h at 80°C, ground through a stainless steel 2-mm sieve and stored in polyethylene drums. Homogeneous samples were sent to different laboratories for analysis. The seven plant tissue samples (alfalfa, tomato, orchard grass, Bermuda grass, timothy, corn and wheat) were analyzed by 18 laboratories using the techniques employed in their laboratories. One laboratory wet-ashed the samples with HNO_3 and $HClO_4$ and the other 17 laboratories dry-ashed them. Methods used and the number of laboratories employing the technique were as follows: Colorimetric: B 2, P 3; flame spectroscopy: Ca 1, K 2, Na 1; AAS: Ca 3, Cu 4, Fe 5, Mg 4, Mn 5, K 3, Na 2, Zn 5; and emission spectroscopy: Al 10, B 13, Ca 13, Cu 13, Fe 13, Mg 13, Mn 13, P 13, K 12, Na 7 Zn 10.

Variations due to differences in oven-drying, ashing temperature, instruments, etc. are discussed.

208 Jones, J.B., Jr. and R.A. Isaac. 1969. Comparative elemental analyses
        of plant tissue by spark emission and atomic absorption spectro-
        scopy. Agron. J. 61: 393-394. 6 ref., 4 tab.

        Plant tissues from several species were analyzed for Al,

Ca, Cu, Fe, K, Mg, Mn, and Zn by AAS with Perkin-Elmer model 303

(Tennessee Corporation) and by spark emission spectroscopy (Ohio

Agricultural Research and Development Centre). Significant

differences were found for K and Mg. Discrepencies between

laboratories were observed for Al, Cu, and Fe. On a standard

wheat plant tissue sample it was found that AAS results were more

reproducible than spark emission results. In general, the results

by the two methods and two laboratories compared favorably.

209 Jones, J.L. and R.D. Eddy. 1968. Determination of iron and nickel
        in water and brine by solvent extraction and atomic absorption
        spectroscopy. Anal. Chim. Acta 43:165-171. 11 ref., 4 tab.

        A rapid and sensitive AAS method is described for the

determination of Fe and Ni in water samples. A single extraction

procedure was effective for Fe at 0.4-200 ppb concentration and

Ni at 2-200 ppb. The complexing agents were 0.2% solutions of

8-hydroxyquinoline and dimethyl glyoxime for Fe and Ni, respec-

tively. The complex was extracted for 15 min with MIBK. Jarrell-

Ash 82-360 was used.

210 Joseph, K.T., V.K. Panday, S.J. Raut, and S.D. Soman. 1968. Per
        capita daily intake of trace elements from vegetables, fruits,
        and drinking water in India. Atom. Absorp. Newsl. 7:25-27. 5
        ref., 5 tab.

        Na, K, Ca, Mg, Mn, Fe, Zn, Cu, Co, Cr, Li, and Rb were

determined with Perkin-Elmer model 303. In water samples, Na, K,

Ca, and Mg were determined directly or after dilution. Other elements were determined after concentrating the samples 40-100 times. Vegetables and fruits were also analyzed.

211 Joseph$_{40}$K.T., M$_{87}$Parameswaran, and S.D. Soman. 1969. Estimation of K^{40} and Rb^{87} in environmental samples using atomic absorption spectrophotometry. Atom. Absorp. Newsl. 8:127-128. 6 ref., 3 tab.

   A wide range of samples (vegetables, fruits, total daily diet, etc.) was analyzed. K and Rb were analyzed by AAS and K^{40} and Rb^{87} values in terms of activity were calculated. Results were checked with K^{40} - β activity using a Geiger-Müller tube along with a coincidence and anti-coincidence arrangement. However, no such check was made for Rb^{87}. The method is applicable in determining low concentrations where counting techniques cannot be applied with reliability.

212 Joseph, K.T., M. Parameswaran, and S.D. Soman. 1970. Micronutrients in nitrogenous, phosphatic and mixed fertilizers. Curr. Sci. 39:145-147. 6 ref., 3 tab.

   K, Rb, Mg, Fe, Cu, Mn, and Zn were determined in $(NH_4)_2SO_4$ and NH_2CONH_2 after water dissolution and in superphosphate, $(NH_4)_2HPO_4$, Factumfos, Suphala after acid digestion. Perkin-Elmer model 303 with air-C_2H_2 flame was used.

213 Joyce, J.P. and P.V. Rattray. 1970. Nutritive value of white clover and perennial ryegrass. III. Intake and utilization of calcium, phosphorus and magnesium. N.Z. J. Agric. Res. 13:800-807. 18 ref., 7 tab.

   Ca and Mg in the HNO_3-$HClO_4$ digests of white clover and perennial ryegrass were determined by AAS using $SrCl_2$ as dilutent and P by AutoAnalyzer.

214 Joyner, T. and J.S. Finley. 1966. The determination of manganese
        and iron in sea water by atomic absorption spectrometry. Atom.
        Absorp. Newsl. 5:4-7. 11 ref., 5 tab., 4 fig.

        Fe and Mn were concentrated by co-precipitation and solvent

        extraction techniques. The single-step extraction with sodium

        diethyl dithiocarbamate into MIBK gave a 20X concentration.

        Perkin-Elmer model 303 with a Photovolt Linear/Log Varicord model

        43 strip-chart recorder was used.

215 Joyner, T., M.L. Healy, D. Chakravarti, and T. Koyanagi. 1967.
        Preconcentration for trace analysis of sea waters. Environ. Sci.
        Technol. 1:417-424. 73 ref., 6 tab.

        Methods of pre-concentration for use in trace-element analysis

        of sea waters by AAS and other techniques are discussed as well as

        efficiency of coprecipitation of Mn, Fe, Ni, Co, Cu, and Zn from

        sea water by AAS.

216 Judel, G.K. and S. Heilenz. 1969. Mineralstoffanalyse von biologischem
        Material mit Hilfe der Atom-Absorptions-Spektralphotometrie (Deter-
        mination of mineral elements in biological material by means of
        an atomic absorption spectrophotometer). Z. Pflanzenernaehr. Bodenkd.
        124:43-51. 6 ref., 1 tab.

        Details concerning sample preparation and optimum adjustments

        and the advantages and disadvantages of C_3H_8 and C_2H_2 gases for

        the determination of Ca, Co, Cu, Fe, Mg, Mn, Pb, and Zn in bio-

        logical materials are discussed. K and Na are determined by emission.

217 Juo, A.S.R. and S.A. Barber. 1969. An explanation for the variability
        in Sr-Ca exchange selectivity of soils, clays and humic acid.
        Soil Sci. Soc. Am. Proc. 33:360-363. 20 ref., 1 tab., 2 fig.

        For Sr-Ca exchange measurements, Ca-saturated soil samples,

        Ca-bentonite, Ca-vermiculite, and Ca-humate were equilibrated

with $0.05\underline{M}$ CaCl$_2$ solutions containing SrCl$_2$ (10^{-4} to $10^{-3}\underline{M}$).

Ca and Sr in the initial and the equilibrated solutions were

determined by a Jarrell-Ash AA unit.

218 Kahn, H.L. 1965. Atomic absorption speeds precision trace-metal
     analysis. Food Eng. 37(5):105-108. 4 fig.

       Discusses use of AAS in food chemistry (e.g. Cr in grease

resistant packaging paper).

219 Kalb, G.W. 1970. The determination of mercury in water and sediment
     samples by flameless atomic absorption. Atom. Absorp. Newsl.
     9:84-87. 6 ref., 1 tab., 5 fig.

       Hg in the low ppb range in water and sediment samples can

be determined (253.65 nm) by the technique described. The method

is rapid and the detection limit is dependent only on the sample

size. Perkin-Elmer model 303 was used.

220 Khalifa, E.M. and S.W. Buol. 1968. Studies of clay skins in a
     Cecil (Typic Hapludult) soil: I. Composition and genesis. Soil
     Sci. Soc. Am. Proc. 32:857-861. 19 ref., 2 tab., 2 fig.

       A, B, and C horizons and the clay skins of B and C horizons

were extracted at 50°C with Na$_2$S$_2$O$_4$ in a citrate buffer at pH

4.75 and Fe determined by Perkin-Elmer model 303. For CEC deter-

mination, Mg saturated fine clay was treated with $1\underline{N}$ (pH 7.0)

Ca(CH$_3$COOH)$_2$ and the supernatant, after centrifuging, was

analyzed for Mg by AAS.

221 Khan, F.R. and A.H. Cornfield. 1968. The direct determination of
     iron in soil extracts by atomic absorption spectrophotometry.
     Plant Soil 29:189-192. 5 ref., 1 tab.

Dry and waterlogged soils were extracted with $1\underline{N}$ NH_4OAc

(pH 7.0) $1\underline{N}$ NH_4OAc (pH 3.0) and Morgan's reagent ($0.5\underline{N}$ HOAc –

$0.75\underline{N}$ CH_3COONa, pH 4.8) for Fe. Results of direct aspiration

in AA (Unicam SP90) were compared with a colorimetric method

after destruction of organic matter in the extracts with 30%

H_2O_2. There was good agreement between the two methods. It

was concluded that Fe can be determined by AAS by direct aspira-

tion of the extracts without preliminary treatment (except dilu-

tion where necessary).

222 Khera, A.K., E. Steinnes, and A. Øien. 1970. A comparative study on
the aluminium determination in ammonium acetate soil extracts by
spectrophotometry, activation analysis and atomic absorption.
Acta Agric. Scand. 20:33-34. 6 ref., 1 tab.

Soil (10 g) was extracted with 100 ml $1\underline{N}$ NH_4OAc. Al was

determined by spectrophotometry, neutron activation and AAS

(N_2O-C_2H_2 flame; Techtron burner type AB40). For AAS, no sample

preparation was carried out. No significant difference was

found between the methods. Relative merits of the methods are

presented.

223 Kisfaludi, G., C. Henry, and J. L. Jourdain. 1971. Dosage du plomb
dans les eaux par spectrophotométrie de flamme à absorption
atomique. (Lead determination in water by atomic absorption
spectrophotometry). Chim. Anal. 53:388-390. 3 ref.

Two methods of Pb determination in water by AAS were compared

(a) direct sample spraying (air-C_3H_8 flame), and (b) nebulization

after extraction by APDC – hexane (air-C_2H_2 flame). Content

range determined: 0.003-3 mg/ℓ. Pye Unicam SP90 was used.

224 Kittrick, J.A. 1971. Stability of Montmorillonites: I. Belle Fourche
      and Clay Spur Montmorillonites. Soil Sci. Soc. Am. Proc. 35:140-
      145. 22 ref., 2 tab., 1 fig.

          Samples of montmorillonite from South Dakota and from

      Wyoming were used for this study. They were suspended in various

      solutions in polyethylene bottles and agitated for 3 to 4 yr [sic].

      Total Al, Fe, K and Si in montmorillonite was determined with X-ray

      spectrograph using a glass fusion procedure. The results were

      checked with total element analysis for Al, Fe and Mg (HF digest)

      and Si (Na_2CO_3 fusion). Al, Fe, and Si were estimated colori-

      metrically and Mg by AAS. Periodic analysis for Al, Fe, Mg, and

      Si were done in the equilibrating solutions by the above techniques

      and Na by flame photometry.

225 Koirtyohann, S.R. and M. Hamilton. 1971. Atomic absorption spectro-
      photometric determination of molybdenum in fertilizers. J. Assoc.
      Off. Anal. Chem. 54:787-789. 5 ref., 1 tab.

          For sample preparation, 1.0 g fertilizer sample was treated

      with 20% HCl and with $8\underline{N}$ NH_4OH. Then 8-hydroxyquinoline solution

      was added and pH adjusted to 1.6 ± 0.1. After transferring to

      separatory funnel, 10.0 ml $CHCl_3$ (and again 5.0 ml) was added and

      the $CHCl_3$ layer   transferred to a volumetric flask. MIAK was

      added. After making up to volume, Mo was determined using N_2O-

      C_2H_2 flame, at 313.2 nm. The method is precise and sensitive.

      However, the results obtained were about 5% higher than actual.

226 Kumamaru, T., Y. Otani, and Y. Yamamoto. 1967. A new method for the
      determination of phosphorus by atomic absoption spectrophotometry
      using molybdenum as a light source. Bull. Chem. Soc. Jpn. 40:
      429. 10 ref.

In this method P is determined indirectly. Si, As, and Ge do not interfere. Various organic extractants were compared and n-butyl acetate was found to be most efficient. The method may be applied to determine P in industrial water. Mo (313.3 nm) was determined by Nippon Jarrell-Ash model AA-1.

227 Kurdi, F.H. and K.L. Babcock. 1970. Cation uptake from bentonite suspensions by excised barley roots. Plant Soil 33:413-424. 14 ref., 4 tab., 4 fig.

Excised barley roots and filtrates of clay suspensions were analyzed by Perkin-Elmer model 303 for Na, K, Ca, and Li, the first three in the presence of 500 ppm $SrCl_2$ and $0.1\underline{N}$ $HClO_4$ and Li in the presence of 4 meq KCl/ℓ as a protective solution.

228 Kuwata, K., K, Hisatomi, and T. Hasegawa. 1971. The rapid determination of trace amounts of cadmium and copper in river and sea water by atomic absorption spectroscopy. Atom. Absorp. Newsl. 10:111-115. 18 ref., 5 tab., 6 fig.

Cd and Cu were determined with Perkin-Elmer model 303 in the range 0.05-10 ppb and 0.5-40 ppb, respectively, after extraction with Na-DDTC into MIBK.

229 Lacy, J. 1965. Automatic procedures for the determination of calcium, potassium, magnesium and phosphorus in soil extracts. Analyst 90:65-75. 12 ref., 3 tab., 5 fig.

An AutoAnalyzer system, in conjunction with AA, was used for simultaneous determination of P, Mg, and either Ca or K in soil extracts (NH_4OAc, pH 7, $1\underline{N}$). Ca and K were determined by flame photometer, Mg by AAS and P colorimetrically. Routine determinations can be carried out with accuracy and precision at a rate of 30-40/h.

230 LaFlamme, Y. 1967. Determination of aluminum in soils by atomic absorption spectroscopy. Atom. Absorp. Newsl. 6:70-71. 10 ref., 2 tab.

A method is described to determine $1\underline{N}$ KCl extractable Al in soils (soil 10 g + solution 100 ml). To study interference, different amounts of Fe were added to a $1\underline{N}$ KCl solution containing 50 µg/ml Al. Recovery of Al was incomplete in absence of Fe and slightly higher results were obtained when Fe concentration was 200 or 300 µg/ml. A 2-in. slot burner was used on a Perkin-Elmer model 303.

231 LaFlamme, Y. 1968. Determination of free silica in soils by atomic absorption spectrophotometry. Atom. Absorp. Newsl. 7:101-102. 7 ref., 2 tab.

Free SiO_2 in soil was extracted with Tamm's reagent ($0.2\underline{N}$ oxalic acid and $0.2\underline{N}$ ammonium oxalate). AAS results agreed well with gravimetric method. Complete recoveries (96-102%) of added Si were obtained. Perkin-Elmer model 303 was used.

(Note in Atom. Absorp. Newsl. 8:64, 1969: Tamm's reagent only dissolves "amorphous silica" and not "crystalline silica" such as quartz.)

232 LaFleur, K.S. 1970. Color of heated South Carolina Ultisols. Soil Sci. 110:379-382. 13 ref., 2 tab., 4 fig.

Red, red-yellow, and yellow soils were extracted with dithionite-citrate solution for "free" Fe oxide and "free" Mn oxide. Extracted Fe and Mn were analyzed by AAS. Fe^{+2} was extracted with $0.1\underline{N}$ H_2SO_4 at 95°C for 16 h and determined colorimetrically.

233 Lagerwerff, J.V. 1971. Uptake of cadmium, lead and zinc by radish
        from soil and air. Soil Sci. 111:129-133. 11 ref., 2 tab.,
        1 fig.

        Soils were collected at 7 and 200 m from a heavily travelled

        road. A 20-g soil sample was shaken with 40 ml $1\underline{N}$ HCl for 1 h,

        centrifugate collected and analyzed for Cd, Pb and Zn by AAS.

        Radish was grown for 6 wk in cardboard containers lined with

        polyethylene in an open field at 200 m from traffic and in a

        growth chamber located in a windowless room. Tops and roots

        were analyzed for Cd, Pb and Zn as above.

234 Lagerwerff, J.V. and A.W. Specht. 1970. Contamination of roadside
        soil and vegetation with cadmium, nickel, lead, and zinc.
        Environ. Sci. Technol. 4:583-586. 37 ref., 2 tab.

        Soils (0-5, 5-10, and 10-15 cm) were collected adjacent

        to four heavily travelled roads. A 10-g sample was shaken for 1 h

        with 20 ml $1\underline{N}$ HCl and centrifuged. Grass samples were digested

        with hot HNO_3 and $HClO_4$. Cd, Ni, Pb, and Zn were determined at

        228.8, 232.0, 283.3, and 213.9 nm, respectively.

235 Lakanen, E. 1966. Separation and concentration of trace metals
        by means of pyrrolidine dithiocarbamic acid. Atom. Absorp.
        Newsl. 5:17-18.

        Soils were extracted with acid NH_4OAc ($0.5\underline{N}$ HOAc, $0.5\underline{N}$

        NH_4OAc, pH 4.65). Trace elements were concentrated by extraction

        with pyrrolidine dithiocarbamic acid.

236 Lambert, M.J. 1969. The determination of copper, chromium and arsenic
        in preservative treated timber by the method of atomic absorption
        spectrophotometry. J. Inst. Wood Sci. 4(6) No. 24:27-36. 23 ref.,
        9 tab.

Species of timber were vacuum-pressure impregnated at

200 lb/in.^{2} for 1 h with a commercial Cu-Cr-As preservative

to give final retentions of about 0.06-0.43% Cu, 0.14-0.63% Cr

and 0.09-0.50% As (w/w) and ground to 2 mm size by a Wiley mill.

For AAS, approx. 5.0 g sample was weighed into a Whatman soxlet

thimble and extracted with 2N HCl in the extractor and the solution

was aspirated. Techtron AA-4 was used (Cu 324.75, Cr 357.87,

As 193.70 nm). Standard deviations of means were found to be

0.004% Cu, 0.003% Cr and 0.008% As. AAS results were compared

with other techniques (As - volumetrically, Cu and Cr - colori-

metrically). Timber of the following species was analyzed -

Monterey pine, yellow sassafras, Australian beech, Ackama paniculata,

Geissois benthami, Schizomeria ovata, Brisbane quandong, Sloanea

woollsii, Endiandra virens, brown bollywood, spotted gum, Manna gum.

237 Lambert, T.L. and C. Blincoe. 1971. High concentration of cobalt in
wheat grasses. J. Sci. Food Agric. 22:8-9. 8 ref., 2 tab.

The concentration of Co in range wheatgrasses (A. desertorium

and A. intermedium) was determined by AAS (213.9 nm), X-ray

fluorescence and chemical methods. A locally assembled AA unit

was used. The samples were cut 1 in. above the ground, washed

in 2-3 changes of petroleum ether (b.p. 40-60°C) to remove adhering

soil and dried at 70°C. After grinding and digesting with HNO_3-

H_2SO_4-$HClO_4$ (10:1:1), SiO_2 was removed by filtration.

238   Lavkulich, L.M. and J.H. Wiens. 1970. Comparison of organic matter destruction by hydrogen peroxide and sodium hypochlorite and its effects on selected mineral constituents. Soil Sci. Soc. Am. Proc. 34:755-758. 16 ref., 7 tab., 1 fig.

