ible, and much detail, including the musculature, is seen within the arteriole at the right. The bottom photograph (*B*) is of a 5-μ section through acid-decalcified dentin of a human tooth. The dentinal tubules that run lengthwise of the section are clearly visible at this magnification of 450 times, as are many small fibers associated with them.

There are still many evident improvements to be made in preparing sections for x-ray microscopy and in mounting them, which will certainly lead to corresponding improvements in the photographs obtained. Nevertheless, these examples demonstrate that microscopy with soft x-rays has already developed to the point where it can provide useful histological information.

V. M. Mosley
David B. Scott
Ralph W. G. Wyckoff
National Institute of Arthritis and Metabolic Diseases and *National Institute of Dental Research, National Institutes of Health, Bethesda, Maryland*

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Graft-Induced Transmission to Progeny of Cytoplasmic Male Sterility in Petunia

Many different manifestations have been revealed of hereditary properties of the cytoplasm. Thus, such different phenomena as maternal characters determined in the egg prior to fertilization, temporary environmentally induced, cytoplasmically determined characters, and interactions between nuclear genes and cytoplasmic factors have been demonstrated (*1, 2*). In a few instances (*3*), hereditary elements in the cytoplasm seem to be independent of nuclear control; one of these is the cytoplasmic male sterility in *Petunia*—the subject of this report (*4*).

The main avenue of attack on the nature of cytoplasmic inheritance has been to transfer by breeding different genomes into different cytoplasms. Despite the advantages of this method in demonstrating the matroclinous products, it neither proves that the cytoplasm as a whole by itself (a genuine "plasmon") determines hereditary traits in the same sense as nuclear genes do, nor can it prove that certain loci ("plasmagenes") are responsible for hereditary properties. Goldschmidt (*2*), while reviewing the body of evidence, tends to reject the plasmagene concept as suggestive, unnecessary, and misleading and chooses to find alternative interpretations to the facts. With certain assumptions Michaelis (*5*) formulated an interesting statistical model for hereditary units in the cytoplasm. Although his assumptions are reasonable, they are arbitrary; and the method is useful only for characteristics that express themselves in measurable gradations. Only in the case of the killer effect in *Paramecium* (*6*) has a self-reproducing hereditary particle of the cytoplasm ("kappa") been demonstrated. The behavior and chemical nature of this particle does not reveal whether it is an intimate part of the cytoplasm or a self-reproducing foreign inclusion producing deleterious effects in certain genotypes. Significant gaps thus exist in our knowledge about hereditary elements of the cytoplasm.

This preliminary report deals with an attempt to obtain evidence on the nature of cytoplasmic male sterility in *Petunia* by means of grafting. The following lines were used (*7*): (i) Northern Star, a fertile variety having a lavender corolla with a large white central star, and (ii) P-431-54 (ms), a completely male-sterile line having a dark garnet corolla and violet throat color. Anthers of the latter are greatly reduced in size and are devoid of functional pollen.

Self- and sib-pollinations of the Northern Star for two generations yielded only fertile progeny. By crossing the male-sterile line with Northern Star and three other unrelated varieties for two generations, exclusively male-sterile progeny were obtained (Fig. 1). These results, which conform to the much wider experience of other workers, suggest that this sterility factor is independent of nuclear genes.

Reciprocal grafts between fertile and male-sterile lines were made in two separate series of experiments in 1954 and 1955. No changes were noticed in the fertility or sterility of the graft components, but observations were limited by the short survival of the scions. All scions of 15 combinations of male-sterile and fertile died shortly after producing a few flowers; consequently, seeds could not be obtained from pollinations with fertile pollen. Scions of the fertile variety grafted on male-sterile stocks survived slightly longer than the reciprocal grafts. Seed was produced from two scions in each of the two series, from both sib- and self-crosses (the latter with pollen from the same flower as well as that from flowers of the donor plant). The germination rate of the seed in petri dishes was approximately 45 percent. All the work was conducted in a greenhouse in complete isolation from other lines of *Petunia*.

