and dried further to constant weight at 105–110° C. Following a chemical analysis for total silica, according to the method described by Sweany, Porsche and Douglass,[1] very thin samples (0.2–0.3 mm in thickness) were subjected to diffraction analysis. The x-ray beam, collimated by two 0.020-inch pinholes, was supplied by a Philips-Metalix tube with a copper target, operating at 20 ma. under an applied potential of 27KVP. The use of thin specimens necessitated exposure times as long as 14 hours, but it was found that with this type of sample, the large amount of organic material present did not mask the pattern of the inorganic constituents. The effect of the tissue was noted in the scattering near the central spot and in the broad halo 3.6 cm in diameter (5.0 cm plate to specimen distance).

In the case of a lead and zinc miner, who had been exposed to silica dust for 40 years and who died of silicotuberculosis, the chemical analysis of the dry lung tissue showed a silica content of 0.90 per cent. (ash 5.38 per cent.), and the diffraction pattern showed very distinctly the characteristic 3.34 A. U. spacing of quartz. Likewise, the lung tissue (silica 1.02 per cent., ash 13.32 per cent.) of a rock miner, who had been exposed to dust for a period of 18 years and who died 8 years later of silicotuberculosis, gave an x-ray diffraction pattern on which this quartz spacing, in addition to numerous other lines, was clearly discernible. In marked contrast to the above is the case of a 72-year old man who had farmed all his life. The lungs showed multiple healed nodular calcifications. Although the silica content was 0.63 per cent. (ash 13.72 per cent.), there were no pathologic evidences of silicosis. In the x-ray diffraction pattern there were several lines closely resembling those given by a typical tuberculous calcification, but the 3.34 A. U. line of quartz was absent. Hence, we may conclude that quartz was not present in any appreciable quantity and that the silica indicated by the chemical analysis was probably largely derived from silicates. Here, then, is a possible explanation of the fact that no silicotic condition existed, even though the silica content was about six times that of normal lung tissue and three times the amount that usually produces silicosis.

In the study thus far it has been possible to detect quartz in lung tissue containing as small an amount as 0.26 per cent. silica. Further refinements of technique incorporating the application of the recently reported monochromators may permit the detection of even smaller amounts. Quantitative studies based upon the method of Clark and Reynolds,[2] suitably modified to avoid the effects of the organic material, are in progress.

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[1] Sweany, Porsche, Douglass, *Arch. Path.*, 22: 593–633, 1936.

[2] Clark and Reynolds, *Ind. and Eng. Chem., Anal. Ed.*, 8: 36, 1936.

## PROLONGED SURVIVAL OF ADRENALECTOMIZED RATS TREATED WITH SERA FROM CUSHING'S DISEASE[1]

IN the latest issue of *Endocrinology* (November, 1937) McQuarrie, Johnson and Ziegler[2] present data on the electrolyte balance in the blood of a patient with Cushing's disease which lends support to the view that this disease is essentially a state of hyperfunction of the adrenal cortex. This evidence upholds the contention of Bauer,[3] held since 1933, that Cushing's disease is primarily the result of a hyperfunction of the adrenal cortex—so much so that he prefers to call the disease "Interrenalismus." Most of those who have written on phases of Cushing's disease have, however, clung to the original hypothesis of Cushing that the primary site of the disease is in the basophil cells of the pituitary.

McQuarrie and his associates demonstrated admirably how Cushing's disease is the direct opposite of Addison's disease from the point of view of clinical signs, electrolyte balance and response to therapeusis. We were independently led to the same conception of the syndrome and have hence treated two patients with Cushing's disease with a regimen of high potassium and low sodium (patients with Addison's disease are given low potassium and high sodium diets) and with x-ray therapy to the adrenals—a treatment to which one of the patients responded in a gratifying manner. Furthermore, it seemed reasonable to suspect the presence of an overabundance of adrenal cortical hormone as being the means by which the syndrome was called forth. Accordingly, under the conditions of experiment outlined below, the sera of the two patients were injected into adrenalectomized rats. The survival periods of these rats were longer than those similarly adrenalectomized and injected with the serum of normal individuals.

It should be pointed out that both patients under discussion showed the classical signs of Cushing's disease. There was obesity of facial, shoulder and trunk distribution, relatively sudden gain of weight of fifty

[1] Aided by grants from the Board of Research of the University of California and the Rockefeller Foundation of New York City.

[2] I. McQuarrie, R. M. Johnson and M. R. Ziegler, *Endocrinology*, 21: 762, 1937.