 A, B, and C horizons from soils of varying pedogenic development were sampled. H_2O_2 and NaOCl oxidation procedures were used for the destruction of organic matter. Acid ammonium oxalate extracts of the residues and the original soils were analyzed for Al, Fe, Mn, and Si by Perkin-Elmer model 303 (air – C_2H_2 for Fe and Mn; N_2O – C_2H_2 for Al and Si). The 0.5$\underline{N}$ NaOH extracts were analyzed for Al and Si only.

239   Leaf, A.L., J.V. Berglund, and R.E. Leonard. 1970. Annual variation in foliage of fertilized and/or irrigated red pine plantations. Soil Sci. Soc. Am. Proc. 34:677-682. 30 ref., 5 tab.

 Current-year needles from lateral branches of the uppermost whorl of 160 red pine trees growing on a sandy outwash soil were sampled over a 6-yr period. Samples were dry ashed at 480°C for 15 h, taken up in weak HCl solution and analyzed for Ca and Mg (AAS), P (colorimetrically), and K (flame spectrophotometer).

240   Lee, J. and C.M. Campbell. 1969. Atomic absorption spectrophotometric and ethylenediaminetetra-acetate-titration methods for calcium and magnesium determinations. J. Dairy Sci. 52:121-124. 10 ref., 2 tab., 2 fig.

 Subtropical forage samples of kikuyu and pangola grass were analyzed for Ca and Mg. EDTA titration gave slightly, but not significantly, higher results than AAS. Due to several advantages AAS is prefered over EDTA titration for routine analysis. Perkin-Elmer model 290 was used.

241 Lehman, G.S. and L.G. Wilson. 1971. Trace element removal from sewage effluent by soil filtration. Water Resour. Res. 7:90-99. 17 ref., 2 tab., 2 fig.

Lysimeter water samples were analyzed for Fe, Mn, Ni, Cu, Zn, Pb, Cd, Co, and Sr by AAS. Grass clippings were analyzed for Fe, Mn, Cd, Zn and Cu. No detectable quantities of Cr, Ni, Pb, Co or Sr were found.

242 Lener, J. and B. Bibr. 1971. Determination of traces of cadmium in biological materials by atomic absorption spectrophotometry. J. Agric. Food Chem. 19:1011-1013. 6 ref., 4 tab.

Celery, parsley, garlic, carrot, onion, potatoes, etc. were ashed with a mixture of H_2SO_4, $HClO_4$, and HNO_3, digests were partially neutralized to pH 5-6 and Cd determined by Techtron type AA-4. Parallel samples, after digestion, were neutralized by NH_4OH, 0.2$\underline{M}$ acetate buffer (pH 10.7) was added and treated with NH_4OH. Cd was extracted with 5 x 10^{-4} $\underline{M}$ dithizone solution in $CHCl_3$. After adding $HClO_4$, the organic dithizone phase was evaporated. The residue was dissolved in 0.01$\underline{N}$ HCl and Cd determined as above. Air-C_2H_2 and air-C_3H_8 flames were tested and the latter selected because of higher sensitivity. It is concluded that the content of Cd in foods may be determined by AAS (228.8 nm) by direct analysis of the plant digests.

243 Lerner, L.A. and V.V. Nedler. 1970. Atomic absorption determination of mobile forms of copper and cobalt in soils. Soviet Soil Sci. p. 758. (From abstract of the paper published in Pochvovedeniye 1970 No. 11, 105-111).

Cu and Co in soil extracts were determined by AAS after concentrating by extraction with dithizone or Na-DDTC in amyl acetate or MIBK.

244 Lerner, L.A., L.P. Orlova, and D.N. Ivanov. 1971. Use of rapid method
of decomposing samples during determination of the total content
of Cu, Zn, and Mn in soils by the atomic absorption method. Soviet
Soil Sci. p. 367-370. 3 ref., 3 tab., 1 fig. (Translated from
Agrokhimiya 5:138-141, 1971).

The soil sample was decomposed in a hermetically sealed Teflon

jar with HF in the presence of aqua regia (e.g., 5 ml aqua regia

and 30 ml 40% HF for 900 mg sample) at 110°C (40-60 min). After

decomposition, an excess of H_3BO_3 (12 g for 900 mg sample digested)

was added and made up to 100 ml. Standards made in water can be

used for this method. Techtron AA-4 with air-C_2H_2 flame was used.

Results of this method of digestion agree satisfactorily with

those of standard method (Pt crucibles).

245 Letham, D.S. and H.J.W. McGrath. 1969. Influence of fertilizer treat-
ment on apple fruit composition and physiology. III. Influence
on contents of phosphorus, magnesium, calcium, and potassium. N.Z.
J. Agric. Res. 12:642-649. 10 ref., 6 tab.

Mid-cortial apple tissue was dried at 70°C first in a fan

oven and then dried at 70°C/20 mm in a vacuum oven. The dried

tissue was ground and redried in a vacuum oven. A 2-g sample was

ashed at 550°C for 16 h, treated with HCl and, after evaporation,

taken up in 25 ml 0.2$\underline{N}$ HNO_3. Ca and Mg were determined by AAS

(1500 ppm Sr added), K by flame photometry and P by colori-

metry.

246 Likens, G.E., F.H. Bormann, N.M. Johnson, and R.S. Pierce. 1967. The
calcium, magnesium, potassium, and sodium budgets for a small
forested ecosystem. Ecology 48:772-785. 41 ref., 11 tab., 8 fig.

Samples of precipitation and stream water were collected at weekly intervals during June 1963-May 1965 in six watersheds of the Hubbard Brook Experimental Forest at West Thornton, New Hampshire. Spectro-analyzed $CHCl_3$ was added to rainfall samples as a preservative. For the collection of drainage water, the polyethylene bottles and caps were soaked in 6$\underline{N}$ HCl, flushed with tap water and rinsed twice with demineralized water. Ca, Mg, K, and Na were estimated, normally within a week of collection, by AAS with Perkin-Elmer model 303. However, no La was used to suppress interferences although Al and SiO_2 were present in stream water. Therefore, all Ca values reported in the paper were low and, on the basis of subsequent work carried out, should be multiplied by 1.6 for stream water.

247 Loneragan, J.F. and K. Snowball. 1969. Calcium requirements of plants. Aust. J. Agric. Res. 20:465-478. 27 ref., 3 tab., 5 fig.

Ca concentration in the tops and roots of several cereals (oats, barley, rye, wheat and corn), herbs (Cryptostemma calendula, storksbill, tomato), grasses (softchess, ripgut grass, perennial ryegrass, stiff darnel) and legumes (lupines, Ornithopus compressus, seradela, alfalfa - barrel, common, crescent-shaped, littoral, snail - subterranean clover) were examined for plants grown in culture solutions. At each harvest, plant roots were dipped briefly in 1$\underline{N}$ $MgSO_4$ solution to remove adsorbed Ca and blotted with absorbent paper to remove excess water. Plants were segregated into tops and roots, some tops were further subdivided into cotyledons hypocotyl, leaves and shoots. HNO_3-$HClO_4$ digests were analyzed for Ca by AAS, using Sr as a releasing agent.

248 Looyenga, R.W. and C.O. Huber. 1971. Determination of silicate in
     waste water by atomic absorption inhibition titration. Anal.
     Chem. 43:498-502. 22 ref., 2 tab., 4 fig.

          A new semi-automatic rapid method for silicate determination

     is proposed. Mg absorption was monitored while using a standard

     Mg solution as a titrant. The method is based on the inhibition

     by silicate of the Mg by AA signal and is applicable down to

     1 μg/ml SiO_2. Jarrell-Ash model 82-516 was used.

249 Losche, C.K., R.J. McCracken, and C.B. Davey. 1970. Soils of steeply
     sloping landscapes in the southern Appalachian Mountains. Soil
     Sci. Soc. Am. Proc. 34:473-478. 20 ref., 5 tab., 1 fig.

          The relative effect of slope aspect and position upon the

     differentiation of the parent rock into soil profiles was deter-

     mined. Exchangeable Ca, Mg, and K were extracted by 1N NH_4OAc.

     Ca and Mg were determined by AAS and K by flame photometry. Free

     Fe, extracted by a $Na_2S_2O_4$ reduction procedure, was determined

     by AAS.

250 Luecke, W. and R. Emmermann. 1971. The application of the boat
     technique for lead, zinc, silver, and cadmium in soil samples.
     Atom. Absorp. Newsl. 10:45-49. 8 ref., 3 tab., 8 fig.

          Ag, Cd, Pb, and Zn can be determined in HCl extracts of

     soils down to the ppb range by the Sampling Boat Technique.

251 Lunar Sample Preliminary Examination Team (D.H. Anderson, E.E. Anderson,
     K. Bieman, P.R. Bell et al.). 1969. Preliminary examination of
     lunar samples from Apollo 11. Science 165:1211-1227. 11 ref.
     and notes, 5 tab., 12 fig.

          Chemical analyses were made principally by optical spectro-

     graphic measurements. Three samples were analyzed by AAS for

     Fe, Mg, Ca, Ti, Na, and K and by a colorimetric procedure for Si.

252 Lunde, G. 1970. Analysis of trace elements in seaweed. J. Sci. Food
        Agric. 21:416-418. 18 ref., 4 tab.

        Seaweed samples were dried at 40-80°C and ground. As, Co,

Mo, Sb, and Se were determined by neutron activation and Fe and

Mn by AAS. Cu and Zn were determined by both these methods. For

AAS about 1-g sample was placed in a water bath (90-100°C) and

dissolved in H_2SO_4 and H_2O_2. After the solutions cleared, the

volumes were made to 25 ml. Perkin-Elmer model 303 was used.

There was good agreement between the results for Cu and Zn by the

two methods.

253 Lutz, J.A., Jr and G.D. Jones. 1971. Chemical composition and yield
        of corn as affected by deep placement of dolomitic limestone.
        Agron. J. 63:9-11. 17 ref., 4 tab., 1 fig.

        The ear leaf (6th leaf) was sampled when corn was silking.

Dry-ashed sample was analyzed for K, Ca, and Mg by flame photometer

and for P by colorimetric method. For AA analysis for Zn, 1-g

sample was digested in a mixture of 10 ml HNO_3 and 2 ml $HClO_4$ and

diluted to 50 ml with 0.5N HCl.

254 Lyon, G.L. and R.R. Brooks. 1969. The trace element content of
        Olearia rani and its application to biogeochemical prospecting.
        N.Z. J. Sci. 12:200-206. 7 ref., 2 tab., 2 fig.

        Samples of daisy bush and their corresponding soils were

collected. Flower heads, leaves, 1-yr-old twigs and older wood

were ashed at 450°C. Ash was dissolved in 2N HCl and analyzed

for Zn and Cu by AAS. Ash was analyzed for Mo by emission

spectrography. $HF-HClO_4$ digests of soils were analyzed for Cu

and Zn by AAS. Soils were analyzed for Mo after ignition at 450°C,

as given for plant samples.

255 Lyon, G.L., R.R. Brooks, P.J. Peterson, and G.W. Butler. 1968. Trace elements in a New Zealand serpentine flora. Plant Soil 29:225-240. 22 ref., 4 tab., 8 fig.

Soils were extracted with 2.5% HOAc for 16 h and extracts analyzed by AAS for Cr, Cu, Ca, Mg, Co, and Ni. Total contents of these elements in plants and soils were determined by emission spectroscopy.

256 Maag, G.W. 1969. Rapid digestion procedures for determination of metallic ions and total nitrogen in sugarbeet samples. J. Am. Soc. Sugar Beet Technol. 15:361-367. 10 ref., 3 tab.

For the determination of various metals by AAS, the leaves and petioles of sugar beet (0.5 g) samples were digested with 5 ml $HNO_3-HClO_4-H_2SO_4$ and with a small amount of Na molybdate as a catalyst. The procedure gave good results. Except for Na and Mo, several cations can be determined.

257 MacLean, A.J. 1968. Fixation of potassium added to soils and its recovery by plants. Can. J. Soil Sci. 48:307-313. 7 ref., 6 tab.

Field and greenhouse experiments were conducted with oats. Plant samples were ashed in a muffle furnace at 450°C and the residue dissolved in HCl. Soils were extracted for water soluble (soil:water 1:2), exchangeable (1N NH_4OAc), and nonexchangeable – (a) 0.01N HCl extractable, and (b) 0.5N NaCl extractable – K. The amounts of K in the extracts were determined by AAS or flame photometry.

258 MacLean, A.J., R.L. Halstead, and B.J. Finn. 1969. Extractability of added lead in soils and its concentration in plants. Can. J. Soil Sci. 49:327-334. 11 ref., 6 tab.

Soils were extracted by $1\underline{N}$ NH_4OAc and $0.1\underline{M}$ $CaCl_2$ and Pb

determined, without further preparation, by Techtron AA-3.

Plant samples were dry-ashed overnight at 500°C and treated with

hot $3\underline{N}$ HCl. For oats and alfalfa grown in a greenhouse, Pb was

determined by AAS and P by colorimetric method. For five species

(alfalfa, asparagus, bromegrass, couchgrass, and timothy) sampled

near a well-travelled highway, Pb was determined by AAS and

dithizone method. AA results were slightly higher than those obtained

by the dithizone method. Standard deviation based on the differences

in Pb values between two methods was ± 1.09 ppm and coefficient

of variability 9.4%.

259 MacNamara, G. and S.J. Toth. 1970. Adsorption of linuron and malathion
     by soils and clay minerals. Soil Sci. 109:234-240. 17 ref.,
     7 tab.

     Mg exchange capacities of the clay minerals were estimated

     by leaching with $Mg(CH_3COO)_2$ solution ($1\underline{N}$ pH 7.0), washing out excess

     salt with water and displacing adsorbed Mg with $0.05\underline{N}$ HCl. The

     extracts were analyzed for Mg by AAS.

260 MacPhee, W.S.G. and D.F. Ball. 1967. Routine determination of calcium
     and magnesium in soil extracts by atomic absorption spectropho-
     tometry. J. Sci. Food Agric. 18:376-380. 9 ref., 3 tab., 2 fig.

     Soils were extracted with $0.5\underline{N}$ HOAc or $1\underline{N}$ NH_4OAc (pH 7.0).

     Addition of $SrCl_2$ to give a final concentration of 1600 ppm Sr

     was satisfactory to eliminate PO_4 and other interferences.

261 Magee, R.J. and A.K.M. Rahman. 1965. Determination of copper in sea
     water by atomic absorption spectroscopy. Talanta 12:409-416.
     12 ref., 9 tab., 1 fig.

Cu–APDC complex was extracted into ethyl acetate and the

organic extract   aspirated. This gave a marked increase in

sensitivity. A standard Uvispek H 700 spectrophotometer fitted

with a Hilger H 1100 AA attachment was employed.

262 Mancy, K.H. and M.K. Stinson. 1968. A review of the literature of
        1967 on wastewater and water pollution control – Instrumental and
        automated analytical methods. J. Water Pollut. Control Fed.
        40:905–922. 143 ref.

Reviews (1967) wide applications of AAS for metal analysis

in natural and wastewaters.

263 Manning, D.C. 1970. Non-flame methods for mercury determination by
        atomic absorption: A review. Atom. Absorp. Newsl. 9:97–99.
        43 ref.

Literature on Hg determination at trace concentrations in

water, plant, soil and other samples by flameless AAS is reviewed.

Hg is reduced to elemental form and free Hg is then determined

at 253.7 nm in an absorption cell. Hg from the solution can also

be deposited onto a base metal and then released thermally into

an absorption cell. Detection limits of 0.001 µg or lower are

possible,while about 0.5 µg/ml are reported for the standard

solution nebulization sampling method.

264 Martens, D.C., D.L. Hallock, and M.W. Alexander. 1969. Nutrient
        distribution during development of three market types of peanuts.
        II. B, Cu, Mn, and Zn contents. Agron. J. 61:85–88. 7 ref.,
        1 tab., 4 fig.

The micronutrients were determined in   cultivars at various

stages of development. The hypocotyl, stem, leaves and fruit were

analyzed separately. Cu, Mn, and Zn were determined by AAS (Perkin-Elmer model 303) on an HCl extract of the dry-ashed (450°C) sample. Total B in the dry tissue sample was estimated by the curcumin procedure.

265　Martens, D.C., M.G. Schnappinger, Jr., and L.W. Zelazny. 1970. The plant availability of potassium in fly ash. Soil Sci. Soc. Am. Proc. 34:453-456. 16 ref., 2 tab., 1 fig.

Greenhouse and laboratory experiments were conducted to evaluate the availability of K in fly ash (samples of bituminous coal ashes and a sample of lignite coal ash) obtained from coal burning power generating plants. KCl and fly ash were mixed with a soil. Corn was grown and above-ground portions harvested after a growth period of 41 days. Samples were dried for 48 h at 70°C and ground to pass a 20-mesh sieve. A 1-g sample was ashed at 450°C for 2 h and the ash dissolved in 100 ml of $0.3\underline{N}$ HNO_3. Na was determined by AAS and Ca, K, and Mg by flame photometry. B was determined, in samples ashed for 3 h at 550°C, by a modification of the curcumin method.

266　Masek, P.R., I. Sutherland, and S. Grivell (ed). 1969- .Atomic Absorption and flame emission spectroscopy abstracts. Science and Technology Agency, London E.C.1.

This is an international journal, issued bimonthly which first appeared in Jan.-Feb. 1969. It contains abstracts of papers (published, unpublished, and presented at the conferences) on all aspects of AAS and classifies applications in agriculture, natural waters, and other fields.

267 Matocha, J.E. and G.W. Thomas. 1969. Potassium and organic nitrogen content of grain sorghum as affected by iron. Agron. J. 61:425-428. 11 ref., 6 tab., 2 fig.

Greenhouse experiments were conducted on two calcareous montmorillonitic soils (pH 7.6 and 8.2) to study the influence of P, K, and Fe on yield and organic N content of grain sorghum. Plants were grown for 4 wk in one soil and 5 wk in the other soil. Plant material was dried (70°C), ground, dry-ashed, and the ash dissolved in dilute HCl. Fe was determined by AAS and K by flame photometry. In field experiments on one of the soils (pH 7.6), seed and leaf samples were analyzed as above.

268 Maxwell, J.A., S. Abbey, and W.H. Champ. 1970. Chemical composition of lunar material. Science 167:530-531. 11 ref., and notes, 3 tab.

Samples were crushed to pass a 100-mesh nylon screen. Na, K, Si, Al, Fe, Mg, Ca, Mn, and Cr results by AAS and other techniques are compared.

269 Maynard, D.N. 1970. The effects of nutrient stress on the growth and composition of spinach. J. Am. Soc. Hortic. Sci. 95:598-600. 15 ref., 4 tab.

Fall and spring experiments were conducted with spinach in the greenhouse in sand cultures. Plants were harvested 92 and 90 days after seeding for the fall and spring crops, respectively. Leaves were separated into mature and immature groups, dried at 65°C, and ground to pass a 20 mesh sieve. The 1-g samples were ashed at 550°C for 12 h in a muffle furnace. Ash extracts was analyzed for P colorimetrically and K, Ca, and Mg by AAS. Excess $LaCl_3$ was used to remove P interference in Ca determination.

?70 McBride, C.H. 1964. Determination of minor nutrients in fertilizers
         by atomic absorption spectrophotometry. Atom Absorp. Newsl.
         3:144-159. 12 ref., 12 tab. (plus 5 supplementary tab.).

         In a collaborative study Cu, Fe, Mg, Mn, and Zn were deter-

    mined in commercial fertilizers and raw materials. A 1.00-g sample

    was dissolved in 10 ml HCl. After evaporating to dryness, the

    residue was dissolved in 20 ml 0.5$\underline{N}$ HCl, boiled, filtered and made

    up to 100 ml. When needed, aliquots were diluted with 0.1$\underline{N}$ HCl.

