this increase is *not* susceptible to carbon monoxide (autoxydation of necrotic substances?). Thus it is possible that a cytolytic effect of the bivoltinizing treatment is responsible for the increased amount of carbon monoxide resistance respiration.

(2) It is possible that the same factor which is supposed to be responsible for the increase of the respiration catalysed by cytochrome-oxidase (*i.e.*, change in the submicroscopic structure of the egg-cytoplasm) may have also increased some respiratory processes which are catalysed *not* by cytochrome-oxidase but by some carbon monoxide-resistant respiratory enzymes, *e.g.*, the yellow enzyme of Warburg. This explanation is in fact an additional argument in favour of our theory as it supposes that the changes in respiration are due to non-specific causes which affect more than one single enzyme system. Such an unspecific factor would be in the first line a change in the sub-microscopic structure of the egg-cytoplasm.

SUMMARY

Artificially enhanced respiration of freshly laid fertilized silkworm eggs (treated with hydrochloric acid for bivoltinization) is more susceptible to carbon monoxide than the normal respiration. The significance of this phenomenon and the details of the results are discussed.

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SUGARCANE (*SACCHARUM OFFICINARUM*) TOP SILAGE AS FEED FOR CATTLE

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THE problem of adequate supply of nutritious fodder for livestock in India durthe dry periods of the year is very baffling. After the monsoon, the cattle have to depend, for greater part of the year, for roughage supply, principally on coarse and bulky fodders like straws which are nutritionally deficient. One of the solutions of the problem seems to be in devising methods for the conservation of surplus green fodder in times of abundance, especially during monsoon months. Hay making and ensilage, if widely undertaken, may solve the problem to a great extent by providing alternative fodder of satisfactory nutritive value.

In previous articles (Kehar and Sahai, 1949; Paul and Rangaswamy, 1947) observations on the nutritive value of sugarcane tops have been reported. As already stated the estimated yield of sugarcane tops in India roughly works out to be 16 million tons annually. At present most of it goes to waste. As this huge production of cane tops is available only during the cane crushing season extending over three to four months, it is not possible to utilise the entire produce as such for feeding cattle. The additional quantity of cane tops after meeting the requirements of the livestock in those parts will be available for conservation by a suitable method. Hence measures must be adopted to conserve the surplus material, to be utilised during periods of scarcity. The observations reported in this article relate to the conservation of sugarcane tops by ensilage and the nutritive value of the ensiled product.

Green sugarcane tops chaffed into 5" to 6" bits were filled, in pits of 8' × 5' × 4'

dimensions layer by layer. After each addition of ten maunds of green material, eight to ten adult persons trampled on the mass thoroughly for about half an hour to exclude air as completely as possible. When the green material reached a foot above the ground level, the top was covered with 6" layer of dried Bharra (*Saccharum munj*) or any other coarse hay. The pits were finally covered with earth and plastered with a mixture of dung and clay. The pits were attended to occasionally and any visible crevices due to shrinkage of the material were replastered.

After a period of four months one of the pits was opened and a representative sample was taken out. The silage was found to be of a yellowish green colour with a pleasant fruity smell.

The average chemical composition of the silage along with that of the original crop is given in Table 1.

TABLE I

Chemical composition of green sugarcane tops and the silage made therefrom

		Fresh Crop	Silage
Dry matter (Percentage of fresh material)		33·86	38·25
		Percentage on dry matter basis	
Ether extract	..	1·33	2·07
Crude fibre	..	29·46	37·51
Crude protein	..	6·41	7·34
Total ash	..	8·16	9·47
Nitrogen-free extractives	..	54·64	43·61
True protein	..	4·77	4·31
Ratio $\frac{\text{true protein}}{\text{crude protein}}$	..	0·74	0·59
Calcium (CaO)	..	0·59	0·71
Phosphorus (P_2O_5)	..	0·45	0·52
pH	..	(Stated as c.c.	4·67 N/10 per 100 gm. of fresh silage)
Total acidity	..		231·000
Amino acids	..		49·45
Volatile acids	.		81·53
Residual acidity	..		100·02
Volatile bases	..		38·05

It will be observed that the silage showed an increased percentage content of crude protein with a diminished true protein content, evidence of the breakdown of protein during the ensiling process. The chief loss would appear to have fallen on the nitrogen-free extractives, whereas fibre content was increased appreciably. Ether extract and ash content have also shown slight increase.

To determine the nutritive value of the silage, feeding experiments were carried out, using two species of animals, namely, kumauni bullocks and buffaloes. Three animals from each species were selected and put on a daily ration consisting of silage feed *ad libitum*, supplemented by rape cake at the rate of 1 lb. per animal. Besides, each animal was given 1 oz. of common salt daily. The silage was highly relished by the animals and was quite palatable. During the feeding period lasting for twenty-five days, animals kept up a healthy appearance and gained on an average 14·7 lbs. in case of kumauni bullock group and 4 lbs. in case of buffalo group.

