rence of the eczema. One month after discontinuance of treatment the iodine number was found to be 97 and 2 weeks later still it was 112, the skin remaining clear. The patient was discharged from the hospital in good condition. Ten days later she returned with a marked generalized eruption and the iodine number determined at the height of eruption was 83.

The tentative conclusion drawn from these preliminary studies is that the mechanism by which external application of crude coal tar effects healing in infantile eczema has much in common with that observed when oils containing unsaturated fatty acids are fed. In both instances clinical improvement is accompanied or preceded by a return of the iodine number of the serum fatty acids from subnormal to normal levels.

7041 P

Adrenal Insufficiency and Capacity for Sustained Work Output.

D. J. INGLE. (Introduced by F. H. Scott.)

From the Psychological Laboratories, University of Minnesota.

During the past 2 years the writer has been investigating work output of adrenalectomized rats with the object of evaluating work capacity as a criterion of adrenal cortex insufficiency. Other questions which we hope to answer are: is the medulla necessary to maintain capacity for normal work? will the injection of extracts completely replace the rôle of the normally functioning cortex? and, is nervous innervation necessary for the normal secretory activity of the cortex? Several findings seem to be reliably established and to deserve report.

We have previously made a brief report on methods.[1] The gastrocnemius muscle of an intact animal is loaded with 100 gm. and is forced to contract 3 times per second by faradic stimulation. The animal is anesthetized with sodium luminal. Our setup allows temperature and humidity control. Four animals may be worked simultaneously, the electrodes to each animal being connected in series allowing the same impulse to stimulate each animal. Automatic recording devices are used. Each animal receives 5 cc. of a 10% dextrose solution through subcutaneous injection every 6

[1] Heron, W. T., Ingle, D. J., and Hales, W. M., *Science*, 1932, **76**, 550.

hours. Under these conditions normal animals may be relied upon to work continuously with only a small decrease, if any, in rate of energy output for a minimum of 5 days. By administration of large amounts of dextrose and some protein we have been able to extend the length of minimum work period to 11 days.

Of 35 adrenalectomized animals kept under optimum living conditions 32 died in an average time of 15 days with a range of 4 to 30 days. For 30 adrenalectomized animals which were worked immediately following operation complete "fatigue" took place in an average time of 15 hours with a range of 4 to 33 hours. These animals succumbed in an average time of 2 hours following "fatigue". The 3 animals from the first mentioned group which had survived adrenalectomy for an excess of 30 days and who were normal in weight, appearance, and behavior all "fatigued" and died within 20 hours after beginning work. From this observation and the additional one that control animals subjected to severe sham operations work and survive as normals we regard the effect of operation itself as of small consequence. It was definitely established that maintenance of anesthesia was a most important factor along with work performance in bringing about this rapid manifestation of adrenal insufficiency.

Administration of an adrenal cortex extract prepared by E. C. Kendall* gave striking results. Small doses were effective in prolonging the survival period and increasing the amount of work done. It was possible to bring about temporary recovery from complete "fatigue". Large doses (½ cc. every 6 hours) given to an animal whose work period began immediately following operation prolonged the period of muscular contraction to 145 hours and the survival period to 147 hours. Although the work done was somewhat less than that accomplished by any normal animal, this survival period compares favorably with that expected of a normal animal under these conditions. With further experimentation on dosage we hope to evaluate adequately the capacity of such cortex hormone preparations to maintain a normal energy output in adrenalectomized rats.

The writer has had consistent success in making autoplastic grafts of the adrenals to ovaries in females and he has been only slightly less successful with similar transplants to the spleen in males. These animals gain weight normally and survive indefinitely while their controls died in each case within 30 days. Most significant is the finding that they work normally. Histological examination of the

* It is a pleasure to acknowledge my indebtedness to Doctor Kendall for the material supplied to me in this work.

grafts reveals normal cortex tissue. Adequate evaluation of the condition of the medulla has not yet been made but the indications are that it has degenerated. Since it is highly improbable that such grafts would reestablish nerve connections, it appears that nervous innervation is not necessary for a normal secretory activity of the cortex. Also, since the medulla has been shown to be non-functional when denervated we assume that it could have played no part in maintaining the normality of these animals.

7042 C

Relation of Resistance and Allergy in Tuberculosis as Shown by Vaccinating Rabbits with B. C. G.

B. J. CLAWSON.

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Resistance. Resistance to a subsequent inoculation of a virulent bovine strain of the tubercle bacillus was developed by vaccinating with B. C. G. Four rabbits were inoculated at 4 weekly intervals with 1 mg. of B. C. G. in 1 cc. of salt solution in each of the following methods: (1) living organisms, subcutaneously; (2) living organisms, intravenously; (3) heat killed (60° C. for 30 minutes) organisms, subcutaneously; and (4) heat killed organisms, intravenously.

The basis of the 4 methods of administering the vaccine was suggested by previous experiments with streptococcic vaccination in which it was found that the intravenous method of giving the vaccine was superior to the subcutaneous method in developing resistance and in not producing allergy. This was true with both living and heat-killed organisms.

Three weeks after the last injection of the B. C. G. vaccine, 9 nonvaccinated rabbits, 4 rabbits vaccinated intravenously with the timothy grass bacillus, and the 16 rabbits vaccinated with B. C. G. were inoculated intravenously with 0.01 mg. of virulent bovine tubercle bacilli. The length of life following the injection of the virulent strain and the degree of involvement, if tuberculous lesions were present, were compared in the nonvaccinated and vaccinated injected animals.

The 9 nonvaccinated rabbits died with extensive pulmonary and generalized tuberculosis, 27, 30, 31, 36, 44, 54, 71, 76, and 97 days