    It was recommended that pipets smaller than 2 ml or volumetric

    flasks smaller than 25 ml not be used. Perkin-Elmer model 303

    was used.

271 McBride, C.H. 1965. Determination of minor nutrients in fertilizers
         by atomic absorption spectrophotometry. J. Assoc. Off. Anal.
         Chem. 48:406-412. 12 ref., 12 tab.

         A collaborative study was undertaken to establish the

    reliability and utility of a general procedure for the AAS determina--

    tion of Cu, Fe, Mg, Mn and Zn in commercial fertilizers and raw

    materials.   Fertilizers used were 10-5-5, 18-46-0, 10-6-4,

    4-8-8, 6-6-6, 9-7-7, 8-6-4, and 18-46-0 (spiked). It was

    recommended that the method be adopted as official "first action"

    for these elements.

272 McBride, C.H. 1965. Determination of minor nutrients in fertilizers
         by atomic absorption spectrophotometry: second collaborative
         study. J. Assoc. Off. Anal. Chem. 48:1100-1103. 2 ref., 1 tab.

         Ca, Cu, Fe, Mg, Mn, Na, and Zn were determined in   fertilizer

    samples by 16 collaborators. It was recommended that the methods

    for Cu, Fe, Mg, Mn, and Zn be continued as official "first action"

    and the methods for Ca, Na and K be studied further.

273 McBride, C.H. 1967. Determination of secondary and minor plant nutrients in fertilizers by atomic absorption spectrophotometry: third collaborative study. J. Assoc. Off. Anal. Chem. 50:401-407. 5 ref., 5 tab.

Results on   samples gave inter-laboratory (19 collaborators) precision of 4-7% for Cu, Fe, Mg, Mn, and Zn in the range of concentrations of agronomic interest. La, Sr, and $N_2O-C_2H_2$ flame were compared in eliminating P interference in Ca determinations. For K determination NaCl was added to get a 0.1% Na concentration and for Na determination KCl was added to get a final concentration of 0.1% K to suppress ionization effects. The procedure for Ca is recommended for adoption as official method of the AOAC.

274 McBride, C.H. 1968. Determination of secondary and minor plant nutrients in fertilizers by atomic absorption spectrophotometry. IV. J. Assoc. Off. Anal. Chem. 51:847-851. 5 ref., 2 tab.

AAS method is recommended for adoption as official "first action" for Ca, Cu, Fe, Mg, Mn and Zn in fertilizers. It is also recommended that the method for K be applied and the one for Na be studied further.

275 McCrackan, M.L., H.J. Webb, H.E. Hammar, and C.B. Loadholt. 1967. Comparison of potassium content of fertilizers by atomic absorption and sodium tetraphenylboron. J. Assoc. Off. Anal. Chem. 50:5-7. 4 ref., 3 fig.

Fertilizer samples were analyzed for K by AAS at 403.8 nm after a dilution of 1:400 and by STPB.

A significant correlation (r = 0.96) was found between the two methods. Results of 101 samples (4-25% K_2O) analyzed in triplicate gave precision of 0.424% by AAS and 0.229% by STPB. The standard

deviation of the difference between the two methods was 0.50%.

Other elements normally found in fertilizers did not interfere

at the wavelength used. To save time percentage absorption was rou-

tinely used rather than converting it into absorbance to prepare

a standard curve. Perkin-Elmer model 303 was used.

276 McFarren, E.F. and R.J. Lishka. 1968. Evaluation of laboratory methods
     for the analysis of inorganics in water. 28 ref., 12 tab. pp. 253-264. In
     R.A. Baker (ed.), Trace inorganics in water. Advances in Chemistry
     Series No. 73. Am. Chem. Soc. Washington, DC.

     Results obtained by a number of collaborators on water

analysis by AAS and other techniques were compiled. Cu, Fe, Mn,

Pb, etc. were determined.

277 McKeague, J.A., A.W.H. Damman, and P.K. Heringa. 1968. Iron-manganese
     and other pans in some soils of Newfoundland. Can. J. Soil Sci.
     48:243-253. 14 ref., 2 tab., 3 fig.

     Samples of the pans and other horizons were collected at

the coast of Avalon Peninsula. Fe and Al extractable by oxalate,

dithionite, and pyrophosphate were determined colorimetrically.

Total Fe and Mn were determined as given by L. Shapiro and W.W.

Brannock (Rapid analysis of silicate rocks. 1956. U.S. Geol.

Surv. Bull: 1036-C), except that Mn was determined by AAS. Some

trace elements (Co, Cu, Ni, Pb, Sr, Zn, and Zr) were determined

by X-ray spectrographic analysis.

278 McKee, W.H. Jr. 1970. Chemical properties of a forest soil affected
     by fertilization and submergence. Soil Sci. Soc. Am. Proc. 34:
     690-693. 17 ref., 3 tab., 2 fig.

     Soils in pots were sampled during each of the dry phases of

the alternately submerged treatment. After oven-drying at 110°C

for 24 h, exchange Al (1$\underline{N}$ NaCl extractable) was determined

colorimetrically and Ca, Mg, Na, and K (1$\underline{N}$ NH$_4$OAc) by AAS. For

determination of CEC, 1-g soil was saturated with 25 ml 1$\underline{N}$ KCl

with shaking for 24 h, centrifuged and washed with 1$\underline{N}$ KCl.

Excess salt was removed by washing with water and methanol. K

was exchanged with Mg(CH$_3$COO)$_2$ and determined by AAS.

279 McLellan, G.W. 1969. Determination of barium in plant material by
       flame emission spectroscopy. Atom. Absorp. Newsl. 8:74-76.
       3 ref., 3 tab., 2 fig.

A 5-g dried plant sample (alfalfa) was dry ashed at 450°C for

16 h taken up with 2.5 ml HNO$_3$ and diluted to 50 ml. Ba was

determined by both AAS (Perkin-Elmer model 303) and flame emission.

However, noise and analytical time were excessive in the AAS determination.

280 Mee, J.M.L. and H.W. Hilton. 1969. Rapid direct analysis of zinc in
       sugar products and molasses. J. Agric. Food Chem. 17:1398-1399.
       2 ref., 4 tab., 1 fig.

Raw and refined sugars, sugarcane juices and molasses were

analyzed for Zn by AAS after treating with aqueous citric acid

solutions.

281 Melton, J.R., B.G. Ellis, and E.C. Doll. 1970. Zinc, phosphorus, and
       lime interactions with yield and zinc uptake by Phaseolus vulgaris.
       Soil Sci. Soc. Am. Proc. 34:91-93. 14 ref., 2 tab., 1 fig.

Three successive crops of pea beans were grown in the green-

house on 20 soils (pH 5.7-7.9). Plant tops were harvested with

stainless steel razor blades, dried at 60°C and ground in a Wiley

mill with stainless steel accessories. A 1-g subsample was ashed

in a muffle furnace at 500°C for 4 h. Ash was dissolved in 5 ml

2$\underline{N}$ HCl, filtered and diluted to 50 ml. Zn was determined by Perkin-

Elmer model 303.

282 Melton, J.R., W.L. Hoover, and P.A. Howard. 1969. Atomic absorption
     spectrophotometric determination of water-soluble boron in
     fertilizers. J. Assoc. Off. Anal. Chem. 52:950-953. 7 ref.,
     2 tab., 1 fig.

     Water-soluble B was extracted into a solvent (2-ethyl-1, 3-

     hexanediol in MIBK), and the organic layer aspirated into the

     $N_2O-C_2H_2$ flame for determination by AAS. No significant inter-

     ferences due to elements commonly present in fertilizers were found.

     The proposed method is fast and accurate.

283 Melton, J.R., W.L. Hoover, and P.A. Howard. 1971. The determination
     of mercury in soils by flameless atomic absorption. Soil Sci.
     Soc. Am. Proc. 35:850-852. 6 ref., 1 tab., 1 fig.

     Hg in soils at ppb level or greater can be determined by

     this method. Soils were digested with HNO_3, H_2SO_4, and $K_2S_2O_8$ but

     no heat. Beckman DB-G AA unit was used. Scale expansion on

     the recorder was not required. Recoveries of Hg added to soils

     were good (97.0-102.5%).

284 Melton, J.R., W.L. Hoover, P.A. Howard, and J.L. Ayers. 1970.
     Atomic absorption spectrophotometric determination of boron in
     plants. J. Assoc. Off. Anal. Chem. 53:682-685. 16 ref., 2 tab.,
     1 fig.

     A 10-g plant sample was moistened with approx. 20 ml saturated

     $Ba(OH)_2$ solution, dried at 150°C for 1 h and dry-ashed at 600°C

     for 10 h. Ash was treated with 10 ml 5N HCl. The solution was

     evaporated at 150°C to less than 6 ml. B was extracted into an

     organic phase of 2-ethyl-1, 3-hexanediol in MIBK (3 ml). The

     organic layer, without decantation, is aspirated into $N_2O-C_2H_2$

     flame for B determination at 249.68 nm. B can be determined in

     concentrations as low as 3 ppm. Only fluoride was found to interfere.

     Recovery of added B was 93-107%.

285 Melton, J.R., W.L. Hoover, P.A. Howard, and V.S. Green. 1971 Atomic absorption adaptation of the quinolinium molybdophosphate method for phosphorus. J. Assoc. Off. Anal. Chem. 54:373-375. 6 ref., 1 tab., 1 fig.

The official AOAC gravimetric quinolinium molybdophosphate method has been adapted to AAS. The quinolinium molybdophosphate precipitate is dissolved in NH_4OH and Mo determined by AAS at 320.883 nm with air-C_2H_2 flame. Results for P are calculated on the basis that P in the precipitate with Mo is at a 1:12 molecular ratio. By the proposed method it is possible to make determinations in 1-10 mg P_2O_5 range; most precise determinations are made below 5 mg P_2O_5. P results of Magruder fertilizer samples with gravimetric and the proposed method compared favorably. Techtron model AA-4 with Beckman model 1005 linear - log 10 inch potentiometric recorder was used.

286 Midgett, M.R. and M.J. Fishman. 1967. Determination of total chromium in fresh waters by atomic absorption. Atom. Absorp. Newsl. 6:128-131. 3 ref., 7 tab., 1 fig.

A chelation-extraction atomic absorption procedure, that can detect as little as 1 μg/l Cr is described. Cr is oxidized with $KMnO_4$ and excess $KMnO_4$ is reduced with NaN_3. Then HCl is used to adjust pH to 2.4. Cr is complexed with APDC and extracted with MIBK. Perkin-Elmer model 303 was used.

287 Miller, M.H., C.P. Mamaril, and G.J. Blair. 1970. Ammonium effects on phosphorous absorption through pH changes and phosphorus precipitation at the soil-root interface. Agron. J. 62:524-527. 17 ref., 4 tab., 3 fig.

Corn seedlings grown in vermiculite were transferred to sloping-fronted growth boxes containing a loam soil (pH 7.5).

P^{33} was used. Shoots and roots were digested in H_2SO_4-H_2O_2 and analyzed for Ca, Mg by AA and P by AutoAnalyzer.

288 Mills, C.F., A.C. Dalgarno, R.B. Williams, and J. Quarterman. 1967. Zinc deficiency and the zinc requirements of calves and lambs. Br. J. Nutr. 21:751-768. 22 ref., 6 tab., 4 fig., 5 plates.

Zn content of animal diet was determined at 213.8 nm by AAS. Usually about 1-g sample was boiled in 8 ml HNO_3, 1 ml 60% w/v $HClO_4$ and 0.5 ml 98% w/v H_2SO_4 until a final volume of 0.5 ml was obtained. Acid digests were diluted to 10 ml and aspirated into the air-C_2H_2 flame of an AA unit (model AA 2, Hilger and Watts Ltd., London).

289 Miltimore, J.E., J.L. Mason, and D.L. Ashby. 1970. Copper, zinc, manganese and iron variation in five feeds for ruminants. Can. J. Anim. Sci. 50:293-300. 9 ref., 4 tab.

A large number of samples (legume hay, grass hay, corn silage, oat forage, and grains) was used in this study. A 2-g sample was ashed at 475°C for 5.5-6 h and ash taken up in 25 ml 0.5$\underline{N}$ HCl and aspirated (AAS) for Cu, Zn, Mn and Fe determination.

290 Miltimore, J.E., J.M. McArthur, J.L. Mason, and D.L. Ashby. 1970. Bloat investigations. The threshold fraction 1(18s) protein concentration for bloat and relationships between bloat and lipid, tannin, Ca, Mg, Ni and Zn concentrations in alfalfa. Can. J. Anim. Sci. 50:61-68. 16 ref., 1 tab., 7 fig.

Freshly chopped common alfalfa fed to cattle for bloat investigations were dried. A 2-g sample was ashed at 475° for 5.5-6 h and ash taken up in 25 ml 0.5$\underline{N}$ HCl and analyzed for Ca, Mg, Zn, and Ni by AAS, La being used as a releasing agent in Ca and Mg determination. Ni was determined after APDC-MIBK extraction.

291 Miro, M. and D.C. Sutton. 1970. Barium and strontium determination
     in biological materials by atomic absorption spectroscopy. Appl.
     Spectrosc. 24:220-225. 28 ref., 3 tab., 2 fig.

     Ashed samples of corn grain, hay and other materials were

     analyzed for Ba and Sr at 553.6 and 460.7 nm with $N_2O-C_2H_2$ and

     air-C_2H_2 flame, respectively. Perkin-Elmer model 303 connected

     to a recorder and readout accessories was used. Sr results by

     AAS were compared with other methods.

292 Moffitt, A.E. Jr. and R.E. Kupel. 1970. A rapid method employing
     impregnated charcoal and atomic absorption spectrophotometry for
     the determination of mercury in atmospheric, biological, and
     aquatic samples. Atom. Absorp. Newsl. 9:113-118. 15 ref.,
     5 tab., 7 fig.

     Submicrogram quantities of Hg can be determined by the rapid

     method described (detection limit = 0.02 µg). Hg was determined

     with Perkin-Elmer model 403 at 253.7 nm in air, water, and other

     samples. The total analysis time was less than 3 min for air and

     aqueous samples.

293 Montgomery, H.A.C. 1970. The analysis of aqueous effluents and
     polluted river waters. Proc. Soc. Anal. Chem. 7:35-36. 9 ref.

     Discusses methods available to the analyst in water-pollu-

     tion control laboratories. Digestion of samples with HNO_3 and

     $HClO_4$ or HNO_3 alone and pre-concentration by evaporation, ion

     exchange and solvent extraction for determination of metals by

     AAS are discussed.

294 Moore, D.E. and J.B. Dixon. 1970. Glycerol vapor adsorption on clay
     minerals and montmorillonitic soil clays. Soil Sci. Soc. Am.
     Proc. 34:816-822. 25 ref., 2 tab., 5 fig.

Percentages of montmorillonite and vermiculite were based on the cation exchange method. CEC values for montmorillonite plus vermiculite were obtained by averaging one set of values obtained with Mg and another set with Ca as the exchange ion. Exchangeable Mg was estimated by AAS and exchangeable Ca by X-ray spectroscopy.

295 Moore, P.J. 1970. Methods of analysis of subsurface waters. Trans. Inst. Mining Met. (Sect. B: Appl. Earth Sci.) 79:B107-B115. 19 ref., 2 tab., 1 fig.

The principles involved in some of the important techniques (AAS, gravimetric, volumetric, solution absorptiometry, flame emission, neutron activation, ion-selective electrode) available for water analysis and examples of their application are described.

296 Morard, P. and J.L. Gullo. 1970. Minéralisation des tissus végétaux en vue du dosage de P, K, Ca, Mg. Na (Mineralization of plant tissues for the quantitative analysis of P, Ca, Mg, Na, K). Ann. Agron. 21:229-236. 14 ref., 2 tab.

Leaf and root samples of sorghum were analyzed. One wet digestion and four variations of dry-ashing methods were compared. Dry-ashing after pretreating about 0.2 g plant samples with 2 ml HNO_3 was found satisfactory for P colorimetrically and K, Ca, Mg and Na by AAS.

297 Moss, P. 1969. A comparison of potassium-activity ratios derived from equilibration procedures and from measurements of displaced soil solution. J. Soil Sci. 20:297-306. 32 ref., 2 tab., 3 fig.

For the determination of K-activity ratio by soil-solution displacement method, K in soil solution was determined by an EEL

flame photometer, Ca by a Beckman B spectrophotometer and Mg by

a Techtron AA unit.

298 Motto, H.L., R.H. Daines, D.M. Chilko, and C.K. Motto. 1970. Lead
       in soils and plants: Its relationship to traffic volume and
       proximity to highways. Environ. Sci. Technol. 4:231-237. 19
       ref., 5 tab., 1 fig.

Soil (0 to 6 and 6 to 12-in. samples) and grasses collected along

heavily travelled highways in NE New Jersey were analyzed for Pb.

In greenhouse and field studies, lettuce, carrot, potato, corn

and tomato were harvested when mature and segregated into leaf,

stem, root, tuber, fruits, etc. Plant samples were digested in

4:1 mixture of HNO_3-$HClO_4$. For soil analysis, 2-g sample was

boiled with 15 ml of 72% $HClO_4$ for 2 h and diluted. Pb was

determined by AAS.

299 Mozafar, A., J.R. Goodin, and J.J. Oertli. 1970. Sodium and potassium
       interactions in increasing the salt tolerance of Atriplex
       halimus L.: II. Na^+ and K^+ uptake characteristics. Agron. J.
       62:481-484. 27 ref., 4 fig.

Leaf disks of Tree Purslane were sampled after 10 wk of

growth in different saline media. They were dried at 80°C,

extracted with 10 ml of 1N hot HCl for 30 min and analyzed for Na

and K by AAS.

300 Müller, M. 1967. Die Bestimmung der Mikronährstoffe in Koniferennadeln
       unter weitgehender Anwendung selektiver Verfahren (Determination
       of microelements in conifer needles by means of large-scale
       application of selective methods). Arch. Forstwiss. 16:635-640.
       ref. (cited but no list), 1 tab., 1 fig.

Conifer needles were analyzed for B, Fe, Mo, and Cu by

colorimetry and Zn and Mn by AAS using air-C_2H_2 flame.

301 Murozumi, M., T.J. Chow, and C. Patterson. 1969. Chemical concentrations of pollutant lead aerosols, terrestrial dusts and sea salts in Greenland and Antarctic snow strata. Geochim. Cosmochim. Acta 33:1247-1294. 71 ref., 15 tab., 7 fig.

Ice samples were analyzed by isotopic dilutions (Pb, Ca, K, Ti, and Mg), neutron activation (Cl and Na), AAS (Na, Mg, K, and Ca), emission spectrographic analysis (Si) and colorimetry (Cl). AAS results are compared with other techniques. Nippon Jarrell Ash model 1 equipped with Westinghouse excitation tube was used. Methods of sample handling for AAS are presented.

302 Nadirshaw, M. and A.H. Cornfield. 1968. Direct determination of manganese in soil extracts by atomic-absorption spectroscopy. Analyst 93:475. 3 ref.

Five soils were extracted (25 g soil:100 ml solution, 15 min) with (a) $1\underline{N}$ NH_4OAc, pH 7, (b) $1\underline{N}$ NH_4OAc, pH 7, containing 0.2% hydroquinone, (c) Morgan's reagent ($0.5\underline{N}$ HOAc-$0.75\underline{N}$ NaOAc, pH 4.8) and (d) $0.5\underline{N}$ HOAc. AAS methods were compared with colorimetric periodate oxidation method. Unicam SP90 was used.