After a pre-experimental feeding period of 15 days, a metabolism trial was carried out on animals of both the groups. Digestibility coefficients on an average were found to be crude protein 51·24, ether extract 31·81, crude fibre 61·78, and nitrogen-free extract 38·31, for the kumauni bullock group; and crude protein 49·59, ether extract 38·25, crude fibre 63·92 and nitrogen-free extract 44·01 for the buffalo group. The nutrients in lbs. per 100lbs. of silage(dry basis) were found to be:—digestible crude protein,3·76, total digestible nutrients, 45·115, and starch equivalent, 22·909 for the kumauni bullock group; and digestible crude protein, 3·639, total digestible nutrients, 48·633, and starch equivalent, 26·383 for the buffalo group. Table II gives a comparison of the nutrients per 100 lbs. of sugarcane top silage (dry basis) with some other common silages.

TABLE II

Nutrients in lbs. per 100 lbs. of dry matter

Name of feeds	Digestible crude protein	Total digestible nutrients	Starch equivalent
Sugarcane top silage (Kumauni bullocks)	3·76	45·12	22·91
Sugarcane top silage (buffaloes)	3·64	48·63	26·38
Jowar (*Sorgum vulgare* Pers.) silage	2·35	51·13	29·10
Maize (*Zea Mays*) silage	3·41	61·43	46·80
Spear grass (*Stipa*) silage	1·74	50·22	31·00

From the above table it will be observed that, as regards digestible crude protein, the figure for cane top silage is the highest but

as regards total digestible nutrients and starch equivalent the figures for sugarcane top silage are the lowest in the list.

Balance study for nitrogen, calcium and phosphorus was also made, the results being shown in Table III.

TABLE III

Nitrogen, calcium and phosphorus balances (in gm. per day)

	Kumauni bullock group (average of three animals)	Buffalo group (average of three animals)
Nitrogen (N) ..	+6·48	+13·02
Calcium (CaO) ..	+0·50	+ 4·88
Phosphorus (P_2O_5)	+1·87	+ 3·94

As is seen from the table, the balance for nitrogen is highly positive in both the groups. Calcium and phosphorus balances are also shown to be positive on an average.

It will be observed from the above data that ensilage of sugarcane tops will yield a fodder of high nutritive value and if recourse is taken to this method of conservation the entire surplus produce of sugarcane tops will be utilised and made available for scarcity periods, when there is a great dearth of nutritious and succulent fodder.

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THIRD SYMPOSIUM ON APPLIED MATHEMATICS—ELASTICITY

THE American Mathematical Society now holds annual Symposiums on selected subjects in Applied Mathematics. The subject of the first symposium, held in August 1947, was Nonlinear Problems in Mechanics of Continua. In 1948 the subject of the second symposium was Electromagnetic Theory. Both these symposiums are being published in book form.

The third annual symposium was held at the University of Michigan, Ann Arbor, Michigan, from the 14th of June to the 16th of June, 1949. The subject of the symposium was Elasticity. The Applied Mechanics division of the American Society of Mechanical Engineers was a co-sponsor of the symposium. The proceedings of this symposium are to be published in book form by McGraw-Hill.

This symposium was very well attended. On the second day about 300 mathematicians and engineers from all parts of the United States were present. There were seventeen invited papers and addresses. The Chief contributors included Sir Richard Southwell, Professor E. Reissner, Professor I. S. Sokolnikoff, Professor W. Prager, Professor D. L. Holl and Professor B. R. Seth. In the Applied Mechanics division Professor S. Woinowsky-Krieger, Mr. H. Poritsky, Professor D. C. Drucker and Professor L. H. Donnell were amongst the contributors.

Sir Richard Southwell showed how his relaxation method could be used for the elasto-plastic torsion problem. Professor E. Reissner, Professor F. B. Hildebrand and Professor K. O. Friedrichs dealt with finite deflection theory of plates and shells. Professor I. S. Sokolnikoff gave an account of methods used to solve problems in anisotropic elasticity. He showed how the perturbation method could be used to get approximate results. Professor B. R. Seth pointed out that the method implied that the anisotropic elastic constants could be obtained from the isotropic ones by adding small terms, which was not always possible. Professor D. L. Holl discussed the bending of anisotropic plates under dynamic loads.

Professor W. Prager, Professor D. C. Drucker, Professor U. Coburn, and Mr. P. G. Hodge dealt with plastic problems. Professor B. R. Seth of Hindu College, Delhi, and at present Visiting Professor of Applied Mathematics at Iowa State College, discussed some recent applications of the theory of finite elastic deformations. He criticized some papers of P. M Riz, U. Zvolinsky R. Kappus and R. S. Rivlin. His suggestion that in the non-linear elastic domain the elastic constants should be reduced was very well borne out by papers of E. A. Davis, A. Eyering and G. Halsey, an account of which was given by C. J. Thorne. It was suggested to Professor L. H. Donnell that if these reduced values of the constants were used the wide disagreement between theory and his experimental results on buckling of thin cylinders under axial compression would become much less. Professor B. R. Seth also pointed out to Professor G. E. Hay that, in his problem of the elliptic plate under concentrated load, the use of certain relations involving stress in orthogonal curvilinear co-ordinates would enable him to obtain the solution in a closed form.