[3] J. Bauer, *Klin. Wschr.*, 12: 1553, 1933.

pounds in each of them, amenorrhea in the female and impotence in the male, hirsutism in the female and change in the texture and color of the hair in the male, purplish abdominal *lineae striae,* hypertension, plethora, polycythemia and osteoporosis.

Rats 23 to 25 days of age were used for the experiment. They were adrenalectomized by the usual method and placed on a diet of fresh white bread and tap water. In all, seven groups of animals were adrenalectomized and of these some remained uninjected, others picked at random were injected with sera of normal individuals, while the remaining were injected with the serum of each of the patients with Cushing's disease. Injection was started in the majority of rats on the sixth or seventh day, when one or two of that group had died and the remaining animals showed signs of adrenal insufficiency.

The blood was collected from both patients under sterile conditions and the serum was kept frozen. Hexylresorcinol as preservative could not be used, since it appeared to be highly toxic. Also hemolyzed blood had to be in large part discarded because of its toxicity. Even when caution was taken against these factors, human serum seemed toxic to the rats, in light of the observation that with injection of 1 cc of serum the rats died within 12 hours, whereas the uninjected controls remained living. Therefore the dosage of serum administered was from 0.2 to 0.4 cc intraperitoneally twice a day.

The uninjected control group consisting of 13 rats survived for a period, the median of which was 8.3 days. The 14 receiving normal human serum survived for a period of 8 to 13 days, a median of 10.7 days. Two died on the 13th day, one on the 12th, one on the 10th, one on the 9th, two on the 8th and the remaining 7 on the 11th day. The group injected with the serum of Patient B, consisting of 13 rats, died at a median of 14.0 days, 5 having died prematurely due to infection or accident. Two of these survived 19 days, three 17 days, one 15 days, one 14 days, one 12 days, three 11 days and the remaining two 10 days. Of the group of 7 animals injected with the serum of Patient C, two survived 18 days, two 17 days, one 16 days, one 12 days and one 11 days, with a common median for the group of 15.6.

It would appear that the lengthened survival period of completely adrenalectomized animals may be taken as indicative of the presence in these sera of a substance resembling the adrenal cortical hormone.

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## THE POTASSIUM CONTENT OF SOIL BENEATH A STRAW MULCH

THERE are three prevalent types of soil management in American apple orchards. Tillage predominates in some sections, sod land with perhaps an occasional discing in others, and to a much more limited extent the mulch system is used. In the latter case the land is kept permanently in a sod (usually of nonlegumes) and straw or other material is spread beneath the branches as a mulch. This mulch is renewed from time to time so that there is practically no growth of grasses within the periphery of the area occupied by each tree.

The mulch system was at first condemned as unsound, and dire predictions were made as to the consequences. But after some forty years of continuous mulch such trees are thrifty, productive, and show no signs of deterioration beyond that shown by trees of similar age grown under other systems of culture.

In some of the fruit regions of the United States and Canada the need of other elements than nitrogen, particularly potassium, has become apparent and in many other sections the question of their need has been raised. Without discussing this somewhat controversial question as such, it may be of interest to report the potassium situation in orchards at the Ohio Agricultural Experiment Station, Wooster, under different systems of culture.

In the orchard area as a whole it was found that potassium is very low. The foliage in certain sections has shown a characteristic scorch that is usually associated with K deficiency, for several years. But when potassic salts were applied the potassium was "fixed" in the surface soil and failed to move downward into the root zone of the trees even after ten years of treatment. This had frequently been shown by others[1] and presents a serious problem of supplying trees with this element.

Since the potassium in plant material is largely water soluble it became a matter of inquiry as to whether the leachings of the straw and other mulch materials had accumulated in the surface of the soil where the superficial roots might absorb it. Preliminary "quick tests" were made by using the Thornton method,[2] and they showed to our surprise that available potassium was very high for two to three feet beneath the mulch. It was also shown that potassium was present in any considerable amount only in the first few inches of soil beneath the surface in the adja-

[1] J. T. Way, *Jour. Roy. Agr. Soc.,* 11: 313–379, 1850; F. E. Bear, "Theory and Practice in the Use of Fertilizers." John Wiley and Sons, pp. 215–217, 1929; J. S. Joffe and L. Kolodny, SCIENCE, 84: 2175, Sept. 4, 1936.

[2] S. F. Thornton, S. D. Conner and R. R. Fraser, Purdue Univ. Agr. Exp. Sta. Cir. 204. Rev. August, 1936.