Figure 3 shows the distribution of corresponding data of male and female rats from families subsisting upon a food supply which induces slower growth (Diet A, Diet 16). There is here the same good approximation to a symmetrical distribution of the growth data as in case of the animals on Diet B described above. Apparently this is true also for growth at higher rates than on Diet B. Thus, in such a series now in progress, 676 males show mean, median and mode of 52.8, 53.1 and 53.7 grams, respectively, with a degree of skewness of $-0.11$; and 649 females show 49.7, 50.2 and 51.2 grams, respectively, with skewness of $-0.21$.

Thus, for each sex, for two different segments of the growth cycle, and for experimental animals on three diets inducing distinctly different rates of growth, the growth data show so close an approximation to symmetrical frequency distribution as to add much to the confidence with which one may employ the usual methods of statistical interpretation.

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**A SPECTROGRAPHIC STUDY OF THE OCCURRENCE OF CHROMIUM AND MOLYBDENUM IN CARCINOMA OF THE HUMAN BREAST**

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A systematic study, by us, of the inorganic constituents of human tumors has been under way for several years and the present report deals with the occurrence of molybdenum and chromium in human breast tumors.

Molybdenum.—The occurrence of molybdenum in plants was dealt with in a previous communication.¹ The literature on the presence of molybdenum in animals is very meager. A survey by Ter Meulen² showed it to be present in various parts of the more common domestic animals. He reported it to be present in one human liver and in calf, beef, hog, chicken and cod liver. Two human spleens contained molybdenum as did calf, beef and hog spleens. An examination of various liver preparations for the alleviation of anaemia revealed the presence of molybdenum. Other parts of animals, e.g., blood, bone, stomach and bile, also cow's milk, were examined and molybdenum was found. The findings of Mankin,³ that molybdenum is present in the white of hens' eggs but not in the yolk, were confirmed. Ter Meulen took 5 mgms of molybdenum, as ammonium molybdate solution, and examined his feces and urine for the next three days. 3.63 mgms. were eliminated in the feces
and 2.12 mgrms. in the urine during the three days. He therefore concluded that molybdenum was easily eliminated.

Agnoli reported on some preliminary pharmacological experiments with molybdenum. He found that the administration of ammonium molybdate decreases the coagulation time and the sedimentation rate of the blood.

Waltner found that there was a slight impairment of growth when the diet of rats contained 2% molybdenum.

Suguira, studying the effect of various salts of metals fed to rats inoculated with Flexner Jobling rat carcinoma, found that at 0.2% solution of sodium molybdate in the diet intake of 16.3 mgrms. daily for eight weeks, the animals gained weight slightly, their appearance being good. Using five rats for inoculation, three tumors grew rapidly, one grew slowly and one retrogressed.

We have been unable to find any reference to the occurrence of molybdenum in human tumors.

Chromium.—The occurrence of chromium in human tumors was reported by us in a previous communication. The present study being an extension of our former work does not include the specimens previously reported on. We have reviewed the literature on the occurrence of chromium in soils and plants in a recent publication.

Experimental.—(a) The tumor samples.—The tumor samples were obtained from the Memorial Hospital and the Presbyterian Hospital, New York City. The handling of the containers is described elsewhere. In addition a number of specimens were obtained in silica basins. They were cleaned by fusing potassium bi-sulphate in them, the melt removed with hot water and finally prolonged washing with distilled water. The basins were carried to and from the hospitals in desiccators. Before being placed in the containers the specimens were well washed with distilled water.

(b) Preparing the Samples for Spectrographic Analysis.—The necessity for using “spectroscopically pure” reagents and “spectroscopically clean” apparatus becomes apparent when it is realized that the quantity of molybdenum and chromium present in a test portion is in the neighborhood of $10^{-4}$ mgrms.

The major portion of the organic matter in many cases was destroyed by refluxing with nitric acid in a transparent quartz flask, the condenser also being transparent quartz.

The nitric acid was distilled in a special Pyrex still. The flask was immersed in a boiling water bath, and fitted with a steam jacketed still head to prevent creeping of the acid during distillation. A stream of filtered air was drawn over the surface of the liquid thus removing the vapor which was subsequently condensed and caught in a Pyrex receiver. The first and last portions of each run were discarded and the acid was
distilled three times. Only freshly distilled acid was used for the oxidation of the tumors.

Each specimen was dried in a clean silica basin at 100°C. overnight in a Freas electric oven and weighed. Ten cc. of redistilled nitric acid were used to transfer the specimen from the basin to a transparent quartz flask with a transparent quartz reflux condenser. If the specimen were large, about two grams, a further ten cc. of nitric acid were added for the oxidation. Oxidation at the boiling temperature was carried out for about ten hours. The mouth of the condenser was covered to prevent contamination from dust. The contents of the flask were transferred to a clean silica basin and evaporated to dryness as described in an earlier publication. The residue was dissolved in one cc. of redistilled nitric acid and transferred to a quartz volumetric tube. Further portions of acid were used to wash the basin. The pipette, having a very fine orifice, was used in place of a wash bottle. The tube was immersed in a boiling water bath and the contents of the tube concentrated using a slow stream of filtered air through the system. If the tumor mass, dry, weighed one gram the solution was concentrated to one cc., if 0.8 gram to 0.8 cc. The volumetric tube held a little over three cc. and was calibrated in 0.05 cc.

