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ELECTROCULTURAL METHODS PRACTISED IN PARTS OF NORTHERN INDIA

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In last May I was deputed by the Government of Madras to study electro-cultural methods introduced by Dr. S. S. Nehru in Mainpuri, United Provinces, and by Col. Noel in Peshawar, North West Provinces, and report on the results.

It may be of interest to know that Dr. Nehru is a civilian officer working in the United Provinces, who had a brilliant educational career. After taking the B. A. and B. Sc. degrees at Allahabad at the early age of 16, he went to Cambridge, took two honours degrees and passed the I. C. S. examination. He then took his Ph. D. degree at Heidelberg University in Germany. He was for some time Professor of Physics, when he did some research work in aerodynamical problems. He presided over the Agricultural Section of the Indian Science Congress in 1934. He is a great enthusiast taking great interest at first in the introduction and spread of boorm corn and later on in electro farming. He has published a number of books and pamphlets on his new hobby.

Description of Methods. The treatments recommended by Dr. Nehru for the improvement of crops may be grouped under three heads :— (a) sparking (b) jacketing and (c) utilisation of what are called ' mitogenetic rays '.

(a) *Sparking.* This is done by connecting one end of an electric cable to an old magneto of a motor car, and the other terminal to the material or body to be energised, and then rotating the handle of the magneto from half to one minute, so that the current may pass direct into the body. When materials like seeds, straw etc., are to be sparked they are spread thinly over a wire gauze placed on insulated stands, and the loose end of the electric wire is connected to the gauze and the current passed Very often water is used for the transmission of energy. In those cases the loose end of the coil is dipped in the water and the handle of the magneto turned for half a minute. When water for irrigation is to be charged, the loose terminal from the magneto is inserted in the middle of the water inlet of the field and the magneto worked till the irrigation is completed. Electrically charged water is generally called ' sparked ' water. When sparked water is applied from a height so as to form a thin film or spray over various limbs of a tree or plant the process is spoken as ' Agaskarisation ' named after Mr. Agaskar, the originator of the idea.

(b) *Jacketing* is the name given to the operation of covering a portion —generally the basal region—of trees and plants with ordinary wire netting used for poultry enclosures. It is said that galvanised iron netting of $\frac{1}{2}$ to 2" mesh is very efficient for the purpose ; a band of mesh 9 to 12 inches in width is cut out and wrapped closely round the base of trunks of trees such that two to three inches of this width are buried underground. When trees

increase in girth, the jacket is loosened and a suitable length of netting added. Sometimes the base of the branches is covered when it goes by the name of "Aproning" or "Collaring". Rarely the stalks of flowers and fruits are also wrapped with small strips of the netting.

(c) *Mito-genetic rays.* These are also referred to as M.rays or Gurwitsch rays. These rays are said to stimulate growth. Roots of onion, damaged leptome bundles of potatoes, cotyledons of sunflower, mash of yellow beet, and pulp of *Sedum maximum* are reported in literature to emit these rays. To utilise their beneficial effects two methods are being employed at Mainpuri. One is to plant onion bulbs around trees; and the other is to pass the irrigation water, prior to letting it into the crop, through a series of furrows having onion plants at the sides. Dr. Misra of Jaunpur is using these rays for the treatment of human patients. He has for this purpose devised what is called "M ray-gun". In that apparatus fresh onion seedlings with roots are fixed at one end of a tube while the other end is placed over the area to be treated.

It may be remarked here the last two methods do not literally belong to electric treatments, but Dr. Nehru justifies their inclusion on the ground that jacketing captures electro-magentic energy from air, while onion roots emit M. rays and they thus create a 'field' of energy similar to an 'electric field'.

It may also be said that these methods differ from those used by the previous investigators. They generally drew currents for their experiments from charged net work suspended over the crop or from the differences present in the atmospheric potential gradients. Some grew plants in iron cages devised to destroy the electrical field present in the air, while others applied currents directly to the soil by burying electrodes. Dr. Nehru himself had tried, prior to the evolution of the simple technique now recommended, cumbrous and expensive apparatus like soil ticklers, induction coil, dynamos, radio magnetic cradle, apparatus for x rays, violet rays and ultra violet rays.

