gave a reddish luminescence when shaken in neon and some colorless triboluminescence also.

Longchambon[2] has observed the bands of nitrogen in triboluminescent sugar in air, and Wick,[3] in a thorough investigation of the general phenomena of triboluminescence, finds no triboluminescence of sugar when ground under xylol in a mortar. Both observations would indicate that sugar triboluminescence is mostly due to electric discharge in air. I have observed triboluminescence of sugar broken under various solvents, and additional experiments have led me to the belief that sugar molecules themselves can be excited to luminesce.

If a necco wafer with a wintergreen flavor is broken in a pure hydrogen atmosphere, in a vacuum (some air present, about 0.05 mm Hg) or in 10 to 20 mm neon there is always the greenish flash of light, of about the same intensity as in air. No red excitation of the neon occurs. Necco wafers and lump sugar will also luminesce if broken under water, 95 per cent. alcohol, acetone, toluol and xylol. Indeed, if soaked in alcohol, acetone, toluol or in xylol exhausted with an air pump for 5 minutes, to displace air between the sugar crystals, and then ground in a mortar, a triboluminescence appears in all solvents, brightest in the xylol and toluol and less marked in the acetone. I am therefore of the opinion that true triboluminescence of sugar (*i.e.*, excitation of luminescence in the sugar molecule) can occur as well as electrical discharges in the gas between sugar crystals. The reason the wintergreen-flavored necco wafer is particularly bright is because oil of wintergreen (methyl salicylate) is fluorescent and (1) excited to fluoresce by the triboluminescent light or (2) by electrical discharges when the wafer is broken. In ultra-violet light without the visible (mercury arc and Wood's filter), the wintergreen necco wafer is markedly bluish fluorescent, while lump sugar is practically non-fluorescent. The fluorescence of the wintergreen oil would add itself to the triboluminescence of the sugar when a necco wafer is broken.

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HEPARIN AND THE INHIBITION OF BLOOD-CLOTTING

IN 1936 Fischer,[1] using a purified fibrinogen solution, showed that the clotting of this solution with calcium chloride and thrombokinase was not inhibited by even great concentrations of heparin. Inhibition only occurred after the addition of minute amounts of serium or plasma (fresh or heated to 56° C.). He offered no definite explanation to these experimental results.

Experiments, performed to obtain further information on this process and which are to be published soon, have now shown: (1) The method used by Fischer in purifying the fibrinogen is not very reliable in obtaining a fibrinogen free from prothrombin. A pure prothrombin-free fibrinogen does not clot by the addition of calcium chloride and thrombokinase; (2) solutions containing purified fibrinogen and prothrombin, together with $CaCl_2$, clot readily by the addition of thrombokinase. On this process heparin is without any inhibitory action; (3) plasma and serum contain substances which are necessary for the inhibitory action of heparin.

Heparin alone is thus without any activity against the clotting process, and the activity is due to the presence, together with heparin, of yet unknown substances present in serum and plasma. These experiments thus confirm the recent work of Brinkhous, Smith, Warner and Seegers,[2] and it seems worth while to note such simultaneous and independent, but identical, new results, since this has not happened very often in the history of blood coagulation. The literature concerning this subject is for the most part confused by controversial statements.

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BORON AS A FERTILIZER FOR WESTERN OREGON SOILS

DURING the past decade studies have been conducted by the Oregon Experiment Station Soil Department with the aid of federal Adams funds to determine the value of the so-called minor elements in Oregon soil fertility and plant nutrition. Positive results have been secured with iodine, manganese, copper, zinc and boron. Response from iodine has been secured on Aiken silty clay loam and Deschutes sandy loam. Manganese and zinc have increased yields of certain crops on western Oregon peat. Copper has caused response with soils from the John Day and Illinois Valleys, while boron has been effective on most of the soil types used for alfalfa in northwestern Oregon.

Boron was shown to be essential to normal development of broad beans by Warrington in England in 1923. Boron has been used to control "top sickness" of tobacco, "brown heart" in turnips, "cork spot" in apples, "yellow top" in alfalfa and "crown rot" or "heart rot" of sugar beets, especially on soils of basic reaction. In the Pacific Northwest old soils, leachy soils or those derived from basaltic rocks seem more apt to be deficient in boron. Some unhealthiness in various plants formerly attributed to virus may be due to lack of boron. Soil reaction or lime and moisture

[2] *C. R. Ac. Sc.* 174: 1633, 1922; 176: 691, 1923.
[3] *Jour. Opt. Soc. Amer.*, 27: 275, 1937.
[1] A. Fischer, *Enzymologia*, 1: 81, 1936.
[2] K. M. Brinkhous, H. P. Smith, E. D. Warner and W. H. Seegers, *Am. Jour. Physiol.*, 125: 683, 1939.

contents, perhaps also temperature, may affect availability of boron.