303 Navrot, J. and M. Gal. 1971. Effect of soil clay type on the 'availability' of zinc in some Mediterranean rendzina soils. J. Soil Sci. 22:1-4. 6 ref., 4 tab., 1 plate.

Experiments were conducted to study accumulation and release of Zn as affected by the presence of clay minerals in valley rendzinas of soft limestone parent material. Total and $0.01\underline{M}$ EDTA-$1\underline{M}$ $(NH_4)_2CO_3$ (pH 8.6) extractable Zn in soils and Zn in 67-day-old corn plants was determined by AAS.

304 Navrot, J. and S. Ravikovitch. 1969. Zinc availability in calcareous
      soils: III. The level and properties of calcium in soils and
      its influence on zinc availability. Soil Sci. 108:30-37. 12
      ref., 5 tab., 4 fig.

      Total Zn in soil samples was determined by AAS. Extractable

      Zn ($1\underline{N}$ NH_4NO_3 or $0.01\underline{M}$ Na_2 ethylenediamine di-0-hydroxyphenylace-

      tate) was determined colorimetrically. Oven-dried tomato plants

      were analyzed for Zn by AAS after wet ashing.

305 Neeracher, H., R. Bachofen, and I. Specht-Jürgensen. 1968. Unter-
      suchungen über die Manganverteilung zwischen Zellfraktionen aus
      Spinatblättern und ihr Zusammenhang mit dem Manganhaushalt (Investi-
      gations on the distribution of manganese between cell fractions
      from spinach leaves). Planta 79:235-248. 33 ref., 5 tab., 3 fig.

      Spinach was harvested once a week, beginning 5 wk after

      planting. The leaves were divided into three categories. Hill

      activity and Mn content (AAS; Beckman spectrophotometer) were

      determined. A portion of the sample was homogenized in distilled

      water or in a mixture of $0.6\underline{M}$ sucrose and $0.05\underline{M}$ tris/acetate

      buffer (pH 7.8) and the precipitate (consisting mainly of chloro-

      plast fragments) and the supernatant were analyzed for Mn and N.

306 Nelson, L.E. 1971. The effects of root temperature and Ca supply on
      the growth and transpiration of cotton seedlings (Gossypium
      hirsutum, L) Plant Soil 34:721-729. 19 ref., 2 tab., 4 fig.

      The effect of Ca during germination on seedling quality and

      performance was studied. Cotton plants, after the experimental

      period in culture solutions, were separated into cotyledons, stems,

      and roots. Roots were transferred to tap water for 10 min and

      rinsed four times in demineralized water. Samples were dry ashed

      and ash taken up in dilute HCl. Analyses were performed for Ca and

      Mg (AAS), K (flame emission spectroscopy) and P (colorimetrically).

307 Németh, K., K. Mengel, and H. Grimme. 1970. The concentration of K, Ca and Mg in the saturation extract in relation to exchangeable K, Ca and Mg. Soil Sci. 109:179-185. 15 ref., 1 tab., 5 fig.

Soils from different locations in the northern part of

Germany were analyzed. Saturation extracts and $1\underline{N}$ NH_4OAc filtrates

were analyzed for Mg by AAS and K, Na, and Ca by flame photometry.

308 Nishita, H., R.M. Huang, M. Hamilton, and G.V. Alexander. 1970. Influence of soil heating on the growth and elemental composition of bean plants. Soil Sci. 110:61-70. 35 ref., 1 tab., 7 fig.

Soil was exposed to various temperatures (100, 200, 300, 400,

500, 600, 800 and 1000°C) for 2 h in a muffle furnace. Bean

plants were grown for 52 days in control and treated soils. Soils

were extracted with $1\underline{N}$ (pH 7.0) NH_4OAc and analyzed for Ba, Ca,

K, Mg, Na, and Sr by Perkin-Elmer model 303 unit. Elemental

analyses of plants were done by spectrographic analysis.

309 Nix, J. and T. Goodwin. 1970. The simultaneous extraction of iron, manganese, copper, cobalt, nickel, chromium, lead and zinc from natural water for determination by atomic absorption spectroscopy. Atom. Absorp. Newsl. 9:119-122. 8 ref., 4 tab., 3 fig.

A method for the determination of heavy metals in natural

water in the concentration range of a few ppb, both in the soluble

and particulate phases (> 0.45 µ) is described. In a single-step

chelation-extraction system, the metals were complexed with diethyl-

dithiocarbamic acid and extracted with MIBK. This single extract

was used for all the determinations. Perkin-Elmer model 303 was

used.

310 O'Connor, G.A. and W.D. Kemper. 1969. Quasi-crystals in Na-Ca
     Systems. Soil Sci. Soc. Am. Proc. 33:464-469. 15 ref., 1 tab.
     9 fig.

     Ca-clays were obtained by treating Na-suspensions with $CaCl_2$.

     Na and Ca in the extracts were determined by Perkin-Elmer model

     303.

311 Odurukwe, S.O. and D.N. Maynard. 1969. Mechanism of the differential
     response of Wf9 and Oh40B corn seedlings to iron nutrition.
     Agron. J. 61:694-697. 27 ref., 6 tab., 1 fig.

     Shoots of inbred lines of corn, grown in sand and water

     culture in a greenhouse, were dried in a forced-draft oven at 70°C.

     Ashing was done at 550°C and Fe and Mn were determined by Perkin-Elmer

     model 290 and P colorimetrically.

312 Omang, S.H. 1971. Determination of mercury in natural waters and
     effluents by flameless atomic absorption spectrophotometry.
     Anal. Chim. Acta 53:415-419. 10 ref., 1 tab.

     An extremely sensitive method for the determination of Hg

     (as low as 0.020 µg/1) in water is presented. The samples were

     digested with a mixture of aqueous 2% (w/v) $KMnO_4$ and 1+1 H_2SO_4

     and Hg determined by the cold-vapor AAS technique. Perkin-Elmer

     model 303 equipped with an automatic recorder readout accessory

     and a Hitachi-Perkin-Elmer recorder model 159 were used.

313 Page, A.L. and T.J. Ganje. 1970. Accumulations of lead in soils for
     regions of high and low motor vehicle traffic density. Environ.
     Sci. Technol. 4:140-142. 13 ref., 2 tab.

     Accumulation of Pb in soils over an approx. 40-yr period was

     compared for areas of low and high motor vehicle traffic densities.

     Total Pb was determined by AAS after ashing 0.250 g soil at 450°C

     and then decomposing with $HClO_4$-HF mixture and further treatment.

314 Panday, V.K. and A.K. Ganguly. 1970. The use of water-miscible
       organic solvents in atomic absorption spectrophotometry. Anal.
       Chim. Acta 52:417-423. 12 ref., 3 tab., 2 fig.

       The additon of water-miscible organic solvents enhances the

   sensitivity and reduces interferences in AAS determination of Cu,

   Mn, Zn, Fe, Rb, Ca, and Mg in fresh waters, plant materials, soils,

   and other materials. Perkin-Elmer model 303 was used for air-

   C_2H_2 flame. Ca and Mg were also determined by $N_2O-C_2H_2$ flame

   using Techtron AA-4. Methods of sample preparation are also dis-

   cussed.

315 Pappas, E.G. and L.A. Rosenberg. 1966. Determination of submicrogram
       quantities of mercury by cold vapor atomic absorption photometry.
       J. Assoc. Off. Anal. Chem. 49:782-792. 16 ref., 4 tab., 5 fig.

       The combustion products of wheat samples burnt in a modified

   Schöniger flask were absorbed into 1.2$\underline{N}$ HCl. Vapors of Hg collected

   as HgS, on CdS impregnated asbestos pads, were swept by nitrogen

   gas into a cold vapor cell of AA unit. Hg as low as 0.01 ppm in

   wheat was determined. On an average 86% of the added Hg was

   recovered.

316 Paquay, R., R. De Baere, and A. Lousse. 1970. Statistical research
       on the fate of water in the adult cow. I. Dry Cows. J. Agric.
       Sci., Camb. 74:423-432. 19 ref., 3 tab., 3 fig.

       Grasses, cereals silage, alfalfa, alfalfa silage, clover

   silage, pea straw, cabbage silage, pea-oat silage, hay and barley

   were analyzed, besides other analyses, for Ca and Mg by AAS, for Na

   and K by flame spectrophotometry, and for P by colorimetric methods.

317 Paquay, R., F. Lomba, A. Lousse, and V. Bienfet. 1968. Statistical
         research on the fate of dietary mineral elements in dry and
         lactating cows. I. Calcium. J. Agric. Sci., Camb. 71:173-180.
         11 ref., 4 tab., 1 fig.

         Grasses, cereal silage, alfalfa, alfalfa silage, pea straw,

         barley, clover silage, cabbage silage, pea-oat silage, and hay

         were analyzed, besides other properties, for Ca and Mg by AAS, for

         P colorimetrically, and for Na and K by flame spectrophotometry.

318 Parish, R.W. and F.L. Miller. 1969. The uptake and effects of calcium
         and phosphate on maturity, lignification, and peroxidase activity
         of wheat internodes. Aust. J. Biol. Sci. 22:77-85. 22 ref.,
         5 tab.

         Wheat was grown under various levels of Ca and P in a

         controlled environment. Ca level of internodes was determined

         by AAS.

319 Parker, H.E. 1963. Magnesium, calcium and zinc in animal nutrition.
         Atom. Absorp. Newsl. 2:23-29. 11 ref., 6 tab., 2 fig.

         For animal nutrition studies, a 2.0-g feed sample was dry

         ashed at 600°C. After treating with 2 ml HCl and evaporating,

         the elements were picked up in 3N HCl, diluted and analyzed for

         Ca, and Mg. Mineral, tissue and other samples were also analyzed.

320 Patassy, F.Z. 1965. Lithium determination in waters and plant
         materials by atomic absorption spectrophotometry. Plant Soil
         22:395-398. 5 ref., 3 tab.

         Li results on waters and plant materials by AAS compared well

         with flame photometric method. By the suggested AAS method, 0.015

         and 0.75 ppm Li can be measured in water and plant material,

         respectively. Plant samples were prepared by H_2SO_4-HNO_3-$HClO_4$

         digestion.

321 Paulsen, G.M. and O.A. Rotimi. 1968. Phosphorus-zinc interaction in two soybean varieties differing in sensitivity to phosphorus nutrition. Soil Sci. Soc. Am. Proc. 32:73-76. 17 ref., 3 tab.

Soybeans were grown in nutrient solutions containing different levels of P and Zn to study P-induced Zn deficiency. At the conclusion of the experiment, the plants were separated into roots, stems, and leaves. A 1-g sample was dry-ashed at 200, 400, and 600°C for 2 h and ash dissolved in 0.1$\underline{N}$ HCl and diluted to 25 ml after filtration. P was determined colorimetrically and Zn by Perkin-Elmer model 303.

322 Paus, P.E. 1971. The application of atomic absorption spectroscopy to the analysis of natural waters. Atom. Absorp. Newsl. 10:69-71. 10 ref., 5 tab.

Cd, Co, Cu, Ni, Pb, and Zn were determined with Perkin-Elmer model 403. Extraction and preconcentration are required with the flame AA but not with the Heated Graphite Atomizer (HGA-70). The sample volume requirements are less than those used with the Sampling Boat Technique.

323 Pawluk, S. 1967. Soil analyses by atomic absorption spectrophotometry. Atom. Absorp. Newsl. 6:53-56. 7 ref., 9 tab.

Total and exchangeable Al, Ca, Fe, K, Mg, and Na were determined. The results were compared with other methods (Al-gravimetric, Ca-oxalate and EDTA, Fe-colorimetric, K-chloroplatinate and X-ray flourescence, Mg-EDTA and gravimetric, and Na-emission flame photometry). AAS was found to be suitable both in precision and accuracy. For most analyses time required was reduced by as much as 75%. Perkin-Elmer model 303 was used.

324 Pawluk, S. 1971. Characteristics of fera eluviated gleysols developed from acid shales in northwestern Alberta. Can. J. Soil Sci. 51:113-124. 18 ref., 1 tab., 2 fig.

Two soil pedons were sampled. Mn was determined by HF-HCl dissolution and AAS. Extractable Fe and Al oxides were determined by dithionite-citrate and oxalate methods.

325 Pearson, F.J., Jr. and D.W. Fisher. 1971. Chemical composition of atmospheric precipitation in the Northeastern United States. Geol. Surv. Water-Supp. Pap. 1535-P. 23 p. 17 ref., 3 tab. 7 fig.

The bulk precipitation (mixture of dry fallout and precipitation) samples were analyzed for Ca, Mg, Na, K, NH_4, pH, HCO_3, SO_4, Cl, NO_3, and PO_4, the metals by AAS.

326 Perkin-Elmer Corp. Atomic Absorption Newsletter. 1962- . Published by the Perkin-Elmer Corp., Norwalk, CT (S. Slavin, Ed).

This is a bi-monthly publication which first appeared in Mar. 1962. The abstracts are given in English, French and German. Each volume (except Vol. 3) contains AAS bibliography. Since 1968 the bibliography for the previous year has been published in the Jan.-Feb. issue with an index to such applications as soils, fertilizers, plants, waters, etc.

327 Perkin-Elmer Corp. 1971. Analytical Methods for Atomic Absorption Spectrophotometry. Publ. No. 303-0152. Loose leaf. Perkin-Elmer Corporation, Norwalk, CT.

This is a "cook book" that describes standard conditions for the operation of Perkin-Elmer AAS units and gives details of applications in soil, plant, water, fertilizer, and other samples.

328 Perkins, H.R., S.C. Tiwari, and K.H. Tan. 1971. Characterization
         and classification of a highly weathered soil of the southern
         piedmont. Soil Sci. 111:119-123. 17 ref., 3 tab., 3 fig.

         Soils (each a composite of   pedons) were collected at

     15-cm increments from surface to bedrock. Exchangeable Ca, Mg,

     Na, and K were extracted with $1\underline{N}$ NH_4OAc (pH 7.0) and determined

     by AAS. Extractable Al was analyzed colorimetrically.

329 Perrin, C.H. and P.A. Ferguson. 1968. Comparison of flame and
         burner combinations in atomic absorption spectroscopy. J. Assoc.
         Off. Anal. Chem. 51:654-658. 7 ref., 4 tab.

         Different burners and   gas combinations were used for the

     determination of Ca, Cu, Fe, Mg, Mn, and Zn on   animal feed

     samples by AAS. In most cases an $O_2-C_2H_2$ flame in a total con-

     sumption burner on solutions prepared by dry-ashing gave most

     accurate results. Jarrell-Ash model 82-362 was used.

330 Peterson, G.A. 1971. Nutrient uptake of alfalfa as influenced by
         soil processing and greenhouse potting methods. Soil Sci. Soc.
         Am. Proc. 35:294-296. 3 ref., 3 tab.

         Results are presented on the effects of   soil processing

     methods on uptake of   elements by alfalfa grown on soils from

     different depths. Dry matter was wet digested with HNO_3-HClO_4

     mixture. Extracts were analyzed for P by colorimetric method,

     K by flame photometry and Ca, Cu, Fe, Mg, Mn and Zn by AAS.

331 Phipps, R.H. and I.S. Cornforth. 1970. Factors effecting the toxicity
         of nitrite nitrogen to tomatoes. Plant Soil 33:457-466. 34 ref.,
         4 tab. 1 fig.

         Pot experiments were conducted with tomato. Plant material

     was analyzed for P colorimetrically after Kjeldahl digestion. Sam-

     ples were dry-ashed and K, Ca, and Mg were determined by flame

     photometry and AAS.

332 Pinkerton, A. 1970. The effects of magnesium deficiency on the
     quality and magnesium content of flue-cured tobacco leaf. Aust.
     J. Agric. Res. 21:613-622. 23 ref., 3 tab., 4 fig.

          In an outdoor trial with tobacco in an automatic

     subirrigated sand culture system plants were initially

     supplied with Mg and later deprived of it. Green and cured

     leaves were dried (70°C) and ashed (550°C). Mg was determined

     by AAS using Sr as a suppressing agent.

333 Place, G.A., M.A. Siddique, and B.R. Wells. 1971. Effects of temperature
     and flooding on rice growing in saline and alkaline soil. Agron.
     J. 63:62-66. 14 ref., 4 tab.

          Above-ground portions of rice plant were dry ashed (0.2 g

     sample) and analyzed for K, Mg, Na, Fe, Mn, and Zn by AAS and P

     colorimetrically. For soil analysis, $1.0\underline{N}$ NH_4OAc (buffered to

     pH 3.0) extractable Fe and Mn were determined by AAS.

334 Platte, J.A. 1968. Analysis of industrial waters by atomic absorption.
     5 ref., 4 tabs. pp. 247-252. In R.A. Baker (ed.), Trace inorganics
     in water. Advances in Chemistry Series No. 73. Am. Chem. Soc.
     Washington, DC.

          Metals were complexed with Na-DDTC and extracted in MIBK. The

     method is used routinely to analyze for Fe, Pb, and Cu in high

     brines and Pb and Cd in most industrial waters.

335 Platte, J.A. and V.M. Marcy. 1965. Atomic absorption spectrophotometry -
     a new tool for the water chemist. Am. Power Conf. Proc. 27:851-857.
     15 ref., 5 tab., 5 fig.

          In large boiler plants, many metals (Fe, Cu, Ni, Cr, Zn, Mn,

     Ca, and Mg) in waters and water-formed deposits can be determined

     by AAS.

336 Platte, J.A. and V.M. Marcy. 1965. Atomic absorption spectrophotometry as a tool for the water chemist. Atom. Absorp. Newsl. 4:289-292. 4 ref., 5 tab., 3 fig.

About 200 samples of various industrial waters were analyzed

for Ca, Cu, Fe, Mg, Mn, and Zn and water-formed deposits for Ca,

Cu, Fe, Mg, Ni and Zn with Perkin-Elmer model 303. Ca was added

in Fe and Mn determination to eliminate Si interference, and La

was added in Ca and Mg determination to eliminate interferences

due to Al, P and Si. Results were compared with other methods.

337 Pollock, G.E. and A.K. Miyamoto. 1971. A desalting technique for amino acid analysis of use in soil and geochemistry. J. Agric. Food Chem. 19:104-107. 13 ref., 3 tab., 1 fig.

For isolating amino acids from soils, samples were hydrolyzed

in $6\underline{N}$ HCl (1 part sample:3 parts HCl) followed by evaporation to

dryness and desalting. In the desalting procedure described here,

cation analyses were carried out by Perkin-Elmer model 303: Na

and K by air-C_2H_2 flame, Fe by adding 10,000 ppm La as $LaCl_3$

using air-C_2H_2 flame, Ca and Al by adding 1000 ppm K as KCl using

$N_2O-C_2H_2$ flame, and Mg by adding 1500 ppm Sr as $SrCl_2$ using

$N_2O-C_2H_2$ flame.

338 Potter, A.L., E.D. Ducay, and R.M. McCready. 1968. Determination of sugar in plant materials: measurement of unreduced copper by atomic absorption spectrometry. J. Assoc. Off. Anal. Chem. 51: 748-750. 2 ref., 1 tab., 1 fig.

A solution containing $CuSO_4$, $NaHCO_3$, Na_2CO_3, and Rochelle

salt was added to the solution of reducing sugars. Cu_2O precipitate

formed by the reduction of Cu by the sugars was removed by centri-

fugation. The amount of unreduced Cu in the supernatant solution

was determined by AAS (Perkin-Elmer model 303) at 249 nm wave-

length. The results for reducing and total sugars are com-

pared with the AOAC Shaffer-Somogyi official method.

339 Premi, P.R. 1970. Effect of different levels of copper and zinc added
     as adsorbed cations on purified peat and sewage on nitrogen
     mineralization during incubation of soil. Agrochimica 14:372-
     378. 9 ref., 2 tab.