Progenies were grown from seeds produced by the scions and were subjected to additional test crosses to test the inheritance of male sterility. The results of these tests are summarized diagrammatically in Fig. 1. Progeny of the fertile scions grafted on male sterile stocks consistently included both fertile and sterile plants, whether from self- or sib-crosses. The number of mature plants obtained was small because the seeds germinated poorly in soil and many seedlings died. In the first series from selfing the scions with pollen of the same flower, three fertile and three male-sterile plants were obtained. Two of the male-sterile plants recovered some fertility after the third or fourth flower, and only one plant remained entirely sterile for the 12 months of its life. Seeds obtained from scion flowers pollinated with pollen from the donor plant produced eight fertile and two male-sterile plants. In the second series, 11 plants of a total of 38 remained completely male-sterile. All plants in both series showed the characteristic flower color of the Northern Star and no resemblance to the color of the male-sterile line or that of the F_1's.

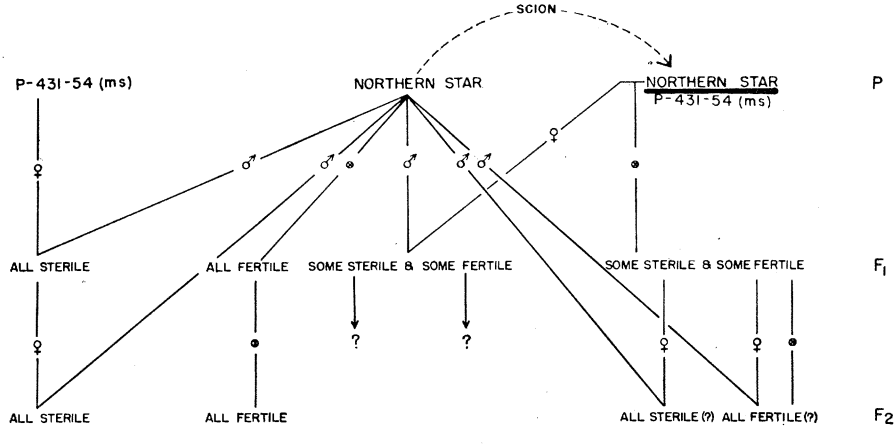

Fig. 1. Diagram of pedigrees. Graft combination indicated in upper right by fraction symbol, the scion being above, the stock below, the line.

Backcrosses between the first-generation male-sterile plants in the progeny of selfed scions and the Northern Star donor gave only male-sterile progeny, but the maximum number of plants tested per backcross was only 28. Only fertile progeny were secured from the selfs and backcrosses with the Northern Star donor of the fertile first-generation segregants in the progeny of selfed scions. Selfing the Northern Star donor likewise yielded only fertile progeny.

For several reasons these data do not permit extensive speculation about the nature of this cytoplasmic sterility. High heterozygosity of the material is likely because it is moderately self-incompatible. Large numbers of offspring of the F_2 are needed to establish independence of the cytoplasmic factor from nuclear genes. Low germination rates and high seedling mortality might have distorted segregation ratios. It would also be of interest to know whether longer lived scions would continue to maintain the same phenotype. The apparently autonomous behavior in the scions might be the result of a certain threshold requirement obscured by the short life of the scions. No explanation can be offered now for the better survival of fertile/male-sterile than reciprocal grafts. Experiments will be undertaken to study these and related problems.

Whatever doubts may be raised by these factors of uncertainty, the fact remains that the grafting induced changes in the fertile scion that resulted in the appearance of cytoplasmic sterility in its progeny. Although it seems most likely that this change was induced by movement of cytoplasmic sterility determinants from stock to scion, the tests do not entirely rule out other explanations. There is a remote possibility, for instance, that nutritional deficiency, which might have been induced by grafting, might cause a disturbance in cytoplasmic enzyme activity in such a way as to lead to an increase or decrease of sterility-determining entities of the cytoplasm.