The concentrate was then poured into a clean micro quartz beaker, transparent, holding about 0.5 cc., the quartz being cleaned with fusion with potassium bi-sulphate, etc.

0.2 cc. of this solution, corresponding to 0.2 grams of the dried tumor, was used for the spectrographic analysis. Using a micro-burette the 0.2 cc. were added in portions of 0.01 cc. to a graphite electrode (1) the electrode being gently warmed after the addition of each drop.

The second method employed was to cut the tumor mass into small pieces using clean platinum tipped forceps and surgical scissors immediately on return to the laboratory from the hospital. The scissors were thoroughly scrubbed with soap and water using a nail brush, washed well with water and finally with distilled water. About 0.5 gram of tumor, wet, was thus cut up and transferred one piece at a time to the lower electrode in the arc stand.

(c) Spectrographic Technique.—A Hilger El spectrograph was used in conjunction with a logarithmic sector. A sphaero cylindrical quartz condensing lens was used to focus the image of the arc on the slit. To facilitate keeping the image on the slit the lens holder was mounted on a coarse screw one revolution of the screw causing the lens to travel about three quarters of an inch. The speed of the sector was about 400 r. p. m. The arc was operated at 10 amperes, 220 volts d. c., the length of the arc being 2 mm. The exposure time was two minutes and in most cases the sector was then removed and a further exposure of two minutes was
given through the middle opening of the Hartmann diaphragm, another portion of the plate being used.

(d) Identification of Molybdenum.—The lines used for the identification of molybdenum were 3193.35 Å, 3170.35 Å, 3158.16 Å and 3132.60 Å.

(e) Identification of Chromium.—Chromium was identified by the following lines, 3578.7 Å, 3593.5 Å, 3605.3 Å, 4254.3 Å and 4274.8 Å.

Molybdenum was found in the following tumors:

Memorial Hospital, New York City

E622—Solid medullary carcinoma of breast. Grade II R.R. Metastatic to axilla.

E709—Infiltrating duct carcinoma of breast. Grade III. Metastatic to axilla.

E1020—Alveolar carcinoma of breast, sweat gland atypical type. Grade II + R.R.

E1438—Mammary carcinoma. Grade II+ Metastatic to axilla.

E2902—Liver from autopsy. Epidermoid carcinoma of bladder. Grade IV.

Presbyterian Hospital, New York City

48860—Intracanicular fibroma of female mammary gland.

49028—Carcinoma of female mammary gland. Papillary cystoadenoma.

Chromium was found in the following tumors:

Memorial Hospital, New York City

D6291—Infiltrating duct carcinoma, breast. Multiple foci of origin, metastatic to axilla. Grade II R.R.

E2183—Large alveolar carcinoma of breast with infiltration. Grade III R.S. node atrophic.

E1535—Small cell infiltrating carcinoma of breast. Grade III. Metastatic to axilla, probably R.S.

E1302—Infiltrating duct carcinoma of breast. Grade II R.R. Nodes free.

E2902—Liver from autopsy. Epidermoid carcinoma of bladder. Grade IV.

Presbyterian Hospital, New York City

49028—Carcinoma of female mammary gland. Papillary cystoadenoma.

50334—Carcinoma of female mammary gland with metastases in axillary lymph gland.

Remarks.—In all, twenty-four specimens of breast carcinoma and one fibroma were obtained from the Presbyterian Hospital and thirty-five specimens of carcinoma of the breast from the Memorial Hospital. With the exception of 49028 the specimens containing molybdenum did not contain chromium and those containing chromium did not contain molyb-
denum. Neither chromium nor molybdenum was found in the spleen of E2902.

Nothing is known of the rôle of either chromium or molybdenum in the animal economy. Chromium and molybdenum belong to the oxidation reduction type of element and although their significance is unknown in human tumors yet it is more than possible that they have a definite and active rôle in the metabolism of the tumor cell.

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2 Ter Meulen, H., Rec. trav. chim., 50, 491 (1931).
4 Agnoli, R., Arch. intern. pharmacodynamic., 44, 235 (1933).

THE ABSENCE OF AUTONOMY IN THE DEVELOPMENT OF THE EFFECTS OF CERTAIN DEFICIENCIES IN DROSOPHILA MELANOGASTER

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In a recent paper presented at the Sixth International Congress of Genetics, Sturtevant\(^2\) indicated the significance of mosaics for the study of the developmental effects of genes.

One of the important questions in this field is that of the autonomous or non-autonomous development of characters. It has been known, since the work of Morgan and Bridges,\(^3\) that in gynandromorphs of *Drosophila melanogaster* which result from elimination of one of the *X* chromosomes, the development of sex and certain sex-linked characters is perfectly autonomous. It has been found since that this autonomy of the differentiation of characters is not a general rule. Sturtevant\(^2\) indicates a series of cases in which the differentiation of the character is influenced