   Soil samples were mixed with dried and ground Cu- and Zn-peat

and sewage sludge to give different levels of Cu and Zn. After

incubation, 0.2$\underline{N}$ EDTA-Na (pH 4.0) extracts were prepared and

analyzed for Cu and Zn by AAS.

340 Price, C.A. and J.W. Quigley. 1966. A method for determining quantita-
     tive zinc requirements for growth. Soil Sci. 101:11-16. 22 ref.,
     3 tab., 4 fig.

   Zn in $\underline{Euglena}$ $\underline{glacia}$ cells was determined with an air-C_3H_8

flame using Perkin-Elmer model 303.

341 Price, N.O. and W.W. Moschler. 1970. Residual lime effect in soils
     on certain mineral elements in barley, fescue, and oats. J. Agric.
     Food Chem. 18:5-8, 13 ref., 1 tab.

   Ca, Cu, Fe, Mg, Mn and Zn were determined by AAS (Perkin-Elmer

model 303) and P by AOAC method in fescue, barley and oats.

Samples were wet ashed with HNO_3 and $HClO_4$.

342 Price, W.J. 1967. Atomic absorption analysis of waters and effluents.
     Effluent Water Treat. J. 7:218-224. 6 ref., 2 tab., 5 fig.

   A review. Determinations of a number of metallic elements

in water analysis are reviewed (alkali metals, Ca, Mg, Sr, Fe, Ag,

Sn, Mo, Ba, Cr, Al, Be, Ti, V, Ta, Hg, Cu, Zn, Pb, Ni, Cs, Na, and

Cd). Advantages of the AAS technique are sensitivity, speed,

specificity and ease of handling samples.

343 Price, W.J. and J.T.H. Roos. 1969. Analysis of fruit juice by
     atomic absorption spectrophotometry. I. - The determination of
     iron and tin in canned juice. J. Sci. Food Agric. 20:437-439.
     11 ref., 6 tab.

     AAS was used for the determination of Fe (air-C_2H_2 flame,

     248.3 nm) and Sn (N_2O-C_2H_2 flame, 286.3 nm) in orange and pine-

     apple juices. The procedure is rapid. No ashing is required.

     Unicam SP90 was used. Addition of 1 ml of 1% (v/v) H_3PO_4 to the

     diluted samples is recommended to avoid citrate interference,

     especially for samples low in phosphate and high in Fe.

344 Proctor, J. 1970. Magnesium as a toxic element. Nature 227:742-743.
     6 ref., 3 tab.

     1$\underline{N}$ NH_4OAc soil extracts were analyzed for exchangeable Ca,

     Mg, and K by AAS. Ni and Cr in soil were determined by X-ray

     flourescence. Above-ground parts of oats were ashed in HNO_3.

     The digests were analyzed for Ca and Mg by an EEL AA unit, K by

     flame photometry, and Ni and Cr by X-ray flourescence.

345 Protz, R., E. De Kalb, and F.F. Riecken. 1967. Determination of
     magnesium in HCl solutions of HF-$HClO_4$ digests of soil clays by
     atomic absorption spectroscopy. Soil Sci. Soc. Am. Proc. 31:
     726-727. 9 ref., 3 tab., 1 fig.

     HCl solutions of HF-$HClO_4$ digests of 2 standard clay minerals

     and 110 soil clays (< 1 μ particle diam) collected from various

     soils were analyzed for Mg by AAS (Perkin-Elmer model 214). Eleven

     soils clays were also analyzed by emission spectrographic analysis.

     Addition of 4000 ppm Sr (as $SrCl_2$) suppressed the inter-

     ferences due to Fe and Al. The difference in total Mg obtained by

AAS and emission spectrographic analysis ranged from 0.9 to 13.2%.
Recovery of added Mg was 96-106%. The mean deviation between
duplicates of 110 soil clay samples was 0.03% Mg (range 0.00 to
0.10% Mg).

346 Purves, D. and E.J. Mackenzie. 1970. Enhancement of trace-element
content of cabbages grown in urban areas. Plant Soil 33:483-485.
10 ref., 2 tab.

B, Cu, Pb, Mo, Ni, and Zn levels of cabbage leaves from
urban and rural areas were compared. Soils from these areas were
analyzed for water-extractable B, EDTA extractable Cu, and HOAc
extractable Pb, Ni, and Zn. B in plant and soil extracts was
determined by porous cup spark excitation using B-free graphite
electrodes. Cu in soil extract was estimated with Zn dibenzyl
dithiocarbamate. Pb and Ni were determined by spectrographic
analysis. Cu and Mo in plant were determined by spectrographic
analysis. Zn was determined by AAS.

347 Pyrih, R.Z. and R.E. Bisque. 1969. Determination of trace mercury in
soil and rock media. Econ. Geol. 64:825-828. 14 ref., 2 tab.,
1 fig.

A 1-g sample (200 mesh) was digested at 200-230°C on a
hot plate with HNO_3 and $HClO_4$. Hg (ic) ion was chelated by dithizone
and Hg extracted into MIBK. With 1-g sample, 50 ppb Hg can be
detected. In this method, organics in the sample do not interfere
with the analysis. Perkin-Elmer model 303 with 3-slot Boling burner
was used.

348 Raad, A.T., R. Protz, and R.L. Thomas. 1969. Determination of Na-dithionite and NH_4-oxalate extractable Fe, Al and Mn in soils by atomic absorption spectroscopy. Can. J. Soil Sci. 49:89-94. 10 ref., 3 tab., 3 fig.

>   Al, Fe, and Mn in acidified $0.2\underline{M}$ $(NH_4)_2C_2O_4$ and 5% $Na_2S_2O_4$

>   (in a $0.2\underline{M}$ citrate buffer) were determined by AAS (Techtron AA-3).

>   It was concluded that these extracts can be analyzed for Fe

>   accurately and rapidly without prior destruction of organic

>   extractants.

349 Rajama, J., O.E. Nikkilä, and P. Mäkelä. 1966. Strontium-90 in Finnish and some imported cereals during the harvest period 1963-64. Nature 211:213-214. 5 ref., 1 tab., 1 fig.

>   Wheat and rye samples (whole grain and flour) were analyzed

>   for Sr by AAS.

350 Ramakrishna, T.V., J.W. Robinson, and P.W. West. 1967. Determination of copper, cadmium and zinc by atomic absorption spectroscopy. Anal. Chim. Acta 37:20-26. 5 ref., 4 tab., 2 fig.

>   A method for the direct estimation of Cd (228.8 nm), Cu

>   (324.7 nm) and Zn (213.8 nm) on water samples is described.

>   Interferences due to anions were eliminated by the addition of

>   EDTA. Sensitivities found for Cd, Cu, and Zn were 2, 8, and 2

>   ppb respectively. Perkin-Elmer model 303 was used.

351 Ramírez-Muñoz, J. 1968. Atomic-Absorption Spectroscopy. Elsevier Publishing Company, Amsterdam, The Netherlands. 493 pp.

>   Part V deals with applications in the analysis of agricultural

>   and other materials.

352 Rann, C.S. and A.N. Hambly. 1965. The determination of selenium by atomic absorption spectrophotometry. Anal. Chim. Acta 32: 346-354. 12 ref., 4 tab., 4 fig.

>   Se content of wheat (approx 10-g sample) was determined by AAS.

353 Rasmussen, P.E. and L.C. Boawn. 1969. Zinc seed treatment as a source
        of zinc for beans (<u>Phaseolus</u> <u>vulgaris</u>). Agron. J. 61:674-676.
        10 ref., 4 tab.

        Five compounds (a) Captan: N- [(trichloromethyl) thio] –

4-cyclohexene-1, 2-dicarboximide (b) Zineb: zinc ethylene-bis-

dithiocarbamate (c) $ZnSO_4 \cdot H_2O$ (d) ZnEDTA and (e) ZnPF:

polyflavonoid zinc complex were applied to the seed

coat of Red Mexican beans. Zn content of these   compounds was

determined by AAS after digestion with HNO_3-$HClO_4$. A randomized

block split-plot field experiment was carried out, in which plant

tops were collected at the four-compound-leaf stage and full bloom stage.

In a pot experiment in a growth chamber, plant tops were collected

at approximately the three-compound-leaf stage of growth. Tops of

plants from both the field and growth chamber experiments were

dried at 65°C. They were digested in HNO_3-$HClO_4$, ash dissolved in

0.1<u>N</u> HCl, and Zn determined by AAS.

354 Rees, T.D. 1970. Analysis of industrial waters. Proc. Soc. Anal.
        Chem. 7:32-34.

        The article deals with some of the methods (polarographic,

AAS, colorimetry, specific ion electrodes, etc.) used for the

analysis of industrial water. Zn determination in water by AA

is discussed – down to about 0.1 ppm can readily be measured.

355 Reese, K.M. 1970. Chemical analysis of moon samples. Anal. Chem.
        42:26A-38A. 2 ref., 2 tab., 1 fig., 3 photos.

        This report is based on the Lunar Science Conference (Jan 5-8,

1970) at Houston, TX. Apollo 11 lunar samples were analyzed by

a large number of investigators. Soil and other materials were

analyzed for Si by AAS while Al, Ca, Mg, K, Mn, Cr, Li, B, Co,

Zn, Sr, Mo, Ag, Cd, Sn, Ba, La, Gd, etc. were determined by other

techniques.

356 Reneau, R.B. Jr. and J.G.A. Fiskell. 1970. Selective dissolution
     effects on cation-exchange capacity and specific surface of some
     tropical soil clays. Soil Sci. Soc. Am. Proc. 34:809-812.
     26 ref., 5 tab., 2 fig.

Clay suspensions of soils from eastern Panama and Wyoming

bentonite samples were prepared. Clay in an aliquot was saturated

with Na. Na was displaced with $1\underline{N}$ NH_4OAc (pH 7) and determined

by flame photometry. Second aliquot was treated with dithionite-

citrate reagent buffered with bicarbonate to get free Fe oxides.

Third aliquot was processed as the second, followed by treatment

with hot $0.5\underline{N}$ NaOH and again with dithionite-citrate for Fe

removal. Fourth aliquot was treated as the third aliquot and

then treated with $0.4\underline{N}$ NH_4F + $0.1\underline{N}$ HCl + $1\underline{N}$ NH_4Cl. Supernatants

from each dissolution step were analyzed for Al, Fe, and Si by

AAS. Storage of solutions in sealed polyethylene vials and rapid

analysis prevented problems generally observed due to precipitate

formation.

357 Richards, G.E. 1969. Water solubility of zinc in a granular mixed
     fertilizer as affected by zinc source and method of addition.
     Soil Sci. Soc. Am. Proc. 33:310-313. 16 ref., 4 tab., 2 fig.

The following 11 compounds (ground to 90% <0.15 mm diam)

were incorporated into an 8-7-6.6 (8-16-8) granular mixed fertilizer:

(a) Water soluble: $ZnSO_4 \cdot H_2O$, $ZnSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$, $Zn (C_2H_3O_2)_2 \cdot$

$2H_2O$, $ZnCl_2$, and polyflavonoid Zn (Rayplex Zn) (b) Slightly soluble:

ZnO, $ZnCO_3$, and Frit (FTE 504) and (c) Chelated source: $Na_2ZnEDTA$, NaZnHEEDTA, and ZnNTA. These compounds and the manufactured product were extracted with HCl (total Zn) and water (water-soluble Zn). Extracts were evaporated, digested with $HClO_4$ (in some cases), and Zn was determined by AAS.

358 Richburg, J.S. and F. Adams. 1970. Solubility and hydrolysis of aluminum in soil solutions and saturated-paste extracts. Soil Sci. Soc. Am. Proc. 34:728-734. 32 ref., 7 tab., 2 fig.

Exchangeable K, Ca, Mg, and Mn were determined on $1\underline{N}$ NH_4OAc extracts and exchangeable Al on $1\underline{N}$ KCl extracts. Analyses were carried out by AAS (Mg and Mn), EDTA titration (Ca), flame photometry (K), Eriochrome Cyanine-R colorimetry (Al), and turbidimetry (SO_4). Soils were wet to 1/3-bar moisture and soil solutions displaced with a saturated solution of $CaSO_4$ containing KCNS as an indicator. Analyses on soil solutions and saturated-paste extracts were carried out as above.

359 Riley, D. and S.A. Barber. 1970. Toxicity of 2-chloro-6-(trichloromethyl) pyridine in soybean (<u>Glycine</u> <u>max</u>. L. Merr.) seedlings. Agron. J. 62:550-551. 6 ref., 1 tab., 1 fig.

N-serve was added @ 0-20 ppm in each pot (800 g silt loam soil, pH 5.5) and incubated for 7 days in a growth chamber. Soybeans were grown in the chamber for 18 days. Shoots and roots were dried at 60°C and dry ashed at 450°C. An HCl extract was prepared. Ca and Mg were determined by absorption and K by emission photometry. P was determined colorimetrically.

360 Riley, J.P. and D. Taylor. 1968. Chelating resins for the concentra-
        tion of trace elements from sea water and their analytical use
        in conjunction with atomic absorption spectrophotometry. Anal.
        Chim. Acta 40:479–485. 14 ref., 2 tab.

        Trace elements were taken up from distilled water and sea

        water by chelating ion-exchange resins Chelex-100 and Permutit

        S1005. The resins were used in conjunction with AAS for simul-

        taneous determination of Cd, Co, Cu, Ni, and Zn in sea water.

361 Roach, A.G., P. Sanderson, and D.R. Williams. 1968. Determination of
        trace amounts of copper, zinc and magnesium in animal feeds by
        atomic-absorption spectrophotometry. Analyst 93:42–49. 20 ref.,
        9 tab.

        An automated method for the determination of Cu (324.8 nm),

        Mg (285.2 nm) and Zn (213.9 nm) by AAS is described. Samples

        (wheat, barley, etc.) were dry-ashed (450°C). Sixty samples/h can

        be analyzed. Unicam SP90 was used.

362 Robinson, J.L., R.G. Barnekow, Jr., and P.F. Lott. 1969. Rapid
        determination of cadmium and copper in plating wastes and river
        water by atomic absorption spectroscopy. Atom. Absorp. Newsl.
        8:60–64. 28 ref., 5 tab., 3 fig.

        Cd and Cu were extracted with MBT into n-butyl

        acetate. Perkin-Elmer model 303 was used. The

        method permits determination of these metals in the concentration

        range 0.001 to 10.0 mg/1. Use of the Perkin-Elmer Sampling Boat

        atomizing system is not recommended for Cu determination.

363 Robinson, J.W. 1966. Atomic Absorption Spectroscopy. Marcel Dekker,
        Inc., New York, NY. 204 pp.

        Chapter 4 of the book is devoted to analytical applications

        of AAS.

364   Robson, A.D., D.G. Edwards, and J.F. Loneragan. 1970. Calcium
          stimulation of phosphate absorption by annual legumes. Aust.
          J. Agric. Res. 21:601-612. 23 ref., 5 tab., 2 fig.

          Effect of increasing the Ca concentration in solution on

          phosphate uptake by   alfalfa species and   subterranean clover

          cultivars was studied in nutrient culture experiments. The

          nutrient solutions were frequently analyzed for P colorimetrically

          and for Ca and Mg by AAS.

365   Rogers, E. 1971. Iron-manganese relations of "Sungold" peaches in
          western Colorado. J. Am. Soc. Hortic. Sci. 96:14-16. 25 ref.,
          2 tab., 1 fig.

          In field experiments, samples of 100 leaves/tree were taken

          from the middle of the terminal shoots. Fe, Zn, and Mn were

          determined by Perkin-Elmer model 303.

366   Rogers, G.R. 1968. Collaborative study of atomic absorption spectro-
          photometric method for determining zinc in foods. J. Assoc. Off.
          Anal. Chem. 51:1042-1045. 14 ref., 1 tab.

          Sucrose solutions, soya meal, white flour and whole wheat

          flour were analyzed for Zn by AAS in 10 laboratories. Average

          recoveries ranged from 98 to 102% with a standard deviation of

          0.2-2.0 and 0.8-2.97 by wet- and dry-ashing, respectively. It is

          recommended that the method be adopted as official "first action".

367   Roos, J.T.H. and W.J. Price. 1970. Analysis of fruit juice by atomic
          absorption spectrophotometry. II. - Direct determination of
          several major and trace metals. J. Sci. Food Agric. 21:51-52.
          2 ref., 4 tab.

          Ca, Mg, Na, K, Mn, and Zn were determined in orange and pine-

          apple juices by AAS. The samples can be aspirated directly after

proper dilution and centrifugation to remove suspended matter.

Initially samples were digested with $HClO_4$ and HNO_3 but it was

found that ashing of the sample was not required. For Ca deter-

mination, $LaCl_3$ (0.5% La w/v in final solution) was employed to

remove interferences due to Al, P and/or silicate ions. Unicam

SP90 was used.

368 Ross, R.G., A.D. Crowe, and D.H. Webster. 1970. Effect of fungicides
on the performance of young McIntosh and Cortland apple trees.
Can. J. Plant Sci. 50:529-536. 13 ref., 4 tab., 1 fig.

Mid-shoot leaves of extension growth were collected and

washed with $0.1\underline{N}$ HCl containing 0.1% alconox cleaner, and oven-dried,

and the dry-ashed samples were analyzed for Zn by AAS.

369 Rossi, N. and E.G. Beauchamp. 1971. Influence of relative humidity
and associated anion on the absorption of Mn and Zn by soybean
leaves. Agron. J. 63:860-863. 10 ref., 3 tab., 4 fig.

Soybeans were grown for 3 wk in a greenhouse. Effects of

relative humidity and either Cl^- or $SO_4^=$ as the accompanying

anion on Mn and Zn uptake by leaves was studied in two growth

chambers. Leaf blades, collected at 0.5, 3, and 7 h and 1, 3,

5, and 7 days after application, were dry ashed at 500°C and Mn

and Zn were determined by AAS.

370 Rudgers, L.A., J.L. Demeterio, G.M. Paulsen, and R. Ellis, Jr. 1970.
Interaction among atrazine, temperature, and phosphorous-induced
zinc deficiency in corn (Zea mays L.). Soil Sci. Soc. Am. Proc.
34:240-244. 24 ref., 3 tab., 8 fig.

A single cross white grain corn was tested. Leaf and grain

samples from field experiment were dried at 70°C, ground to pass

a 20-mesh sieve and wet digested with HNO_3 and $HClO_4$. Seedlings

from the nutrient culture experiments were segregated into roots,

exposed leaf blades, culms and sheaths. They were dried at

70°C, ground to pass a 40-mesh sieve, dry-ashed for 2 h each at

200, 400, and 550°C, and the ash was dissolved in 0.2$\underline{N}$ HCl. The

extracts were analyzed for Zn by AAS and for P colorimetrically.

371 Sachdev, S.L., J.W. Robinson, and P.W. West. 1967. Determination of
manganese, iron, cobalt and nickel in air and water by atomic
absorption spectroscopy. Anal. Chim. Acta 38:499-506.
10 ref., 8 tab., 2 fig.

Co, Fe, Mn, and Ni can be directly determined in water samples

containing Mn in the range of 0.02-1.2 mg/l and Co, Fe and Ni in

the range of 0.2-4 mg/l. Perkin-Elmer model 303 was used.

372 Saha, J.G., Y.W. Lee, R.D. Tinline, S.H.F. Chinn, and H.M. Austenson.
1970. Mercury residues in cereal grains from seeds or soil
treated with organomercury compounds. Can. J. Plant Sci. 50:
597-599. 6 ref., 1 tab.

