doses of streptococci are ineffective in the presence of sufficient numbers of mononuclear cells alone, this resistance is still further enhanced to protection against some ten thousand doses if the streptococci are previously treated with immune serum. Such sensitization of the bacteria, however, does not suffice to afford protection in any degree to the normal animal or even when much larger amounts of immune serum are used.

Our suggestion, then, is that antibacterial serums fail to cure not through the absence of suitable or adequate amounts of antagonistic substances (tropins) but through the absence in the recipient of sufficient numbers of mononuclear cells necessary to accomplish the destruction of the tropinized bacteria. There is further evidence, which can not be recapitulated at this time, that the actively immunized animal varies from the normal animal in the rapidity with which mononuclear cells are mobilized at the point of inoculation, as is indicated by the work of Stuppy, Cannon and Falk, by certain types of local immune reactions and by the study of the conditions of local immunity. Furthermore, in spite of the fact that in the extensive studies of phagocytosis by polymorphonuclears it has been generally accepted that these cells do not differ in the immune animal from their originals in the normal animal, we believe that a study of the qualitative reactivity of the macrophages in the immune animal is indicated. It may well be that not only are mononuclear cells in sufficient number necessary, but that mononuclear cells of an actively immune animal are required to insure passive immunity. Either variety of cells could certainly be supplied from homologous or possibly heterologous animals, and the hypothesis here stated is at least capable of experimental study, whatever the practical outcome in serum therapy may be. Experiments along this line are actively in course.

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## THE COMPOSITION OF PECULIAR CLINKERS FOUND IN SNAGS AFTER FOREST FIRES

CONSIDERABLE interest is being shown by the personnel of the U. S. Forest Service over the occasional finding of peculiar rock-like clinkers in hollow snags which are sometimes left after a forest has been burned over. These clinkers usually have a greenish tint and by some people are thought to be of meteoric origin and responsible for the starting of certain forest fires. While this theory of their origin seemed improbable there was still a general feeling that the presence of the clinker material might be associated with hold-over fires, and a definite knowledge of their composition was desired. The matter was referred to us by Dr. Raymond Kienholz, of the department of botany at the University of Illinois, and all samples analyzed by us were collected by him while he was engaged in forest research work in the northwest. A fuller account of the finding of these clinkers with respect to geographic distribution, forest species and fungal action will be reported later by Dr. Kienholz in the *Journal of Forestry*.

Samples I and II were found on the Kaniksu National Forest near Priest Lake in northern Idaho. Sample III was from the Wind River country of southern Washington, as was also the sample of sound wood. All were taken from the western hemlock (*Tsuga heterophylla*).

The results of the analyses are given in the following table.

CHEMICAL COMPOSITION OF THE CLINKERS AND ASH OF SOUND WOOD

| Constituent | Percentage of constituent | | | |
|---|---|---|---|---|
| | Clinker I | Clinker II | Clinker III | Sound wood |
| Crude $SiO_2$ | .32 | .38 | .41 | |
| $P_2O_5$ | 6.96 | 6.58 | 5.47 | .0227 |
| $R_2O_3$ ($Fe_2O_3$) ($Al_2O_3$) | 1.68 | .99 | .34 | .0096 |
| $SO_3$ | Trace | Trace | .67 | |
| Cl | Trace | Trace | Trace | |
| CaO | 22.02 | 21.90 | 21.79 | .0424 |
| MgO | 6.28 | 4.48 | 4.06 | .0226 |
| $Mn_3O_4$ | 1.21 | 1.32 | 7.17 | .0252 |
| $K_2O$ | 25.01 | 24.54 | 30.42 | .0750 |
| $Na_2O$ | 5.31 | 2.06 | 4.20 | .0173 |
| $CO_2$ | 19.76 | 25.47 | | |
| Total | 88.35 | 87.72 | 74.47 | .2148 |
| Difference (including $H_2O$, carbon, etc.) | 11.65 | 12.28 | 25.53 (incl. $CO_2$) | |

An examination of the table shows that the clinkers are all of quite similar composition. This is especially true of the two from the same locality. Very little data on the complete analysis of ash of American woods is available for the comparison of composition, but rather wide variation would be expected. The species, section of the tree from which the wood was taken, locality in which the tree was grown, and other factors would have a marked influence. If the ratio of each other constituent to $K_2O$ be calculated for clinker III and the ash of the sound wood from the same locality a very close analogy of composition will be observed.

