SEEDLESSNESS IN TOMATOES

IN SCIENCE for December 11, there is an interesting news item,[1] presumably based on a recent paper[2] by Dr. Felix G. Gustafson, in which he describes the production of seedless tomatoes and other fruits as a result of treating unpollinated flowers with various organic acids. It might be of interest to some to know that this phenomenon, in the case of tomatoes at least, occurs in nature, under certain conditions.

In the Winter Garden Region of Texas, as in many other sections of the semi-arid Southwest, tomatoes will grow all summer long under irrigation, but, with the exception of some of the small-fruited varieties such as Red Cherry, they do not set any fruit. As a result of a cross between Large Cherry and Bonny Best some promising selections have been obtained which have larger fruit than the small fruited parent and which at the same time set fruits during the adverse hot dry months. The fruits of these plants contain seeds in June, and usually also in early July, but with the higher temperatures of midsummer, they become seedless. Only once in a while will one contain a seed. In November, the fruits are again seed-bearing. During this seedless period the plants bear just as profusely as at other times and the fruits are of fine quality. In view of Dr. Gustafson's studies it would seem that possibly the substances necessary for fruit formation are stimulated to develop under these Southwestern conditions—perhaps by the pollination process. Drs. Ora Smith and H. L. Cochran have shown that fertilization is often prevented under conditions of high temperatures (such as occur in Texas), even though pollination actually takes place.[3] Practically all varieties fail to set fruits if they are not fertilized, hence the peculiar characteristic exhibited by these tomato selections is an interesting one, especially so in the light of Dr. Gustafson's recent studies.

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A CASE OF INCORRECT IDENTIFICATION

GRANTIA is a sponge that occurs abundantly in Europe and figures largely in European text-books of zoology for that reason. Along the Atlantic coast of North America, and particularly at Woods Hole, Massachusetts, we have a sponge that bears a superficial resemblance to *Grantia*. Many years ago some one carelessly assumed that it was indeed that genus. A few moments are enough to show that such is not the case. *Grantia* Fleming 1828 has a distinct dermal cortex containing a special cortical skeleton of tangentially placed radiate spicules. The American so-called *Grantia* does not have such a cortex. Ours is no unknown genus, but one that has been familiar to students of sponges for over a century; it was named *Scypha* by Gray in 1821. A tentative identification as to species of the Woods Hole "Sycon" sponge may be given as *Scypha* (*Spongia*) *coronata* (Ellis and Solander 1786).

This affects a great deal of labeling in illustrations of American text-books, of museum specimens sold by biological supply houses, and especially labeling of prepared slides distributed by such companies.

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ABNORMAL FEVER CASES

CASES of patients who show abnormally high temperatures for extended periods are occasionally reported. The conclusion in such cases is usually that some artificial means is being used to warm the thermometer.

The author has found such a means in addition to the usual suggestions of heating pad and hot-water bottle that might ordinarily be suspected. If a piece of dry cloth be wrapped about the bulb of a clinical thermometer and then the breath be blown against the bulb with considerable force, it is possible to raise the temperature to 106 to 108 degrees Fahrenheit, which is usually the limit of such thermometers.

An explanation of this, suggested by Dr. F. E. Poindexter, of St. Louis University, is that the water vapor in the breath is adsorbed by the fibers of the cloth. The heat of adsorption causes the rise in temperature above ordinary body temperature.

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SCIENTIFIC BOOKS

MILLER'S COMPLETE WORKS

THANKS to the enlightened generosity of the University of Illinois the first volume of the collected works of George Abram Miller is now available to the mathematical public. In it are reprinted some 59 papers, comprising Professor Miller's contributions to the theory of groups of finite order that were published during the years 1894–99. In addition there are three essays on the early history of group theory written expressly for this volume. They will be found at pages 1, 91 and 427. This is an innovation in such a publication, but is a most happy one. These 58

[1] SCIENCE Supplement, 84: 7, 1936.
[2] F. G. Gustafson, *Proc. Nat. Acad. Sci.*, 22: 628–636.
[3] Ora Smith and H. L. Cochran, Cornell Univ. Memoir, 175, 1935.

pages represent Professor Miller's final judgment after some 40 years' continuous study of his subject. In them honor is given with meticulous care where honor is due. Here is something that can be read with interest and pleasure by every one into whose hands the volume may fall. It is hoped that more of this historical material will enrich the succeeding volumes. It is pleasing to see justice done to the Italian mathematicians, Ruffini, Abatti, Betti, Capelli, Veronese, Frattini, Giudice, Bianchi and Bagnera. No mention is made, however, of the admirable course of lectures delivered at the Ateneo of Madrid by the novelist, dramatist, statesman and mathematician, José Echegaray, and published under the title "Resolución de Ecuaciones y Teoría de Galois" in the year 1897.