Seeds of barley and wheat were treated with organo-

mercury compounds. After harvesting, the soil and

grains were analyzed for Hg by Perkin-Elmer model 290B

equipped with a sampling boat atomizing system, after

digesting with HNO_3 and then with HNO_3-72% $HClO_4$ (1:1 v/v)

mixture and extracting twice with chloroform solution of dithizone.

Minimum detectable amount of Hg was 0.002 ppm. More than 90% Hg

added to sample was recovered.

373 Schall, E.D. 1969. Report on fertilizers. J. Assoc. Off. Anal. Chem. 52:217-218.

The report points out that official "final action" methods

for Ca, Cu, Fe, Mg, Mn, and Zn by AAS have been adopted by the

Association. It is recommended that studies on Mo determination

by AAS be continued.

374 Schaller, K.H., K. Lindner, and G. Lehnert. 1968. Atomabsorptionsspektrometrische schwermetallbestimmung im trinkwasser (Determination of heavy metals in potable water by atomic absorption spectrophotometry). Arch. Hyg. Bakteriol. 152/4:298-301. 23 ref., 4 tab.

Concentrations of heavy metals (Cd, Cu, Ni, Pb, and Zn) in

drinking water, determined by AAS, are presented: Cd, 228.8; Cu, 324.7;

Ni, 232.0; Pb, 217.0; Zn, 213.86 nm.

375 Schnappinger, M.G. Jr., D.C. Martens, and G.W. Hawkins. 1969. Response of corn to Zn-EDTA and $ZnSO_4$ in field investigations. Agron. J. 61:834-836. 25 ref., 3 tab., 1 fig.

For soil characterization, Zn was extracted with $0.1\underline{N}$ HCl

and total Zn by Na_2CO_3 fusion. Leaf or whole above ground

portion of corn was obtained during vegetative growth. Leaves

were also collected at silk stage. Tissue samples were dried at

70°C for 48 h , 1 g digested in a mixture of 10 ml HNO_3 and 2 ml

$HClO_4$ and diluted to 50 ml with $0.5\underline{N}$ HCl. Zn in soil and plant

extracts determined by AAS.

376 Schnitzer, M. and E.H. Hansen. 1970. Organo-metallic interactions in soils: 8. An evaluation of methods for the determination of stability constants of metal-fulvic acid complexes. Soil Sci. 109:333-340. 11 ref., 3 tab., 5 fig.

The organic matter used was fulvic acid originating from the

Bh horizon. It was extracted, purified and dried. The ion

exchange equilibrium method and the method of continuous variations

were used for determining metal/fulvic acid ratios and stability

constants. In the ion exchange equilibrium method, all metal

(Al, Ca, Co, Cu, Fe, Mg, Mn, Ni, Pb, and Zn) analyses in the fil-

trate were carried out by AAS.

377 Schnitzer, M. and S.I.M. Skinner. 1967. Organo-metallic interactions
     in soils: 7. Stability constants of Pb^{++}-, Ni^{++}-, Mn^{++}-, CO^{++}-, Ca^{++}-,
     and Mg^{++}-fulvic acid complexes. Soil Sci. 103:247-252. 9 ref.,
     6 tab., 2 fig.

Stability constants, at pH 3.5 and 5.0, of complexes formed

between fulvic acid (FA) and Ca, Co, Mg, Mn, Ni and Pb divalent

metals are given. The filtrates and washings containing Co^{++}-,

Mg^{++}-, Mn^{++}-, and Pb^{++}-FA were analyzed, without destroying FA, by

Technicon AA-3 AA unit. Ni was determined colorimetrically.

Since AAS was not sufficiently sensitive for Ca, it was deter-

mined by radio-isotope technique.

378 Schroeder, H.A., A.P. Nason, I.H. Tipton, and J.J. Balassa. 1967.
     Essential trace metals in man: Zinc relation to environmental
     cadmium. J. Chronic. Dis. 20:179-210. 66 ref., 13 tab., 4 fig.

Zn and Cd were determined, with Perkin-Elmer model 303

using a Boling burner, in soil, humus, water, snow superphosphate,

phosphate rock, Zorka superphosphate and following samples: Lima

beans, brown beans, string beans, peas, lentils, black beans,

kidney beans, potatoes, turnips, carrots, kohlrabi, onion, beets,

radish, lettuce, cucumber, artichoke, tomato, asparagus, green

pepper, spinach, cabbage, cauliflower, parsley, mushroom, yam,

cristofine, hot pepper, sugarcane, peanut, walnut, hazelnut,

Brazil nut, pecan, almond, coconut, tangerine, apricot, papaya,

custard apple, banana, coffee, tea, orange juice, grape juice,

black pepper, paprika, mustard, thyme, ginger, allspice, cinnamon,

caraway seeds, bay leaf, garlic, wheat, rye, oats, barley, millet,

sunflower seeds, corn, endive, broccoli, swiss chard, eggplant,

squash, red spruce, white pine, juniper, aspen, white and red

oak, European birch, American beech, locust, quince, sumac,

genipa, flamboyant, ferns (Athyrium angastum, Osmunda cinnamonea

Polyptichium avastichoides, Pteridum lutiusculum) alfalfa, maid

apple, Hawaiian Tree Hibiscus, poppy, peony, Caribbean seaweed,

dog almond, and monkey's ear.

379   Scott, R.O. 1960. The application of direct-reading spectrochemical
        methods to soil analysis. 7th Int. Congr. Soil Sci., Madison, WI.
        Vol. 2, Comm. 2, 10-15. 20 ref., 2 tab.

        AAS has greater sensitivity than flame photometry

        for some elements and has been used for Mg, Na, K, Zn, Ca, Fe,

        and Cu determination.

380   Segar, D.A. 1971. The determination of trace metals in saline waters
        and biological tissues using the heated graphite atomizer.
        Sensing Environ. Poll. Joint Conf. (Palo Alto, CA, Nov. 8-10),
        Pap. 71-1051. 5 pp. 22 ref., 5 tab., 3 fig.

        A selective technique has been developed for Fe determination

        in sea water. Heated graphite atomizer (Perkin-Elmer model HAG-70)

        was used. A similar technique may be used for V, Cu, Ni, and Co

        in saline water when present in quantities higher than unpolluted

sea waters. APDC-MIBK solvent extraction permits Fe, Cu, Zn, Ni, Co and Pb determination in sea water. Trace metals (Ag, Cd, Co, Cu, Cr, Fe, Mn, Ni, Pb, and Zn) in marine plant tissue were also determined after organic extraction.

381 Shah, J., E.C. Maxie, and W.C. Landgraf. 1966. Manganese free radicals in cobalt-60 gamma irradiated strawberries. Nature 210:210. 22 ref.

Mn in strawberries was determined by AAS.

382 Sharma, K.C., B.A. Krantz, A.L. Brown, and J. Quick. 1968. Interactions of Zn and P with soil temperatures in rice. Agron. J. 60:652-655. 12 ref., 1 tab., 4 fig.

A clay loam soil was used. The tops and roots of the rice plant were analyzed for Zn by AAS.

383 Sharpee, K.W., A.E. Ludwick, and O.J. Attoe. 1969. Availability of zinc, copper and iron in fusions with sulfur. Agron. J. 61: 746-749. 7 ref., 1 tab., 2 fig.

Uptake of Cu, Fe, and Zn by four successive crops of corn, from applications of fusions of compounds of Cu, Fe and Zn with flowers of S, was studied in pot experiments. Plant tissue (0.2-2 g) was ashed at 580°C in a muffle furnace for 2 h, ash was treated with 2.75$\underline{N}$ HCl and filtrate diluted with water to 0.5$\underline{N}$. Cu, Fe, and Zn were determined at 324.7, 248.3, and 219.3 nm, respectively by AAS using a Jarrell-Ash AA-FE Unit. Total S was determined on a different ash prepared in accordance with AOAC method and determined turbidimetrically. Soil S extractable with 0.2$\underline{M}$ ammonium citrate (pH 4) was also determined turbidimetrically.

384 Shelton, J.E. and D.C. Zeiger. 1970. Distribution of manganese[54] in 'Delicious' apple trees in relation to the occurrence of internal bark necrosis (IBN). J. Am. Soc. Hortic. Sci. 95:758-762. 23 ref., 3 tab., 6 fig.

Apple trees were grown in quartz sand in plastic pots and supplied with complete nutrient solutions varying in Mn content (0.5, 5.0, and 50 ppm). Leaf, bark tissue, and twig samples were ashed in a muffle furnace at 550°C, dissolved in HNO_3 and diluted, and Mn was determined by AAS.

385 Siman, A., F.W. Cradock, P.J. Nicholls, and H.C. Kirton. 1971. Effects of calcium carbonate and ammonium sulphate on manganese toxicity in an acid soil. Aust. J. Agric. Res. 22:201-214. 18 ref., 6 tab., 3 fig.

In a field experiment the influence of increasing rates of lime and $(NH_4)_2SO_4$ on French beans was studied on an acid red basaltic soil (pH 4.5-4.8), rich in Mn. Leaves were dry ashed and Mn determined by AAS. Water soluble and exchangeable Mn in soils were determined colorimetrically.

386 Singhal, K.C. and B.K. Banerjee. 1968. Indirect estimation of phosphorus in rock phosphate by atomic absorption spectrophotometer using ion-exchange decomposition technique. Technology 5:239-241. 4 ref., 1 tab., 2 fig.

Powdered rock phosphate samples were shaken with cation-exchange resin and water at 80°C for 2 h. Ca (10 ppm) was added to standards and filtered samples. Unreacted Ca was determined and P thus calculated. Perkin-Elmer model 303 equipped with air-C_2H_2 premix burner and digital readout accessory (DCR-1) was used.

387 Singhal, K.C., A.C. Banerji, and B.K. Banerjee. 1968. Indirect method
     of estimation of phosphorus by atomic absorption spectrophotometry.
     Technology 5:117-119. 8 ref., 1 tab., 1 fig.

          A 0.1-g rock phosphate sample was digested in HCl and HNO_3.

     An HCl extract was prepared. The extracts and standards were

     diluted 1:1 with 60 ppm $SrCO_3$. Untreated Sr was determined and P

     calculated.

388 Singhal, K.C., R.C.P. Sinha, and B.K. Banerjee. 1969. Estimation of
     low content of biuret in urea by atomic absorption spectrophotometry.
     Technology 6:95-97. 11 ref., 1 tab., 2 fig.

          Biuret in urea was estimated indirectly by complexing it with

     Cu in alkaline medium ($CuSO_4$ and KOH). The method is sensitive

     and accurate and can be used for the determination of low con-

     centrations of biuret in the samples.

389 Sinha, R.C.P., K.C. Singhal, and A.C. Banerji. 1968. Determination
     of some trace impurities in drinking water by atomic absorption
     spectrophotometry. Technology 5:121-122. 2 ref., 1 tab.

          Trace quantities of Cr, Li, Co, Mn, Cu, Pb, Fe, Ba, Zn, K,

     Mg, Na and Ca were determined in drinking water.

390 Slavin, S. (ed.): See Perkin-Elmer Corp. Atomic Absorption Newsletter.

391 Slavin, W. 1962. Agricultural applications of atomic absorption
     spectrophotometry. Atom. Absorp. Newsl. 1:13-19. 15 ref.,
     1 fig.

          A review of applications of AAS in soil and plant analysis

     of papers published from 1958 to 1962.

392 Slavin, W. 1965. Applications of atomic absorption spectroscopy in
     the food industry. Atom. Absorp. Newsl. 4:330-334. 34 ref.,
     6 tab.

A review of the applications of AAS to food chemistry (plants

and vegetables, foodstuffs and animal feeds, beverages, water

analysis, etc.).

393 Slavin, W. 1968. Atomic Absorption Spectroscopy. John Wiley & Sons, New York, NY. 307 pp.

Deals with, among other topics, instrumentation techniques,

and applications in agriculture and other disciplines.

394 Smith, J.D., R.A. Nicholson, and P.J. Moore. 1971. Mercury in water of the tidal Thames. Nature 232:393-394. 8 ref., 1 tab.

Surface waters were made $1\underline{N}$ in H_2SO_4 and $0.05\underline{N}$ in $KMnO_4$ and

shaken for 1 h. After H_2O_2 treatment, a silver wire coil (freed

of Hg) was added to each sample and shaken overnight. Coil was

removed, washed with water and acetone and dried in air. Hg

amalgamated with the Ag was driven off by heating to about 250°C.

The Hg vapor was passed in a stream of N_2 through a cell in an

AA unit.

395 Smith, J.H., D.L. Carter, M.J. Brown, and C.L. Douglas. 1968. Differences in chemical composition of plant sample fractions resulting from grinding and screening. Agron. J. 60:149-151. 10 ref., 2 tab.

Alfalfa, barley straw, corn leaves, red clover, and wheat

straw were ground in a Wiley mill through a stainless steel or

brass screen and sieved into different particle sizes (>20, 20-30,

30-60, 60-100, and <100 mesh). Analyses were carried out for N, P,

K, Ca, Mg, Zn, Se, and SiO_2, by AAS for Ca, Mg, and Zn.

396 Soman, S.D., V.K. Panday, and K.T. Joseph. 1969. Atomic absorption
          spectrophotometry in water analysis. Am. Ind. Hyg. Assoc. J.
          30:527-530. 7 ref., 4 tab.

          Samples of fresh and natural water were analyzed by

          Perkin-Elmer model 303 for Ca, Mg, Na, and K either directly or

          after dilution. For trace elements (Li, Rb, Sr, Co, Fe, Mn, Cr,

          Cu, and Zn), pre-concentration by simple evaporation was found

          to compare favorably with other concentration techniques.

          HCl was added to the polyethylene bottle to help prevent the

          absorption of metal ions on the container wall and the growth of

          micro-organisms in the samples.

397 Spencer, D.W. and P.G. Brewer. 1969. The distribution of copper,
          zinc and nickel in sea water of the Gulf of Maine and the Sargasso
          Sea. Geochim. Cosmochim. Acta 33:325-339. 16 ref., 5 tab.,
          4 fig., 6 app.

          Sea water was filtered through 0.45 μ (Millipore HA) membrane

          filters and analyzed for Cu, Ni, Zn, Co and Fe by AAS after a

          prior solvent extraction concentration step (APDC-MIBK). Perkin-

          Elmer model 303 was used (Note: No data on Co and Fe are given

          in the paper.)

398 Spencer, D.W., D.E. Robertson, K.K. Turekian, and T.R. Folsom. 1970.
          Trace element calibrations and profiles at the Geosecs Test
          Station in the Northeast Pacific ocean. J. Geophys. Res. 75:
          7688-7696. 9 ref., 6 tab., 9 fig.

          Sea water samples were analyzed by four collaborative

          laboratories for Sr, Cs, Rb, Co, Ni, Sc, Cu, Sb, Zn, Fe, and

          U. Of these, Cu, Zn, Fe, Ni, and Sr were determined by some

          laboratories by AAS - Sr by direct aspiration and the rest by

          APDC-MIBK extraction. For other elements and for some of the Cu,

          Zn, Fe, Ni, and Sr analyses, other methods were used.

399 Spencer, D.W. and P.L. Sachs. 1969. A study of potential interferences
        on the determination of particulate aluminum in sea water using
        atomic absorption spectrometry. Atom. Absorp. Newsl. 8:65-68.
        9 ref., 7 tab.

        Suspended material collected on a 0.45-μ membrane filter was

        ashed in a Pt crucible, treated with 2 ml HF and 1 drop H_2SO_4,

        taken up in 2 ml 2N HCl and diluted to a total weight of 5 g. K

        (1000 ppm) was added to samples and standards. Ca, Fe, Na, and

        SO_4, individually or mutually, did not interfere in the Al deter-

        mination (Perkin-Elmer model 303).

400 Spencer, D.W. and P.L. Sachs. 1970. Some aspects of the distribution,
        chemistry, and mineralogy of suspended matter in the Gulf of
        Maine. Mar. Geol. 9:117-136. 22 ref., 7 tab., 8 fig., 1 app.

        Samples of suspended matter were collected by filtering sea

        water through 0.45 μ membrane filters. The air-dried filters were

        ashed in Pt crucibles at 500°C after initial treatment with alcohol

        and charring. The residue was treated with HF and H_2SO_4. HCl

        extracts were analyzed for Fe, Mn, Co, Ni, Zn, and Cu by Perkin-

        Elmer model 303. Al was determined after addition of 1000 ppm K.

401 Sreekumaran, C., K.T. Joseph, and M. Parameswaran. 1970. Occurrence
        of sodium, potassium, rubidium, calcium and strontium in some
        Indian rivers. Curr. Sci. 39:105-106. 11 ref., 3 tab.

        Na, K, Rb, Mg, Ca, and Sr contents of waters from some major

        Indian rivers and an estimate of the input of these elements into

        the oceans through these rivers are presented. Samples were

        collected from the mid-stream regions of the rivers and filtered

        through Millipore filters before AAS analysis. K and Ca were

        estimated directly while Na and Mg were first diluted 20 times. For

        Rb and Sr samples were digested with acids.

402 Stahly, E.A. and N.R. Benson. 1970. Calcium levels of 'Golden Delicious' apples sprayed with 2,3,5- triiodobenzoic acid. J. Am. Soc. Hortic. Sci. 95:726-727. 15 ref., 1 tab.

Apples were separated into skin and flesh (stem and calyx end). After freeze-drying the tissues were ground in a Wiley mill or with mortar and pestle to pass a 20-mesh sieve. Ca, K, and Mg were determined with a Jarrell-Ash AA unit. B was determined by a method given in Anal. Chem. 1954. 26:418-421.

403 Steckel, J.E. and R.L. Flannery. 1965. Automatic determination of phosphorus, potassium, calcium, and magnesium in wet digestion solutions of plant tissue. Technicon. Symp. Aut. Anal. Chem. New York, NY, Sept. 10. pp. 116-122. 8 ref., 6 tab., 8 fig.

Plant tissue samples of snapbean, soybean, sorghum, and barley were washed and oven-dried at 70°C. The samples were wet ashed with HNO_3 and $HClO_4$. Results of K, Ca, and Mg by Auto-Analyzer (Ca and K by flame photometry and K colorimetrically) and AAS were found to be related by simple regression with significance at the 0.05% level.

404 Steckel, J.E. and R.L. Flannery. 1971. Simultaneous determinations of phosphorus, potassium, calcium, and magnesium in wet digestion solutions of plant tissue by AutoAnalyzer. 7 ref., 6 tab., 8 fig. pp. 83-96. In L.M. Walsh (ed.), Instrumental methods for analysis of soils and plant tissue. Soil Sci. Soc. Am., Inc., Madison, WI.

Abstract same as Steckel and Flannery (403).

405 Štupar, J. 1964. Bestimmung von rubidium in materialen der agrikultur durch atomabsorptions - flammenphotometrie. (Determination of rubidium in agricultural materials by atomic absorption-flame photometry. Z. Anal. Chem. 203:401-409. 5 ref., 7 tab., 4 fig.

Rb was rapidly and accurately determined in extracts of plant ash or soil. HCl, H_3PO_4, $HClO_4$ caused a considerable decrease

in the absorption of Rb. The influence of flame emission of K

(767 nm line) was suppressed by a lens. Except for Cs, cations

did not interfere in the analysis. Kidney bean, potato, cabbage,

barley, orchard grass, French ryegrass, and maize plant samples

were analyzed.

406 Štupar, J. 1964. Determination of rubidium in agriculturally important
     materials by atomic-absorption flame photometry. Ljubljana, Rep.
     R-425. 11 p.

This is the same as Štupar (405).

407 Štupar, J. 1966. The application of an absorption cell for determining
     of some metals by atomic absorption. Mikrochim. Acta 722-736.
     11 ref., 5 tab., 6 fig.

