However, defects in visual acuity do not occur in consequence of cortical extirpations if animals are tested with lines which cover most of the visual field and which are spaced at the proper intervals in the field of vision. The visual acuity of the operated cats in responding to alternate black and white stripes under these conditions is at least 11 minutes of arc, the maximum acuity which could be measured by the different patterns used in this part of the experiment.

More adequate determination of threshold acuity of the cats was provided by the use of the separated black or white striations, which were spaced at distances of 2.5 cm on the rotating cylinder. The visual acuity of the operated animals in responding to white stripes was found to be 0.5 to 0.7 minutes of arc, whereas for the black lines the acuity of vision was determined to be between 4.1 and 8.2 minutes of arc. The visual acuity of normal cats is approximately equal to that found in the operated animals, both when measured by the method here described and when determined in a discrimination set-up.[4]

The high degree of visual acuity which the operated animals display in responding to complex patterns moving across the visual field is a matter of spatial summation of impulses in subcortical optic centers, for the responses do not occur with single lines or to stripes too widely distributed in the visual field. However, in order that the refined vision in these animals may exist at all, the subcortical centers must be anatomically differentiated to a degree sufficient to mediate the acuity of vision demonstrated.

It seems to the writer that the facts first described are of importance in explaining how the brain works in permitting mammals to respond to small differences in visual pattern. The belief[5] that the projection areas of the cortex are the only mechanisms which are sufficiently organized to mediate detailed pattern vision is evidently incorrect when the present results and interpretations are recognized. Instead, there seems to be a much more complex integration of function in the nervous system in controlling impulses basic to pattern vision than the mere projection of "neural figures" on the visual areas of the cortex. Evidently, the facts concerning the neural relations of visual acuity reported here indicate an unrecognized significance in the complexity and the nature of the projection of retinal fibers upon the pretectal region and upon the superior colliculus of the midbrain.

KARL U. SMITH

THE UNIVERSITY OF ROCHESTER

[3] K. S. Lashley and M. Frank, *Jour. Comp. Psychol.*, 17: 355–393, 1934.

[4] K. U. Smith, *Jour. Genet. Psychol.*, 49: 297–313, 1936.

[5] S. Poliak, "The Main Afferent Fiber-Systems of the Cerebral Cortex in Primates." Berkeley: Univ. Calif. Press, 1932. Pp. xiv + 370.

INDUCTION OF POLYPLOIDY IN NICOTIANA

IT is well known that tetraploidy may be readily induced experimentally in the tomato through the production of shoots from the callus tissue growing over the cut surface of decapitated stems. Nicotiana, however, fails to produce callus tissue and shoots in response to this method of treatment. Attempts to modify the treatment by application of yeast extract, lanolin or petroleum jelly to the cut surface or by enclosing it in a moist chamber have also been unsuccessful. When, however, the cut surface was smeared with a hetero-auxin paste made by thoroughly mixing crystals of indole-3-acetic acid with melted anhydrous lanolin in the proportion of 10 milligrams of the former to each gram of the latter, prompt development of callus tissue occurred. After about six weeks numerous buds were produced which rapidly developed into well-formed shoots, many of which have proved to be tetraploid.

The hetero-auxin treatment was first applied in a shaded greenhouse to plants of the F_1 *sylvestris-tomentosa* and F_1 *sylvestris-tomentosiformis* hybrids. From 125 treated plants, an approximately random lot of 1,973 callus shoots has been examined. In one subsample of 1,324 shoots, including all the first callus shoots obtained and about 800 normal shoots which were eliminated later directly from the cutting flats, 170 were tetraploid; while in another subsample of 649 plants no less than 102 were tetraploid, including two narrow-leaved shoots. Subsequent production of callus shoots has brought the number of tetraploids to well over 500. Besides the tetraploids about 50 shoots are of an abnormal type, having very thick stems, thick, malformed leaves and exceptionally large stomata (probably 8n), and six, each of a different type, had narrow leaves or other characteristics which appeared to mark them as modified diploids or tetraploids. The high proportion of tetraploidy and the apparent presence of higher degrees of polyploidy seem to indicate a positive effect of the treatment beyond that of merely inducing production of callus tissue.

Classification of the shoots was based on comparative size of stomata which appeared to be a perfectly reliable criterion, if examinations were made of small leaves at comparable stages of development. A few tetraploid shoots of *sylvestris-tomentosiformis* have reached maturity and their tetraploid constitution is evident from examination of microsporocytes and pollen production. They exhibit a flat plate with apparently 24 pairs of chromosomes (24 bodies have actually been counted), and regular meiotic behavior, as contrasted with the highly irregular distribution of the 24 chromosomes of the normal hybrid. Pollen

counts of 1,374 grains gave 85 per cent. of normal-appearing grains, whereas only .5 per cent. were good in a sample of 1,465 grains of F_1 pollen. The doubling has evidently resulted in the establishment of an amphidiploid condition, as is to be expected in sterile hybrids of this kind.