RAFAEL FRANKEL
Department of Vegetable Crops, University of California, Davis

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Bony Dimensions and the Estimation of Men's Reference Weight

"Standard" body weight has been defined as the average weight for height, age, and sex. Both the term and the definition are unsatisfactory. The adjective *standard* may readily suggest that the value found in a height-weight table is not only "desirable" but "optimal." For this reason, Pett, in presenting the results of the Canadian survey (*1*), speaks simply of average weights. Only detailed studies of morbidity and mortality can yield information on the biological significance of given degrees of overweight or underweight at a particular age (*2*).

Although stature is a relatively good predictor of total skeletal weight (*3*), it is not an adequate measure of the bony framework in the estimation of reference weights. First, ordinary height-weight standards do not take into account the individual differences in the relative contribution of the legs and the trunk (plus head) to stature. Second, and more important, the lateral dimensions of the skeleton are not considered.

The need for paying attention to characteristics of "body build" other than height has been recognized, but adequate data for adults are not available. The widely circulated tables of "ideal" (later, "desirable") weights for women and men, issued by the Metropolitan Life Insurance Company, give ranges of weight at a given height for individuals of small, medium, and large frame. Unfortunately, no definition of the frame size is provided (*4*).

In the present study, which was carried out on random samples of Minneapolis firemen (N, 238; mean age, 41.6 years), five bony dimensions were included: stature (S); cristal height, as a measure of "leg length" (L); bicristal (C) and biacromial (A) diameters, as measures of linearity-laterality of the frame; and the biepicondylar diameter of the humerus (H). The width of the limb bones is of interest as a pure skeletal measure. The lateral size of the bony frame of the trunk is of consequence primarily because of the associated variation in the size of the skeletal musculature and viscera, not because of the direct contribution of the pelvic and shoulder girdles to body weight.

An equation, of the type $\hat{Y} = a + b_1X_1 + b_2X_2 + \cdots bnXn$, for predicting body weight (W) from the five bony dimensions and age (E) is given in Table 1. The multiple $R = 0.6487$. The t-tests indicate that the measure of leg length (L) does not contribute significantly to the accuracy of prediction. Omitting this variable, $R = 0.6469$. The resulting prediction equation is given in Table 2.

Deviations from a reference weight, predicted on the basis of bony dimensions, indicate more accurately the under- or overdevelopment of soft tissues in a given individual than stature alone. Measurements of the thickness of subcutaneous fat, from skinfolds (*5*), help us to interpret these deviations in terms of approximate body composition (*6*). Leanness-fatness is thus added to underweight-overweight as a second "dimension" in the description of human body. Women, in comparison with men, would be classified as "light but fat," while football players or steelworkers (*7*) would be typically "heavy but lean."

Table 1. Prediction of weight (W, in kilograms) from five bony dimensions (in centimeters) and age (E, in years), with t-tests of the significance of the beta coefficients of the predictors in a multiple regression equation. Significance levels: $t_{0.05} = 1.960$, $t_{0.01} = 2.576$, $t_{0.001} = 3.291$.

Predicted weight		t-values of beta coefficients
$\hat{W} = -111.704$		
$+0.532$	S	2.704*
-0.220	L	0.966
$+1.088$	C	2.530†
$+1.114$	A	3.801‡
$+5.772$	H	4.248‡
$+0.134$	E	2.150

* Significant at the 1-percent level. † Significant at the 5-percent level. ‡ Significant at the 0.1-percent level.

Table 2. Prediction of weight (W, in kilograms) from four bony dimensions (in centimeters) and age (E, in years), with t-tests of beta coefficients of the predictors.

Predicted weight		t-values of beta coefficients
$\hat{W} = -106.074$		
$+0.377$	S	3.302*
$+1.051$	C	2.455†
$+1.085$	A	3.722*
$+5.794$	H	4.265*
$+0.131$	E	2.100†

* Significant at the 0.1-percent level. † Significant at the 5-percent level.

JOSEF BROŽEK
Laboratory of Physiological Hygiene, School of Public Health, University of Minnesota, Minneapolis

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