The most remarkable thing known about groups of finite order was discovered by Sylow. Professor Miller brings out clearly how near Cauchy was to Sylow's Theorem, and one seems to read between the lines his regret that Cauchy did not have the good fortune to divine this great theorem for which he had a proof ready to hand. Indeed, it would have made a great difference to Jordan if he had had the use of Sylow's happy discovery when he was writing his great "Traité des Substitutions."

Since Professor Miller inserted these historical notes largely to define the place of his own work in relation to that of his predecessors and contemporaries one can criticize him only mildly for omissions. But he does not do justice to the many papers on group theory written by Jordan after 1870. For example, instead of the paragraph on page 447 devoted to the special theorem which asserts that if a primitive group of degree n contains a circular permutation of degree p (a prime) it is at least $(n-p+1)$-fold transitive, a theorem extracted from the Traité des Substitutions of 1870, it would have been better to have recalled Jordan's theorem of 1871, which may be stated as follows:

If a primitive group G of degree n contains a transitive subgroup H of degree m, it will be at least $(n-m-2q+3)$-fold transitive, q being the greatest divisor of m such that the letters of H can be divided into systems of imprimitivity of q letters each in two or more different ways. If no divisor of m has this property (as when H is primitive or cyclic), G will be $(n-m+1)$-fold transitive.

This theorem is not exactly an epigram, and is difficult in every way, but is far deeper and vastly more important than the earlier special case that Professor Miller cites. Another piece of pioneering done by Jordan that should certainly have been mentioned is his discovery that every finite group of linear homogeneous substitutions on n variables has an invariant Abelian subgroup whose index is less than a fixed limit depending on n alone.

There are other achievements of Jordan that might well have been mentioned. As it now stands, it may seem to a reader of the volume under review that Jordan is just one among many, while the fact is that the amount and quality of his work in this field place him head and shoulders above all but the astounding genius Galois.

Professor Miller is the recognized authority on groups of low order. This is the immediately useful part of the subject. The contents of this one volume alone are sufficient to justify this high compliment. His first great self-imposed task was to check and complete the lists of primitive groups of degree less than 18, and the intransitive and imprimitive groups through degree 10. Miller's lists do indeed seem to be final. At the same time he was engaged on a similar careful determination of the groups of low order, regardless of the degree. The eighteenth paper of this volume (page 131) gives a list of all the regular permutation groups whose orders are less than 48, and in its 38 pages all statements made are proved. In particular he corrected the fantastic assertion of Le Vavasseur that there are at least 75 groups of order 32, a number that was definitely fixed in this masterly memoir at 51. Here too is found for the first time the commutator subgroup and the proof that the quotient group with respect to it is Abelian, and that no proper subgroup of the commutator subgroup has an Abelian quotient group. This was an important advance in the use of the commutator: $s^{-1}t^{-1}st$.

In looking through this volume it is interesting to note the gradual growth of the abstract group idea. One elementary theorem that is now in constant use took form as that idea became clearer. It occurs twice (without proof) in this volume, and it is instructive to compare the two versions. On page 252 we find:

If a group contains two self-conjugate subgroups that have only the identity in common, it may be represented as an intransitive group which is not simply isomorphic to any one of its transitive constituents.

Then on page 363 there is the more definite statement, referring clearly to an abstract group:

If a group contains two self-conjugate subgroups (differing from identity) which have only identity in common, it can always be represented as an intransitive group which involves no transitive constituent whose order is equal to the order of the group. As such transitive constituents we may use the quotient groups (represented as substitution groups) with respect to the two given self-conjugate subgroups.

This seems to be the first statement of this fundamental theorem; but why did Professor Miller not give a proof? It is probable that he visualized the two quotient groups side by side in two columns and "saw" that the resulting intransitive group would be simply isomorphic to the given abstract group, and propositions seen in this way are sometimes awkward things to put down in black and white.