A cell made of vitreosil glass was used in place of the frequently

used fish-tail burner for the determination of Fe, Co, Cu, Ag,

and Pb by AAS. Water, grass, apple leaves, fern, peach leaves

(digested with HNO_3+ $HClO_4$ mixture 17 + 3) and other samples were

analyzed. Water was analyzed directly and after extraction with

APDC. The method described is highly sensitive, rapid and simple.

It was found that the best concentration range is 0.1-1 µg/ml and

in some cases even lower. Results were compared with ordinary

AAS, flame emission and spectrophotometric methods.

408 Talalaev, B.M. and O.N. Mironova. 1970. Atomic-absorption determina-
     tion of silver in industrial effluents. Zh. Analit. Khim. 25:
     1134-1136. 13 ref., 2 tab., 3 fig.

An AA method for determining Ag in effluent from a catalyst

plant is described. In this method the chemical composition

of the effluent does not affect Ag absorption.

409 Tan, K.H., R.A. Leonard, A.R. Bertrand, and S.R. Wilkinson. 1971. The metal complexing capacity and the nature of the chelating ligands of water extract of poultry litter. Soil Sci. Soc. Am. Proc. 35:265-269. 23 ref., 1 tab., 3 fig.

The effect of organic matter originating from broiler house litter (containing chicken manure and partially decomposed wood-shavings) on soil properties was studied. Aqueous extracts (12.7 mg organic matter/ml) of the litter were prepared. Al, Cu, Mg, and Zn were added, mixtures shaken for 1 h with a wrist-action shaker and decanted. The solutions were dried and digested with $HClO_4$-HNO_3 (1:4) mixture. The digests were analyzed for Cu, Mg, and Zn by AAS and for Al by arc spectrograph.

410 Tanaka, G., A. Tomikawa, H. Kawamura, and Y. Ohyagi. 1968. Determination of strontium by atomic absorption spectrophotometry. J. Chem. Soc. Jpn. 89:175-185. 13 ref., 4 tab., 25 fig.

Sr was determined at 460.7 nm with Perkin-Elmer model 303. The effect of 21 metal ions on Sr absorption was studied. Plant, water, and other samples were analyzed. It was concluded that a large number of samples could be analyzed, the error being within 4%.

411 Temperli, A.T. and H. Misteli. 1969. Determination of potassium in soil extracts by atomic absorption spectrophotometry. Anal. Biochem. 27:361-363. 1 ref., 1 tab.

A 20-g sample was shaken with 100 ml water for 1 h. Extract was filtered and then centrifuged for 10 min at 3000 g. To 0.2-2 ml sample extract 0.5 ml of an aqueous solution, 2%, Kalignost (STPB) was added. After clarifying the solution, K was

determined by AAS. Recoveries of added K ranged from 98-102%.

Results compared with those obtained by emission spectrophotometry.

It was also found that Kalignost was not required for determining

K in apple cider. Unicam SP90 was used.

412 Tenny, A.M. 1967. Application of atomic absorption spectroscopy to
     water pollution control. Instrum. News 18 (1):1, 14-15. 6 ref.,
     1 fig.

Several advantages of the use of AAS in industrial

wastewater and water pollution control analysis are given.

As many as 400 samples/instrument/day have been analyzed.

Samples from the waterways are checked for Ca, Cd, Cr, Cu, Fe, K,

Mg, Mn, Na, Ni, Pb, and Zn and occasionally for Ag and Li. Most

of the elements can be determined by electronic scale expansion

and sample dilution. APDC-MIBK extraction is required for Ag

determination.

413 Thomas, R.L., R.W. Sheard, and J.R. Moyer. 1967. Comparison of
     conventional and automated procedures for nitrogen, phosphorus,
     and potassium analysis of plant material using a single digestion.
     Agron. J. 59:240-243. 10 ref., 5 tab., 1 fig.

Samples of grain and forage, wet-ashed (H_2SO_4-H_2O_2) and

dry-ashed gave comparable results for K by AAS. P was deter-

mined colorimetrically. Details of simultaneous N and P analysis

by AutoAnalyzer, and K by AAS (Techtron model AA-3), on plant

samples, performed on a single H_2SO_4-H_2O_2 digest, are presented.

414 Thorpe, V.A. 1971. Determination of mercury in food products and biological fluids by aeration and flameless atomic absorption spectrophotometry. J. Assoc. Off. Anal. Chem. 54:206-210. 4 ref., 4 tab., 3 fig.

A simple, rapid modification of a method developed at the Fisheries Research Board of Canada for determining Hg in water, animal feeds and other products is described. In this method the samples are solubilized at 50°C with H_2SO_4, oxidized with strong $KMnO_4$ solution and reduced with $SnCl_2$. Hg vapor is passed through AAS. Perkin-Elmer model 303 was used. Recoveries of Hg added to samples were adequate. Replicate analyses on different days showed good precision.

415 Travis, D.O., W.L. Powers, L.S. Murphy, and R.I. Lipper. 1971. Effect of feedlot lagoon water on some physical and chemical properties of soils. Soil Sci. Soc. Am. Proc. 35:122-126. 12 ref., 4 tab., 7 fig.

Lagoon water from cattle feedlot runoff was added to four undisturbed soil cores (6.7 cm diam, 42 cm length). After each run, the columns were sectioned into 3-cm increments, leached with $1\underline{N}$ NH_4OAc (pH 7) and analyzed for Ca and Mg by AAS and for Na and K by flame photometry. Lagoon water was also analyzed for these elements.

416 Trent, D. and W. Slavin. 1964. Factors in the determination of strontium by atomic absorption spectrophotometry with particular reference to ashed biological samples. Atom. Absorp. Newsl. 3:53-64. 8 ref., 5 tab., 13 fig.

Hay sample was ashed at approx 450°C for 18 h. HCl extract of 1 g ash was prepared and diluted to 250 ml containing 1% La

in final solution. 5X scale expansion was used. Sr absorption

is decreased by the presence of Al, P, and Si and was increased

by alkali metals. The purpose of diluting the extract to a

large volume (250 ml) was to keep phosphate level below 1000 ppm

and total alkali content between 100 and 1000 ppm to eliminate

interference. Perkin-Elmer model 303 was used.

417 Trierweiler, J.F. and W.L. Lindsay. 1969. EDTA-Ammonium carbonate
soil test for zinc. Soil Sci. Soc. Am. Proc. 33:49-54. 11 ref.,
2 tab., 5 fig.

Tops of corn plants, grown on 42 soils in a greenhouse study

were dried at 70°C, ground to pass a 20-mesh sieve and digested

with HNO_3-$HClO_4$-H_2SO_4. Zn was determined, after SiO_2 had settled,

by Perkin-Elmer model 303. Soils were extracted with HNO_3-$HClO_4$-

H_2SO_4-HF (total Zn), dithizone, 0.01$\underline{N}$ HCl and a solution (pH 8.6)

that contained 0.01$\underline{M}$ EDTA and 1$\underline{M}$ $(NH_4)_2$ CO_3. Zn on soil extracts

was determined as above.

418 Truong, N.V., G.L. Wilson, and C.S. Andrew. 1971. Manganese toxicity
in pasture legumes. I. Effects of calcium and phosphorus levels
in the substrate. Plant Soil 34:309-330. 65 ref., 9 tab.

Soil and solution culture experiments with white clover

and a solution culture experiment with tropical legumes

(Glycine wightii, Phaseolus atropurpurens, Stylo and Centro) were

conducted. Wet digests of tops and roots were analyzed for Mn,

Fe, Mg, Ca, Na, and K by AAS. P in soil and plants was determined

colorimetrically. 0.02$\underline{N}$ HCl leachates of soil were analyzed for

Na and K by flame photometry and Ca and Mg by AAS. Mg was

determined using a 0.5 cm path length flame (air-C_2H_2) at 285.2 nm

and a range of 10-60 ppm. Ca was determined at 422.7 nm (air-

C_2H_2). PO_4 and SO_4 interferences were removed by adding an acetate

form of Amberlite resin 1 RA-400 to the digest and shaking gently

for 5 min with a mechanical shaker. Soils were also analyzed

for Mn (total, exchangeable, and easily reducible). (Note: Part

of the information was obtained by personal communication with

Dr. C.S. Andrew, CSIRO, St. Lucia, Australia.)

419 Tušl, J. 1970. Determination of zinc in stock and mixed feeds by
     EDTA extraction and atomic absorption spectrophotometry. J. Assoc.
     Off. Anal. Chem. 53:1190-1192. 10 ref., 1 tab.

Zn was extracted from various feeds by a solution of Na_2 EDTA

(0.1M) alkalized to pH 8.5-9 with ammonia and determined by AAS.

EDTA extraction was almost as efficient as wet ashing with HNO_3-

$HClO_4$ but more rapid and easier. EDTA extraction was preferable

to dry ashing at 550°C as considerable losses of Zn occurred on

dry ashing. AA model H1170 (Hilger & Watts Ltd., England) was

used.

420 Uman, G.A. 1968. A critical view of spectro methods for water
     quality control. J. Water Pollut. Control Fed. 40:R484-R488.
     8 ref., 2 fig.

Discusses AAS and other techniques available to an analyst

for water quality control.

421 Ure, A.M. and M.L. Berrow. 1970. Analysis of EDTA extracts of soils
     for copper, zinc and manganese by atomic absorption spectrophotometry
     with a mechanically separated flame. Anal. Chim. Acta 52:
     247-257. 33 ref., 8 tab., 4 fig.

The method described using a mechanically separated air-C_2H_2 flame shows an improvement in sensitivity and detection over a normal unseparated flame. Results for Cu, Zn, and Mn determined on EDTA extracts of soils by the described technique were compared with the porous-cup spark emission method. Techtron model AA-4 was used. A 15-g sample is shaken on an end-over-end shaker for 1 h with 75 ml 0.05$\underline{M}$ EDTA solution (neutralized to pH 7.0 with NH_4OH).

422 Ure, A.M. and R.L. Mitchell. 1967. The determination of cobalt in soil extracts by atomic absorption – A study of interference effects. Spectrochim. Acta 23B:79-96. 41 ref., 4 tab., 10 fig.

A method has been developed for the determination of 0.05-2.5 ppm Co (2.5% HOAc soluble) in soil (1-50 µg Co in 10 ml solution) by AAS. Soil extracts were evaporated and treated with HNO_3 followed by HCl. The residue was dissolved in a mixture of 5 ml 0.06$\underline{N}$ HCl and 5 ml C_2H_5OH. Interferences due to the presence of more than 0.3% extractable Ca and up to 0.5% extractable Al can be reduced to an insignificant level.

423 Van Cleve, K. and L.L. Noonan. 1971. Physical and chemical properties of the forest floor in birch and aspen stands in interior Alaska. Soil Sci. Soc. Am. Proc. 35:356-360. 16 ref., 4 tab., 2 fig.

L, F, and H layers of the forest floor in quaking aspen and paper birch forests were digested with $HClO_4$. Total P in the extracts was determined by colorimetry and total Ca, K, Mg, Mn, and Zn by AAS. Water-soluble and exchangeable cations were analyzed for Ca, Fe, K, Mg, Mn, and Zn by AAS.

424 Van den Driessche, R. 1969. Relationships between Douglas fir seedling
growth and levels of some soil and tissue nutrients. For. Chron.
45:273-277. 6 ref., 6 tab., 2 fig.

   Soils from nursery experimental plots were analyzed for

exchangeable K by flame emission and for Mg by AAS. Root and shoot

samples from first season growth of Douglas fir were ashed with

$HClO_4$ and analyzed for P (colorimetrically), K (emission), and

Ca and Mg (AAS). Seedlings grown in a greenhouse experiment were

also analyzed as above.

425 Varju, M.E. and E. Elek. 1971. Determination of soluble copper in
soils by atomic absorption spectroscopy. Atom. Absorp. Newsl.
10:128. 4 ref., 1 tab.

   A 10-g dry sample (10 soils) was shaken with 100 ml 3% v/v

HNO_3 for 2 h . After filtration, Cu was determined by AAS (Perkin-

Elmer model 290B) and diethyldithiocarbamate colorimetric method.

AAS results agreed closely with colorimetric results. A 1 ppm

Cu standard was analyzed six times by AAS and precision was found

to be ± 2%.

426 Varley, J.A. and P.Y. Chin. 1970. Determination of water-soluble
sulphate in acidic sulphate soils by atomic-absorption spectro-
scopy. Analyst 95:592-595. 8 ref., 5 tab.

   A 10-g sample was shaken with 50 ml distilled water for

10 min and left overnight. The following morning it was shaken

for 2 h and filtered. In a suitable aliquot predetermined by

a conductivity measurement, SO_4 was precipitated by the addition

of a known quantity of $BaCl_2$. The excess of Ba remaining in the

solution was determined by AAS at 553.6 nm. The procedure is

rapid and compares well with the gravimetric results. Sulphate

determined on 12 soils indirectly by AAS (Perkin-Elmer model 290)

was compared with gravimetric $BaSO_4$ method and turbidity method

on an AutoAnalyzer.

427 Vaughn, W.W. and J.H. McCarthy, Jr. 1964. An instrumental technique
     for the determination of submicrogram concentrations of mercury
     in soils, rocks, and gas. U.S. Geol. Surv. Prof. Pap. 501-D:D123-
     D127. 5 ref., 2 tab., 3 fig.

     In the proposed method an analog signal produced when Hg

     vapors absorb UV light is converted to digital form and calibrated

     to Hg concentration. The lower limit of sensitivity is 5 ppb

     when 1 g sample is used.

428 Voegeli, P.T., Sr. and R.U. King. 1969. Occurrence and distribution
     of molybdenum in the surface water of Colorado. Geol. Surv.
     Water-Supp. Pap. 1535-N. 32 p. 7 ref., 3 tab., 1 fig., 1 plate.

     Samples collected from principal streams and their chief

     tributaries and from a few reservoirs and lakes were analyzed for

     Mo by (a) Spectrographic method (b) Thiocyanate method and (c)

     Dithiol methods (spectrophotometric and AAS).

429 Vosters, M., F. Hanappe, and P. Buat-Menard. 1970. Determination of Cl,
     Na, Mg, K and Ca in firn sample 66-A-Z from New Byrd Station,
     Anarctica-Comparison with work of Murozumi, Chow and Patterson.
     Geochim. Cosmochim. Acta 34:399-401. 2 ref., 2 tab.

     A sample of melted firn was analyzed for Na, Mg, K, and Ca

     by AAS and for Na and Cl by neutron activation. For AAS, preconcen-

     tration of the sample was done in a dust-free room pressurized

     with filtered air. Sr was added to suppress chemical interferences

     in Ca and Mg determinations.

430 Wall, R.E., Y.P. Kalra, and R. Prasad. 1971. Concentration of micro-
        nutrients in foliage of aspen (<u>Populus</u> <u>tremuloides</u> Michx.) in
        Manitoba. Can. Dep. Fish. For., Can. For. Serv. Inf. Rep. A-X-47. 7 pp.
        9 ref., 2 tab.

        Cu, Fe, Mn, and Zn were determined in the HCl extracts of

        chlorotic and apparently normal foliage after dry-ashing at 450°C.

        Soils were analyzed for (1$\underline{N}$ NH$_4$OAc, pH 7.0 extractable) Ca, Mg and

        Mn and 1% Na$_2$EDTA extractable Cu, Fe, and Zn. Perkin-Elmer model

        303 was used.

431 Wallace, A., E. Frolich, and O.R. Lunt. 1966. Calcium requirements
        of higher plants. Nature 209:634. 5 ref., 2 tab.

        Ca and Mg levels in tobacco and corn leaves were determined

        on wet-digested samples with AAS.

432 Walsh, A. 1955. The application of atomic absorption spectra to
        chemical analysis. Spectrochim. Acta 7:108-117. 30 ref., 3 tab.

        This is the first paper suggesting the application of atomic

        absorption spectra in analytical work.

433 Warburton, J.A. 1969. Trace silver detection in precipitation by
        atomic absorption spectrophotometry. J. Appl. Meteorol. 8:464-
        466. 5 ref., 2 tab., 2 fig.

        AAS seems to be a sensitive method for determining small

        concentrations of Ag (10^{-11} g/ml) in aqueous samples after ion

        exchange extraction (on a strong sulphonated polystyrene cation

        exchange) followed by elution in an organic matrix (MIBK). It

        has found application in AgI seeding experiments. Beckman D-B

        type AA unit was used.

434 Ward, G.M. and M.J. Miller. 1969. Magnesium deficiency in greenhouse tomatoes. Can. J. Plant Sci. 49:53-59. 9 ref., 6 tab.,

Tomatoes were grown in a sand culture experiment in a greenhouse and the plants segregated into cotyledons, leaves 1-2 lamina, leaves 3-4 lamina, upper leaves, leaves 1-2 petioles, other leaf petioles, and stem. Dry-ash extract was prepared and analyzed for Ca, Mg, and K by AAS.

435 Warnock, R.E. 1970. Micronutrient uptake and mobility within corn plants (Zea mays L.) in relation to phosphorus-induced zinc deficiency. Soil Sci. Soc. Am. Proc. 34:765-769. 28 ref., 7 tab., 2 fig.

A greenhouse study was conducted on a calcareous soil (saturated paste pH 8.4). Corn plants were harvested 56 days after planting and separated into leaf, stem, and root tissue. The samples were wet-ashed with HNO_3-$HClO_4$. P was determined colorimetrically and Fe, Mn, and Zn by AAS.

436 Watanabe, F.S., S.R. Olsen, and C.V. Cole. 1971. Ionic balance and growth of five plant species in four soils. Agron. J. 63:23-28. 15 ref., 8 tab., 3 fig.

Plant samples (barley, cotton, buckwheat, sorghum, and pinto bean) were digested with HNO_3 and $HClO_4$-H_2SO_4 mixture. Ca and Mg were determined by AAS using Perkin-Elmer model 303, K and Na by flame photometry and P by colorimetric method.

437 Weed, S.B. and R.A. Leonard. 1968. Effect of K^+-uptake by K^+-depleted micas on the basal spacing. Soil Sci. Soc. Am. Proc. 32:335-340. 20 ref., 3 tab., 8 fig.

Micas (biotites, phlogopite, and muscovites) were depleted of their K contents with solutions of $NaB(C_6H_5)_4$. The

K was re-introduced into them by two methods, one of them utilizing suspensions of Ca or Mg - saturated expanded mica. The filtrates were analyzed for K by flame photometer and for Ca and Mg by AAS.

438 Weger, S.J. Jr., L.R. Hossner, and L.W. Ferrara. 1969. Determination of boron in fertilizers by atomic absorption spectrophotometry. J. Agric. Food Chem. 17:1276-1278. 9 ref., 4 tab., 1 fig.

For the determination of small quantities of B in fertilizers and related compounds by AAS, B is complexed and extracted from aqueous acid solution with 5% 2-ethyl-1, 3-hexanediol in $CHCl_3$. This procedure decreases the amount of interferences (water soluble salts, and refractory complexes) and increases the sensitivity of B determination. Detection limit is 1 ppm B. The working range is 0-100 ppm. Sensitivity is 1.5 ppm (249.97 nm). Perkin-Elmer model 303 was employed, using a 2-in. N_2O burner head.

439 Weger, S.J. Jr., L.R. Hossner, and L.W. Ferrara. 1970. Determination of boron in fertilizers by atomic absorption spectrophotometry. Atom. Absorp. Newsl. 9:58-60. 9 ref., 3 tab., 2 fig.