In Oregon, recent experiments by the writer have demonstrated that yellow top of alfalfa can be controlled and yield strikingly increased on various soils by use of 30 pounds of boric acid an acre. Normal color was restored in the field within thirty days and with controlled conditions in the greenhouse within a few days. Bronzing and blighting of tops has been prevented and branching promoted.

Yellow top of alfalfa develops mainly under droughty conditions, although poor drainage may also lessen availability of boron. New leaves near the top of the stem become bronzed and then yellowish and tend to shatter off. The terminal bud and the blossoms may develop a blighted appearance. Application of boric acid or borax causes a lush green growth with branching of stems and, apparently, longevity of the alfalfa stand is promoted.

Boric acid has been used periodically in our experimental culture solutions for a decade to overcome a certain type of chlorosis or yellowing of foliage. One-half part per million has proven sufficient and may safely be used. The injurious effect of an excess is difficult to distinguish from that of a deficiency.

Chemical analyses of water, plant and soil profiles collected by the writer and made in our laboratories or by the U. S. Department of Agriculture show unfavorably low boron content in soils, waters and plants from affected areas. The use of boron to correct malnutrition has doubled boron content of plants, has slightly affected protein content and raised chlorophyll content 50 per cent. Boron content by the acid digestion method has ranged from 1½ part per million for peat to 7 parts per million for Willamette silty clay loam and is fairly uniform throughout the soil profile, though perhaps more available in the surface soil.

During the past three seasons in two dozen trials, use of boron on northwestern Oregon soils has controlled yellow top of alfalfa and trebled the yield for dry weather cuttings. Boron promises to be as profitable for western Oregon alfalfa land as sulfur has been in eastern Oregon. Similar symptoms have been observed and corrected on clovers and grasses.

Surface canker or "breakdown" of table beets has been controlled in the plant house and field in our experiments the past year perhaps for the first time. Canker caused rejection of whole fields of the 1937 crop.

Celery stem crack has been more completely controlled in field trials by Professor A. G. B. Bouquet and the writer where early applications were made. Assistance was given in treating some six acres.

Symptoms of boron "deficiency" disease, such as bronzing of tops and cracking at the nodes (or joints) with asters, broccoli and cabbage have led to boron applications to soil about these plants with promising results.

INDICATED EFFECTS OF BORON

(1) Boron may aid in the development of nodules on legumes.

(2) Apparently it is necessary for maintenance of elasticity and good condition of the conducting tissues and growing tip of the stem.

(3) It is apparently necessary for proper cell division and to the growing tip.

(4) Lettuce develops improperly in the absence of boron.

(5) May control nutritional deficiency diseases such as "heart rot" or surface "canker" of beets, "yellow top" of alfalfa and "stem crack" of celery.

(6) May aid availability of iron or of moisture.

(7) Boron may promote longevity and branching of alfalfa.

(8) Boron seems to improve keeping quality of apples.

There is less evidence of any deficiency of boron in eastern Oregon unless on neutral soils with rapid drainage. At the Hood River field station drought spot has been controlled with borax, and keeping quality of apples grown on Milton gravelly loam is reported by O. T. McWhorter to be improved. Use of boron with zinc is reported by Stephenson and Schuster to have been more effective in correction of little leaf of stone fruit trees near The Dalles.

While chemically pure boric acid was applied in dilute solution with a garden sprinkler in early, controlled experiments, the use of ordinary borax is usually cheaper for field use and will give similar results (unless on soils of basic reaction) if applied evenly and very early in the season. The boron treatment has been found to carry into the third season. Thirty pounds of borax may be evenly mixed with an equal amount of sandy loam or uniformly mixed with superphosphate or other fertilizer to dilute and aid evenness of application over each acre. The granular form has been successfully sown, as is clover seed. Slight temporary toxicity has followed application of 40 pounds of boric acid an acre to grass. Two pounds boric acid contain approximately as much of the element boron as does three pounds of borax. Borax may be secured of wholesale druggists or certain fertilizer dealers in Portland at about $3.25 per 100-pound bag. Several tons have been applied to western Oregon soils this 1939 season. It appears possible to increase the annual crop value in Willamette Valley at least $100,000 a year by the use of borax as fertilizer.

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