There is no justification for the assumption that the clinkers are of meteoric origin.

Their greenish tint is due to manganese in the manganate state. Although the manganese content of Sample III is much greater than that of either of the other samples, it is not unusual. Various investigators[1] report quantities of $Mn_3O_4$ which range from less than 1 per cent. to over 40 per cent. of the pure ash of the wood.

The peculiar rock-like character of the clinkers is probably due to the collection of a large quantity of the ash in the hollow snag, followed by occasional wetting from rain and finally a fusion of the mass during a later vigorous burning of the surrounding wood. It is doubtful if any chemical action due to the clinker would be capable of causing ignition of a snag and a rekindling of a fire. The formation of the clinkers is probably incidental to hold-over fires.

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## THE EFFECT OF X-RAYS ON POTATO TUBERS FOR "SEED"[1]

IN view of the recent article by Johnson[2] on increased tuberization of potatoes caused by X-rays, it may be worth while to report results of a similar experiment in which the findings were contrary to those indicated above. Certified "seed" of both Irish Cobbler and Green Mountain varieties was used, and two dosages of X-rays were employed.

One half of each tuber was irradiated and the other half was left untreated as a control. One lot of half tubers was irradiated for ten minutes and a second lot for five minutes, using a Waite and Bartlett machine, 200 K.V., 4 M.A., distance 50 cm, field 20 x 20, filter 1 mm al., *i.e.*, in human, erythema dosage 10-min. = 2 E.D., 5-min. = 1 E.D. The tubers were placed with the cut side down and sprouts up when irradiated. Sprouts were just beginning to develop at the time of exposure and the tubers were planted in the field on the following day. Each "seed" piece was cut to a weight of thirty grams using the "bud" end, and the pieces were spaced nine inches in the row. The corresponding treated and untreated pieces were planted in adjoining rows thirty-two inches apart. The soil used was Sassafras sandy loam of good fertility, and a 5–8–7 fertilizer was used at the rate of 1,000 pounds per acre. Ordinary tillage was practiced and the plants were dusted periodically with lead arsenate to control the potato beetle. The crop was harvested by hills after the vines were dead, and each tuber was weighed separately.

Plants from the lot of tubers receiving the ten-minute exposure produced only 84.4 per cent. as many tubers of all sizes as the untreated controls, and only 89.6 per cent. as many tubers weighing over forty-five grams each. Although the total weight of all tubers was reduced 6.0 per cent. by the treatment, the total weight of tubers weighing over forty-five grams each was increased 6.1 per cent. The average weight per tuber of marketable stock (over forty-five grams per tuber) was 81.6 grams for the lot irradiated ten minutes, as compared with 68.9 grams for the untreated lot.

Plants from the lot of tubers irradiated five minutes produced 104.7 per cent. as many tubers of all sizes as the controls; and 105.1 per cent. as many tubers weighing over forty-five grams each. The total weight of all tubers was increased 3.0 per cent. by the treatment, and the total weight of marketable tubers was increased 3.8 per cent. The average weight per tuber of marketable stock was 74.7 grams for the lot treated five minutes, as compared with 73.7 grams for the corresponding untreated lot.

The ten-minute irradiation caused the first leaves of the plants to assume a peculiar shape. The leaf tips appeared to have been injured and the blade was pinched-in as it approached these lesions. The margins of the leaf curled downward, and the leaf in general seemed to be somewhat more glossy than normal leaves. Subsequent leaves of these plants were normal. After formation of normal leaves the plants were vigorous, and remained green several days later than untreated plants at time of maturity. No striking abnormalities resulting from irradiation were noted in the harvested tubers. Irradiation for five minutes produced no apparent modification of plants or tubers.

These results indicate that strong dosages which cause definite lesions on leaves may also reduce the number of tubers formed; but such tubers may attain a greater size, so that yields of marketable stock are not lowered. It seems likely that still stronger dosages may reduce tuberization still further, and perhaps the yield of marketable stock as well. Further experiments of this nature are being planned.

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[1] Czapek, "Biochemie der Pflanzen," II, 411, 1920.

[1] Journal Series paper of the New Jersey Agricultural Experiment Station, department of agronomy.

[2] E. L. Johnson, "Tuberization of Potatoes Increased by X-rays," SCIENCE, 68: 231, 1928.