by presenting, essentially, only the monosubstitution products of benzene. Reference is made to several types of dyes, including the azo, benzidine, triphenyl methane, indigo, alizarin and naphthalene varieties. Reference is also made to certain medicinals, and to pyridine and quinoline, as related to the alkaloids. A simplified substitution table is included.

It is hoped that the charts may be of a certain service to the teacher as an aid to the presentation of his subject; and as a help to the student to fully appreciate that presentation. It is further designed to aid the student in reviewing his work, and in comprehending it as a whole, as well as in its component parts.

Realizing that it is virtually impossible to include all compounds or all reactions which are of importance, in a classification such as they are presenting, the writers will appreciate any constructive criticism from teachers of organic chemistry, by means of which the charts may be made more useful.

These may be obtained in any quantity, in a folder including both, from D. Van Nostrand & Company, New York.

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SPECIAL ARTICLES

A SATISFACTORY RATION FOR STOCK RATS

As long as actual feeding trials must serve as the means for determining the nutritive sufficiency of rations, laboratory animals such as the rat, rabbit, dog and guinea pig will always be used in large numbers for this work as well as for cultural work in bacteriology, for pathology, immunology and kindred sciences. For this reason anything which can be done to facilitate the breeding and maintenance of these animals in sufficient numbers and in excellent condition will often free the laboratory worker from much uncertainty with respect to maintaining the continuity of his researches.

The writer has been especially impressed with the desire for information in regard to rat culture as brought out by the numerous inquiries received in the last five years for a ration formula satisfactory for rats. From the character of much of the experimental work reported from different laboratories it also is evident that many of the rat-feeding experiments are now being carried out on rats not entirely suitable for the various problems under investigation. This is true by virtue of the fact that most young rats are undersized, due to limited milk production of the mother causing them to not only partially starve but also to eat excessively of the mother's ration before their time. The rations on which they are kept are often too low in good proteins, too low in calcium, sodium or chlorine or too low in the fat-soluble vitamines. The trouble may not always be on the deficiency side, however; the ration may contain too much indigestible material, too much protein, and sometimes even too much fat-soluble vitamines, the latter not inhibiting growth but causing excessive storage which is very disturbing in experiments designed to test for these constituents.

In spite of the need for a good economical rat ration practically nothing appears in the literature to meet the situation. In view of this the writer sees fit to publish the composition of his stock ration, which, finely ground and fed with fresh whole milk and water in separate containers ad libitum, has given him excellent results for a number of years. It is constituted as follows:

Yellow corn	76.0
Linseed oil meal	16.0
Crude casein	5.0
Ground alfalfa	2.0
Sodium chloride	.5
Calcium carbonate	.5

From the theoretical standpoint it would be best to have different rations for growth, for reproduction and lactation and for maintenance, but that is a refinement which probably is not practical under most laboratory conditions, as most of the animals are either growing, reproducing, lactating or recuperating from the strain of the latter, all of which conditions require a ration with a narrow nutritive ratio. As to whether or not the requirements are satisfactorily met is best indicated by the ability of the mother to withstand the strain of reproduction repeatedly and by the growth of the young. With this we have had absolutely no trouble. The females are kept for breeding purposes for a year with no signs of premature senility, and the young average in at least 90 per cent. of the litters 40 to 55 grams in weight at an age of 23 days; in fact, when they weigh less at this age we discard them as unsuitable for experimental work.

When milk is omitted from the ration the results are not as satisfactory. This is due to a number of factors. In the first place, the content of available fat-soluble vitamines is not sufficient. This we have remedied by the addition of one to two per cent. of cod liver oil, but it leaves the ration less satisfactory when the rats of the colony are to be used for work on these vitamines. In the second place, the calcium content is too low; in fact, even with milk included in the ration, the calcium is not too high for optimum results. We have purposely kept the calcium added as carbonate low because it is apparently not the best salt to use in

large amounts, probably due to neutralization of gastric contents; we have, however, obtained very good results with one per cent. of precipitated calcium phosphate or 1.5 per cent. of bone ash, but our experience with these, in view of the good results obtained with the ration as outlined, are not sufficiently extensive to warrant the change when milk is fed. In the third place, the protein content could probably be advantageously increased.