The two papers in which the primitive groups of degree 15 and degree 16 are determined are models of their kind. In the second, page 270, it is shown in Miller's easy, graceful, flowing style that all the primitive groups of degree 16 (not alternating or symmetric) contain a self-conjugate subgroup in which every permutation is of order 2. This result suggests how inaccessible are the groups of degree 32, and how pitifully few are the distinct families of primitive groups we know or can reasonably hope to know.

The volume is very handsome. Paper and typography are all that could be desired, and the editing and proofreading is as near perfection as is humanly possible. As to misprints, it ties the present record of Lehmer's list of primes, as far as the reviewer was able to discover in an extensive but not complete reading.

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SPECIAL ARTICLES

THE ISOLATION OF A HOMOGENEOUS HEAVY PROTEIN FROM VIRUS-INDUCED RABBIT PAPILLOMAS

Two years ago[1] a crystalline protein was obtained by chemical treatment of the juice of plants diseased with tobacco mosaic virus. Numerous chemical, biological and physical experiments[2] indicate that this protein is the agent responsible for the disease. Similar chemical procedures have not yielded pure virus proteins from plants infected with other viruses. Recently, however, the development of methods involving differential ultracentrifugation has made possible the purification of proteins associated with the activity of certain of the less stable plant viruses.[3] The effectiveness of these methods has suggested the desirability of similar studies with animal viruses. The unusual stability of the virus causing infectious papillomatosis (Shope) recommends this agent as a favorable subject for such a study.

We have isolated from the virus-induced warty masses[4] from western cottontail rabbits a high molecular weight protein with which is associated the infectiousness of the disease. The following procedure has been adopted in preparing this protein. From 5 to 10 grams of glycerolated wart tissue known to be infectious were ground with sand and extracted with 100 cc of normal saline. After preliminary clarification by low-speed centrifugation extracts were ultracentrifuged[5] in 17 cc tubes for about two hours in a maximum field of 60,000 times gravity. The pellets thus thrown down were pooled and taken up in 7 cc of 0.1 M phosphate buffer solution, cleared of aggregated colloidal matter by low-speed centrifugation and again ultracentrifuged at 60,000 g to yield a pellet of heavy matter. This process was continued 3 to 4 times, or until tests with the analytical ultracentrifuge showed that all light-weight impurities had been lost in the supernatant fluids and all fine colloidal matter had been aggregated and eliminated through the intermediate low-speed centrifugations. Sixty grams of wart tissue derived from 5 different sets of warts were treated in this fashion. In 3 instances the papillomas were the result of "natural" infections; in the other 2 the growths had been induced by experimental inoculation. These tissues had different degrees of infectivity, suspensions of the most active producing rapidly growing papillomas in domestic rabbits 7 days after inoculation of saline extracts, the poorest requiring 13 days for the production of scattered warts.

Differential ultracentrifugation in each case provided a heavy protein free from colloidal impurities and detectable amounts of light-weight contaminants. A solution containing one mg per cc of this purified substance was opalescent and gave positive color reactions with the Millon, xanthoproteic and biuret reagents. A portion of the same solution failed to yield an immediate positive Molisch test for carbohydrate, but a faint violet ring of color developed on standing. The material was found to contain about 15 per cent. nitrogen by Kjeldahl analysis. The heavy protein is completely coagulated at a temperature of 66–67° C. and leaves a supernatant that is free of protein; the activity of papilloma extracts[6] begins to diminish at 67° C. and is completely destroyed at 70° C.

In the analytical ultracentrifuge the heavy protein from each sample sedimented with the sharp boundary that characterizes a single molecular species. In every instance the sedimentation constant was the same—

[1] W. M. Stanley, SCIENCE, 81: 644, 1935.

[2] W. M. Stanley, *Amer. Jour. Bot.*, 24: No. 2, 1937.

[3] W. M. Stanley and R. W. G. Wyckoff, SCIENCE, 85: 181, 1937.

[4] We are indebted to R. E. Shope of this Institute for the material used in this investigation.

[5] R. W. G. Wyckoff and J. B. Lagsdin, *Rev. Sci. Instr.*, 8: No. 3, 1937.

[6] R. E. Shope, *Jour. Exp. Med.*, 58: 607, 1933.