The hetero-auxin treatment has also been applied successfully to plants growing in the field. Under these conditions plants of *N. glauca, N. tomentosa, N. tomentosiformis* and F_1 *sylvestris-tomentosa* have produced callus shoots abundantly and tetraploid shoots have been found among them in even higher percentages than in the greenhouse. Plants of *N. tabacum* (Maryland Mammoth, *purpurea* and *purpurea Mammoth*), F_1 *glutinosa-tomentosa* and F_1 *glutinosa-sylvestris* have produced a few callus shoots, among them some tetraploids. Plants of *N. rustica* (*brasilia*), *N. wigandioides* and F_1 *glutinosa-tomentosiformis* have produced callus tissue and roots but as yet no callus shoots. It seems probable, however, that the relatively poor reponse in these instances is to be ascribed to poor condition of the plants, rather than to unsuitability of the treatment. To be regularly successful, the treatment must be applied to young plants in good growing condition.

Successful outcome of the treatment appears to depend upon careful attention to a number of details. Plants should be decapitated so that five or more good leaves remain on the plant. Internodal cuts respond to treatment just as well as those made through or close to nodes. The cut surface should be covered with a thin layer of the hetero-auxin paste immediately after decapitation, after which it should be protected, especially if exposed to direct sunlight, by covering with two or three folds of muslin or with a manila paper bag loosely tied to the stem. When buds begin to develop the covering should be gradually removed. It is important to have the plants in good growing condition and to keep them so during the course of the experiments. The plants should be disbudded immediately after treatment and any new axillary shoots should be removed as they appear. Successful treatment is followed by prompt development of callus tissue, which may in some instances take on a rounded, tumor-like appearance. After four to six weeks buds begin to develop, often so thickly as to completely cover the callus surface with a close tuft of shoots. The shoots may be classified when two or three inches long by examination of strips of epidermis peeled from the lower surface of the leaves. Callus shoots may be removed and treated as cuttings, or one or two selected ones may be left to develop in place after removal of the rest. There seems to be a tendency for normal shoots to develop more promptly than polyploid ones, so that it is advisable to remove the earlier shoots as soon as they are large enough to be examined, in order to give the less rapidly developing polyploid shoots a chance.

The writer is indebted to Dr. Roy E. Clausen for general supervision of these experiments and to Dr. Folke Skoog for assistance in the use of hetero-auxin preparations.

WALTER H. GREENLEAF
UNIVERSITY OF CALIFORNIA

ADENOMATOUS LESION IN STOMACH OF STRAIN I MICE

THE I strain of mice was originated by Dr. L. C. Strong[1] in 1927 by crossing a pink-eyed dilute brown and a dilute brown piebald stock. From this cross he selected five recessive characters, namely: pink-eyed, dilute, brown, non-agouti and piebald and continued the strain by brother-to-sister mating. Female mice of this strain seldom lived longer than fourteen months.

A litter of strain I mice was procured from the Roscoe B. Jackson Memorial Laboratory and the progeny of these mice, obtained by brother-to-sister mating, have been used as experimental animals in this laboratory. The strain has been of considerable interest for, up to the present time, none of the breeding females has developed a spontaneous mammary gland carcinoma. Furthermore, the mice have proved to be very resistant to the growth of transplantable mouse sarcomas 37 and 180 as well as resistant to the induction of subcutaneous tumors by lard solutions of carcinogenic hydrocarbons.

It was during the course of an experiment in which strain I mice had been injected subcutaneously with a lard solution of 1:2:5:6-dibenzanthracene that the stomach lesion was first encountered. The question arose as to whether the lesion was induced by the carcinogenic compound or whether it occurred spontaneously in members of this strain. Consequently strain I mice which had not been subjected to any experimental procedure were sacrificed and examined for the presence of stomach growths.

Twenty-one mice, aged 2.5 to 15 months, were killed and autopsied immediately. At three or four months, a progressive gastric lesion began, which was fairly comparable in brothers and sisters and in more distant relations of the same age. Practically all animals ten months old and over showed the condition in advanced form.

The principal change occurred in the pyloric chamber of the glandular portion of the stomach, which became large, solid, firm, opaque and slightly congested, with small grey nodular elevations on the serosa. In old mice the stomach contained little food and the cardiac chamber was compressed against the

[1] This information concerning strain I mice was kindly supplied by Dr. Strong in a personal communication.