As milk is available in sufficient quantities at all times in the writer's laboratory, no extensive or prolonged experience with a milk-free ration comparable in efficiency to a milk-containing ration can be drawn upon. When available, fresh whole milk produced by cows on a non-varying ration should be used as a constant ingredient of the stock colony ration, as it serves to cover most effiicently not only known requirements, but no doubt many requirements not as yet appreciated. The factor of proper nutritive condition of the young rats before being started on their various dietary regimens is a factor which enters into the results of all experiments and therefore is worthy of far greater attention than it is given in most laboratories.

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ALKALOIDAL CONTENT OF DATURAS AFFECTED BY MOSAIC INJURY

PLANTS of *Datura Stramonium* grown in the drug garden maintained by the Department of Pharmacognosy of Western Reserve University during the season of 1922 were severely injured by mosaic. The injury affected both green-stemmed and purple-stemmed plants, both being, apparently, equally susceptible. The symptoms of the disease appeared during the height of the growing season, being manifested in the developing leaves, which remained small, and became mottled and distorted. The width of the affected leaves was much reduced, while the tips and the extremities of the dentations were more nearly of normal length, giving the leaves the characteristic stringy appearance not uncommon in mosaic troubles. The plants as a whole were below normal in development.

As the drug value of these Daturas, both of which are official as "Stramonium" in the United States Pharmacopoeia, is believed to depend on their alkaloidal content, alkaloidal analyses were made of both diseased leaves and leaves from plants which showed no mosaic. Leaves taken for analyses were hand-picked from closely adjoining plants at the same time. The petioles were removed. The leaves were dried simultaneously, as rapidly as possible, on the same shelf of a hot-air oven at a temperature not over 100°. Analyses were made by the official method of the United States Pharmacopoeia IX. The results are tabulated below.

TABLE I

					Per cent. alkaloids	Average
Purple-stemmed	plants,	mosaic,	Sample	1...	0.27	
"	"	"	"	2...	0.28	0.275
"	"	normal	"	1...	0.147	
"	"	"	"	2...	0.138	0.142
Green-stemmed	plants,	mosaic,	Sample	1...	0.27	
"	"	"	"	2...	0.303	0.285
"	"	normal	"	1...	0.072	
"	"	"	"	2...	0.072	0.072

It will be noted that the figures for mosaic plants of both varieties are slightly above the official alkaloidal requirements (0.25 per cent.) for Stramonium as a drug, and, by themselves, are therefore by no means remarkable. The notably low results of the normal leaves may be considered as rather unusual, especially in the case of the green-stemmed plants, inasmuch as both varieties appear rarely to fall below the pharmacopoeial requirement. The locality of growth was considerably shaded. Schneider[1] has observed that plants of the closely related *Atropa belladonna* show a markedly higher alkaloidal yield when grown in full sun. Inasmuch as the Daturas are normally sun-loving plants, it appears not improbable that the factor of insolation may have been involved. As the mosaic plants were subjected to the same conditions, this factor can not be held responsible for the marked disparity in content between normal and mosaic leaves. Sievers[2] has shown a marked increase of alkaloidal content following prevention of flowering in the Daturas; while flowering was by no means inhibited in these mosaic plants, it was apparently hindered to some extent by the distortion of the flowering-tops. In Sievers's experiments, however, inhibition of flowering increased the size of leaves—the converse of the effect of mosaic. The same author[3] has also shown an increased concentration of the alkaloidal content of belladonna in the tender growing parts, which, in the Daturas, are most affected by mosaic. It is evident, of course, that a given weight of mosaic material represents a considerably greater number of leaves than the same weight of normal leaves.

[1] Schneider, Albert, "The cultivation of belladonna in California," Bulletin 275, Agricultural Experiment Station, Berkeley, Cal., 1916.

[2] Sievers, A. F., "The influence of inhibiting flowering on the formation of alkaloids in the Daturas," *Jour.* of the American Pharmaceutical Association, Vol. X, No. 9, pp. 674–676, 1921.

[3] Sievers, A. F., "The distribution of alkaloids in the belladonna plant," *Am. Journ. Pharm.*, Vol. 86, No. 3, p. 97, 1914.