Fertilizers of several grades (0-0-60, 11-48-0, 0-46-0, 16-8-8, 3-9-18, 6-12-12, and 0-20-20) were analyzed for small amounts of B. In this method B is complexed and extracted from aqueous acid solution with a 5% solution of 2-ethyl-1, 3-hexanediol in $CHCl_3$ to increase sensitivity and decrease refractive interference. Acid soluble (6$\underline{N}$ HCl) and total (Na_2CO_3 fusion) B were analyzed. The low detection limit (1 ppm B) allows low concentrations of B to be analyzed. The methods are compared with AOAC method and emission spectrographic analysis.

440 Weissberg, B.G. 1971. Determination of mercury in soils by flameless
       atomic absorption spectrometry. Econ. Geol. 66:1042-1047.
       16 ref., 4 tab., 2 fig.

       The article compares the results of Hg analyses (at 253.7 nm)

       of the vapors recovered with a single beam AA unit combined with

       a Au filter, with two modifications of this method designed to

       further reduce and eliminate organic constituents from the vapor

       to be subjected to measurement.

441 West, F.K., P.W. West, and T.V. Ramakrishna. 1967. Stabilization
       and determination of traces of silver in waters. Environ. Sci.
       Technol. 1:717-720. 4 ref., 4 tab.

       A procedure for determining Ag in waters in ppm to ppb range

       is described. Na_2EDTA was used (0.4 g Na_2EDTA/100 ml sample)

       to stabilize the sample to prevent adsorptive losses of Ag to the

       container walls. Ag was determined by AAS after isolation of Ag

       dithizonate complex and concentration into ethyl propionate.

       Perkin-Elmer model 303 was used. The procedure is specific and

       widely applicable.

442 West, P.W. and C.B. Herrin. 1965. Simple atomic-absorption photometer
       for water analysis. J. Am. Water Works Assoc. 57:492-499. 13
       ref., 5 tab., 3 fig.

       Freedom from interference and matrix effects is the most

       important feature of the AA technique. River and lake waters

       and a synthetic mixture were analyzed for Ca, Mg, Na, and K.

       $SrCl_2$ (4 mg/ml) was used as a releasing agent in the determination

       of Ca and Mg.

443 Westermann, D.T., T.L. Jackson, and D.P. Moore. 1971. Effect of
        potassium salts on extractable soil manganese. Soil Sci. Soc.
        Am. Proc. 35:43-46. 18 ref., 3 tab., 2 fig.

        K salts were mixed with soils from the surface horizon (0-20

cm) and incubation carried out at 25°C in a water bath. Soil

(10 g) was extracted with successive 30-ml portions of 0.5$\underline{M}$

$Mg(NO_3)_2$. After filtration the volume was made up to 100 ml

with the extractant. Mn was determined by AAS without any prior

treatment of the extract. It was not necessary to digest the extract

with HNO_3-$HClO_4$ for complete recovery of Mn.

444 White, R.P. 1969. Hydroxylamine hydrochloride as a reducing agent
        for atomic absorption determinations of manganese in dry-ashed
        plant tissue. Soil Sci. Soc. Am. Proc. 33:478-479. 4 ref.,
        2 tab.

        Potato tissue (20-mesh) was wet-ashed with HNO_3-$HClO_4$ and

residue taken up in 1$\underline{N}$ HCl. Dry-ashed (550°C for 4 h) sample

was divided into two parts, one portion was boiled with 6N HCl and to

the other NH_2OH-HCl in 1$\underline{N}$ HCl was added (room temperature). Mn was

determined by Perkin-Elmer model 303 equipped with DCR concentra-

tion read-out attachment and K and Mg by emission flame photometry.

It was concluded that NH_2OH-HCl plus 1$\underline{N}$ HCl adequately reduced

(to the Mn^{++} form) and dissolved the difficultly soluble oxides of

Mn (MnO_2 and Mn_3O_4) formed by dry-ashing. This eliminated treat-

ment of dry-ashed sample with hot HCl.

445 White, R.P., E.C. Doll, and J.R. Melton. 1970. Growth and manganese
        uptake by potatoes as related to liming and acidity of fertilizer
        bands. Soil Sci. Soc. Am. Proc. 34:268-271. 11 ref., 3 tab.,
        3 fig.

Potatoes were grown on a sandy loam soil (pH 4.7). Vines, harvested at two stages of growth, were dried at 65°C and ground to pass a 1.25-mm screen. Perkin-Elmer model 303 was used to analyze Mn on HNO_3 and $HClO_4$ digests.

446 Whitehead, N.E., R.R. Brooks, and P.J. Peterson. 1971. The nature of uranium occurrence in the leaves of Coprosma australis (A. Rich.) Robinson. Aust. J. Biol. Sci. 24:67-73. 19 ref., 1 fig.

To study the distribution and chemical forms of U, the leaves of an indigenous shrub, Coprosma australis, growing in a mineralized soil in New Zealand were collected. Seedlings were also grown in greenhouse. Leaves were washed with distilled water, freeze-dried, and ground in a hammer mill to pass a screen of 0.5 mm mesh size. U was determined after ashing, dissolution of ash and solvent extraction to remove U from interferring cations. Detection limit of 10 ng was obtained using a fluorimetric attachment to an AAS unit.

447 Wilk, H.B. and P. Ojanpera. 1970. Chemical analyses of lunar samples 10017, 10072, and 10084. Science 167:531-532. 1 note, 3 tab.

Rock and dust samples were analyzed by gravimetric, colorimetric, AAS, titration, neutron activity, qualitative, flame, and emission spectroscopy methods. AAS results of Al, Cr, Ni, and Zn are presented.

448 Williams, H.R. and A.E. Burge. 1970. A method for the determination of sulphur levels in plant material by atomic absorption spectrophotometry. Queensl. J. Agric. Anim. Sci. 27:169-175. 3 ref., 5 tab.

A 300-mg sample (mixed grasses and mixed legumes) was burnt in a liter combustion flask containing O_2 at atmospheric pressure, in the presence of H_2O_2 and $0.2\underline{N}$ NaOH. SO_4 was precipitated by a known amount of $BaCl_2$. The unreacted Ba was determined by AAS (Techtron type AA-4, air-C_2H_2, 553.55 nm, standard Ba 0-300 ppm, adjusted to 1500 ppm Sr). The results obtained were comparable to the turbidimetric method (490.0 nm).

449 Williams, T.R., B. Wilkinson, G.A. Wadsworth, D.H. Barter, and W.J. Beer. 1966. Determination of magnesium in soil extracts by atomic absorption spectroscopy and chemical methods. J. Sci. Food Agric. 17:344-348. 19 ref., 9 tab.

In a study by the collaborating National Agricultural Advisory Service laboratories, 244 soils were extracted with $1\underline{N}$ $CaCl_2$, Morgan's reagent, $1\underline{N}$ NH_4NO_3, $1\underline{N}$ NH_4OAc and $1\underline{N}$ $NH_4OAc/HOAc$. Mg was determined by AAS and a number of standard chemical methods. AAS was found to be rapid and reliable. It was distinctly superior for estimating low levels (deficiency levels in soils). In recovery experiments, recoveries of Mg added to extracts were $100 \pm 2\%$. Acidic extractants were unsatisfactory for calcareous soils (they gave higher results due to dissolution of free CO_3) except where a narrow soil to extraction solution ratio and a short shaking time were used.

450 Woolson, E.A., J.H. Axley, and P.C. Kearney. 1970. Soil calcium determination using a calcium-specific ion electrode. Soil Sci. 109:279-281. 10 ref., 1 tab., 1 fig.

A 4.00-g air-dry soil sample was shaken with 50 ml $0.5\underline{N}$ NaOAc (pH 8.2) in a 250 ml polyethylene centrifuge

bottle for 2 h. After centrifugation, 10.0 ml supernatant

solution was diluted to 100 ml. Ca was determined with a Ca-

specific ion electrode and AAS (Perkin-Elmer model 303). The

AAS results correlated highly (r = 0.99) with those of specific

electrode.

451 Wünsch, A. Von and K. Teicher. 1962. Über die bestimmung von Mg
in pflanzensubstanzen durch absorptions-flammenspektroskopie
(The determination of magnesium in plant material by atomic
absorption flame photometry). A. Pflanzenemaehr. Bodenkd. 97:
101-106. 16 ref., 2 tab., 1 fig.
    Mg can be determined accurately and rapidly in plant
material by AAS.

452 Wutscher, H.K. and E.O. Olson. 1970. Leaf nutrient levels, chlorosis,
and growth of young grapefruit trees on 16 rootstocks grown on
calcareous soil. J. Am. Soc. Hortic. Sci. 95:259-261. 11 ref.,
2 tab.

    Grapefruit trees on 16 rootstocks, including 8

hybrids, were studied on a calcareous soil (pH 8.4). Leaves

were collected and washed with a detergent. P was determined

colorimetrically, B by the method given by Dible et al. (Anal.

Chem. 1954. 26:418), Cl with a chloridometer, Na and K by

flame emission spectroscopy and Ca, Mg, Fe, Mn, Cu, and Zn by

AAS.

453 Yuan, T.L. and H.L. Breland. 1969. Evaluation of atomic absorption
methods for determinations of aluminum, iron, and silicon in
clay and soil extracts. Soil Sci. Soc. Am. Proc. 33:868-872.
12 ref., 6 tab., 5 fig.

    Fe and Al in $1\underline{N}$ NH_4OAc (pH 4.8) and $0.1\underline{N}$ HCl extracts, Fe

in $(NH_4)_2C_2O_4$ (pH 3.0), and citrate-bicarbonate buffered $Na_2S_2O_4$

extracts and Al and Si in 0.5N̲ NaOH extracts of clay and soil

(Quartzipsamments, Psammaquents, Haplumbrepts, Paleudults,

Ochraquults, and Haplaquods) were analyzed by Perkin-Elmer model

303 with a Model DCR digital concentration readout. Results were

compared by colorimetric methods or by calculating the recoveries

of added Fe, Al, and Si in the extracts. Highly significant

correlations and regressions were obtained between the two tech-

niques. The coefficients of variations for 10 determinations

were below 3% for Al, Fe, and Si (except for Si at less than 15

ppm and Fe less than 2 ppm). With AAS, the error caused by salt

accumulation in the burner was found to be considerable.

454   Zaugg, W.S. 1967. Determination of phosphate in fresh and sea water
      by atomic absorption spectrophotometry. Atom. Absorp. Newsl.
      6:63-65. 7 ref., 2 tab., 1 fig.

Use is made of the indirect determination of PO_4 by measuring

the absorption of Mo in phosphomolybdic acid. Organic solvent

was used for extraction. No interference occurs if concentration

of silicate is less than 0.35 mM (21 µg/ml as SiO_2) and that of

arsenate is less than 2.5 µM (0.19 µg/ml As). Perkin-Elmer model

303 was used to determine Mo (379.8 nm).

455   Zlatkis, A., W. Bruening, and E. Bayer. 1969. Determination of gold
      in natural waters at the parts per billion level by chelation and
      atomic absorption spectrometry. Anal. Chem. 41:1692-1695. 14
      ref., 7 tab.

The concentration step was done by chelation on a chromatographic

column containing a support coated with a polyschiff base. The

chelated form of Au was determined (243 mµ) by AAS after solvent

extraction with MIBK. Perkin-Elmer model 303 was used.

456 Zook, E.G., F.E. Greene, and E.R. Morris. 1970. Nutrient composition
        of selected wheats and wheat products. VI. Distribution of
        manganese, copper, nickel, zinc, magnesium, lead, tin, cadmium,
        chromium, and selenium as determined by atomic absorption spectro-
        scopy and colorimetry. Cereal Chem. 47:720-731. 8 ref., 7 tab.

        Mn, Cu, Ni, Zn, Mg, Pb, Sn, Cd, and Cr were determined by

    AAS in samples of (hard, soft, and durum) wheat and wheat products.

    Se was determined colorimetrically. Samples (about 55 g) were

    ashed overnight at 480°C in 100 ml Pt crucibles. Ash was treated

    with 6$\underline{N}$ HCl, dried and re-ashed overnight. HCl extracts were

    prepared. Jarrell-Ash AA unit was used.

457 Zunino, H., M. Caiozzi, P. Peirano, and M. Aguilera. 1970. Phosphate
        fixation in acidic soils derived from volcanic ash in Chile as
        influenced by the naturally occurring exchangeable cations.
        Agrochimica 14:557-564. 21 ref., 4 tab.

        Volcanic-ash derived soils were used to study phosphate

    fixation. To determine the nature and quantity of cations held

    by resin, soil-resin mixture was eluted with 6$\underline{N}$ HCl. The elute

    was analyzed for Ca and Mg by AAS (Perkin-Elmer 303), K by flame

    photometer and Al and Fe colorimetrically.

JOURNAL LIST

Serial titles were abbreviated according to "Biosis 1974 List of Serials" by Bio Sciences Information Service of Biological Abstracts, Philadelphia. The journal titles are listed in alphabetical order of the abbreviations. The following is the list of journals from which the references were taken. However, it does not include journals which were scanned but did not have relevent references.

Acta Agric. Scand.
Acta Agriculturae Scandinavica (Sweden)

Agrochimica
Agrochimica (Italy)

Agron. J.
Agronomy Journal (US)

Am. Ind. Hyg. Assoc. J.
American Industrial Hygiene Association Journal (US)

Analyst
Analyst (England)

Anal. Chim. Acta
Analytica Chimica Acta (US)

Anal. Biochem.
Analytical Biochemistry (US)

Anal. Chem.
Analytical Chemistry (US)

Anal. Lett.
Analytical Letters (US)

Ann. Agron.
Annales Agronomiques (France)

Appl. Spectrosc.
Applied Spectroscopy (US)

Arch. Forstw.
Archiv. Fuer Forstwesen (Germany)

Arch. Hyg. Bakteriol.
Archiv Fuer Hygiene und Bakteriologie (West Germany)

Atom. Absorp. Newsl.
Atomic Absorption Newsletter (US)

Aust. J. Agric. Res.
Australian Journal of Agricultural Research (Australia)

Aust. J. Biol. Sci.
Australian Journal of Biological Sciences (Australia)

Aust. J. Soil Res.
Australian Journal of Soil Research (Australia)

Biochem. Biophys. Res. Commun.
Biochemical and Biophysical Research Communications (US)

Bot. Gaz.
Botanical Gazette (US)

Br. J. Nutr.
British Journal of Nutrition (England)

Bull. Chem. Soc. Jpn.
Bulletin of the Chemical Society of Japan (Japan)

Can. Dep. Fish. For., Can. For. Serv. Inf. Rep.
Canadian Department of Fisheries and Forestry, Canadian Forestry Service
Information Report (Canada)

Can. J. Anim. Sci.
Canadian Journal of Animal Science (Canada)

Can. J. Plant Sci.
Canadian Journal of Plant Science (Canada)

Can. J. Soil Sci.
Canadian Journal of Soil Science (Canada)

Cereal Chem.
Cereal Chemistry (US)

Chem. Geol.
Chemical Geology (Netherlands)

Chem. Listy
Chemicke Listy (Czechoslovakia)

Chim. Anal.
Chimie Analytique (France)

Crop Sci.
Crop Science (US)

Curr. Sci.
Current Science (India)

Deep-Sea Res.
Deep-Sea Research (England)

Ecology
Ecology (US)

Econ. Geol.
Economic Geology (US)

Effluent Water Treat. J.
Effluent and Water Treatment Journal (England)

Environ. Sci. Technol.
Environmental Science and Technology (US)

Experientia
Experientia (Switzerland)

Food Eng.
Food Engineering (US)

For. Chron.
Forestry Chronicle (Canada)

Geochim. Cosmochim. Acta
Geochimica et Cosmochimica Acta   (England)

Geoderma
Geoderma (Netherlands)

Geol. Surv. Water-Supp. Pap
Geological Survey Water-Supply Paper (US)

Inl. Waters Br., Dep. Energy Mines Resour. Tech. Bull.
Inland Waters Branch, Department of Energy Mines and Resources, Technical
Bulletin (Canada)

Instrum. News
Instrument News   (US)

Int. Congr. Soil Sci.
International Congress of Soil Science (US)

J. Agric. Food Chem.
Journal of Agricultural and Food Chemistry (US)

J. Agric. Sci., Camb.
Journal of Agricultural Science (England)

J. Am. Soc. Hortic. Sci.
Journal of the American Society for Horticultural Science   (US)

J. Am. Soc. Sugar Beet Technol.
Journal of the American Society of Sugar Beet Technologists   (US)

J. Am. Water Works Assoc.
Journal of the American Water Works Association   (US)

J. Assoc. Off. Anal. Chem.
Journal of the Association of Official Analytical Chemists   (US)

J. Appl. Meteorol.
Journal of Applied Meteorlogy   (US)

J. Chem. Soc. Jpn.
Journal of the Chemical Society of Japan   (Japan)

J. Chronic Dis.
Journal of Chronic Diseases   (US)

J. Dairy Sci.
Journal of Dairy Science   (US)

J. Food Sci.
Journal of Food Science (US)

J. Food Technol.
Journal of Food Technology   (England)

J. Geophys. Res.
Journal of Geophysical Research   (US)

J. Inst. Wood Sci.
Journal of the Institute of Wood Science   (England)

J. Sci. Food Agric.
Journal of the Science of Food and Agriculture   (England.)

J. Soil Sci.
Journal of Soil Science   (England)

J. Water Pollut. Control Fed.
Journal Water Pollution Control Federation   (US)

Lab. Pract.
Laboratory Practice   (England)

Limnol. Oceanogr.
Limonology and Oceanography   (US)

Mar. Geol.
Marine Geology   (Netherlands)

Mikrochim. Acta
Mikrochimica Acta   (Austria)

Nature
Nature   (England)

Nat. Can. (Que.)
Naturaliste canadien (Que.) (Canada)

N.Z.J. Agric. Res.
New Zealand Journal of Agricultural Research (New Zealand)

N.Z.J. Sci.
New Zealand Journal of Science   (New Zealand)

Plant Physiol.
Plant Physiology (US)

Plant Soil
Plant and Soil   (Netherlands)

Planta
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Proc. Am. Power Conf.
Proceedings of the American Power Conference (US)

Proc. Soc. Anal. Chem.
Proceedings of the Society for Analytical Chemistry (England)

Queensl. J. Agric. Anim. Sci.
Queensland Journal of Agricultural and Animal Sciences (Australia)

Science
Science   (US)

Sensing Environ. Poll. Joint Conf.
Sensing of Environmental Pollutants Joint Conference   (US)

Soil Sci.
Soil Science (US)

Soil Sci. Soc. Am. Proc.
Soil Science Society of America Proceedings   (US)

Sov. Soil Sci.
Soviet Soil Science   (English Translation - US)

Spectrochim. Acta
Spectrochimica Acta   (N. Ireland)

Talanta
Talanta (US)

Technicon Int. Congr. Adv. Aut. Anal.
Technicon International Congress, Advances in Automated Analysis   (US)

Technicon Symp. Aut. Anal. Chem.
Technicon Symposium, Automation in Analytical Chemistry   (US)

Technology
Technology (India)

Trans. Inst. Mining Met.
Transactions of the Institution of Mining and Metallurgy (England)

U.S. Geol. Surv. Prof. Pap.
U.S. Geological Survey Professional Paper (US)

Water Resour. Res.
Water Resources Research (US)

Z. Anal. Chem.
Zeitschrift Für Analytische Chemie (Germany)

Z. Pflanzenernaehr. Bodenkd.
Zeitschrift Für Pflanzenernaehrung und Bodenkunde (West Germany)

Zh. Analit. Khim.
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PLANT

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APPENDIX

Applications of atomic absorption spectrophotometry in soil,

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☐ Addition

☐ Correction

☐ Comment

Details: _____

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