Their Application and Effects. These methods are applied by Dr. Nehru and his collaborators either singly or in combination to plants, animals and human beings. Special electrotherapy has been developed for each group and a set of recipes have been formulated. A few of these together with their effects are set out in statement I.

Dr. Nehru has included all these methods in the programme of rural uplift work that is being done in Mainpuri district. Members of Fruit Growers' Association, Mainpuri of which Dr. Nehru had been the President and guide, adopt them in the various centres in the district. The results obtained by them are being recorded in the various bulletins and in the journal "Gram Sudar" published by the above association. It is learnt that as the result of electro-farming many of them were able to carry away a number of prizes in many of the exhibitions, and that, the methods are being practised by a few in Ceylon, Malaya, Central America U. S. A., Germany and Sicily with great success and enthusiasm.

STATEMENT I

Mode of application.	*Effects claimed*
I(a). Annual crops.	
(a) Sparking the dry seed.	(1) Better and earlier germination of seeds. Seeds that are difficult to germinate sprout quickly
(b) Soaking the seed in sparked water before sowing.	
(c) Irrigating the crop with sparked water.	(2) More tillering in canes.
(d) Irrigating with onionised water.	(3) Less of insect damage.
(e) Raising the nursery on a sparked seed bed.	(4) Less consumption of irrigation water.
(f) Wrapping fruit stalks with a small piece of wire netting.	(5) Profuse production of flowers and fruits.
(g) Holding wire netting just touching the top of plants infested with insects and passing the current through the wires.	(6) Reduction in alkalinity.
	(7) Growing crops out of season.
	(8) Insects killed or stunned.
I(b). Perennial crops.	
(a) Jacketing at the base of trunks and aproning the branches.	(1) Dying and sickly trees rejuvenated and revived.
(b) Sparking the jackets.	(2) Non-bearing trees stimulated to fruiting.
(c) Irrigating with sparked water.	(3) Production of more fruits.
(d) Agaskarisation.	(4) The size of fruits increased.
(e) Planting onions around.	(5) Trees raised on alkaline lands stimulated to grow and bear fruits.
(f) Planting of mango near dhak, citrus near mango trees.	
II. Animals.	
(a) Sparking the feed.	(1) In the case of buffaloes more milk and better butter are produced.
(b) Soaking the feed in sparked water.	(2) The animals are made more energetic.
(c) Using sparked water for drink.	(3) In the case of poultry, the hatchability is increased; the eggs are bigger.
(d) Activation of thyroid glands by sparking.	(4) Pullets reared on electrically treated feed grow more rapidly.
(e) Sparking the affected regions and massaging.	(5) Wounds are healed very quickly.
(f) Washing the wounds with sparked water.	(6) In the case of pigs, hairs grow quicker and longer.
III. Human beings.	
(a) Drinking sparked water.	(1) Pain in the affected parts is reduced.
(b) Sparking the affected regions.	
(c) Washing the sores with electrified water.	(2) Inflammations subside.
(d) Activating the glands by sparking them.	(3) Fever, partial paralysis are cured.
(e) Application of M. ray gun.	(4) Wounds are healed quickly.
(f) Disinfecting well water periodically by sparking.	(5) Stomach troubles are got rid of.
(g) Wearing of a necklace made of 1 to 4 strands of iron wire.	(6) Sleep is increased.

My Observations. I may be permitted to state here that my visit to Mainpuri happened at a time when there was practically no crop on the ground. My observations were therefore limited to the following

Wheat seedlings and straw-berries raised in pots; sugarcane, colocasia, melons, gourds, mango, citrus, pomegranate, papaya, falsa, peaches, and plum trees; treated poultry, buffaloes and human patients.

Mr. Ahmed, Revenue Divisional Officer, Mainpuri was conducting an interesting experiment with treated wheat in pots. He at first had groups of ten seeds sparked and sowed them in two small pots and irrigated one set with sparked and the other with plain water. It was interesting to see the seedlings watered with sparked water greener and healthier than those raised with plain water. Likewise a pot of straw berries raised with sparked water was better than the control at Turnab Farm. At Mangaon a plot of half an acre of sugarcane was raised from setts soaked in sparked water and irrigated with sparked water. In a plot of 10 cents opposite to the above-plot the same variety of cane was irrigated with plain water. On comparing both, the former was greener in appearance, had more tillers and low mortality from shoot borer. At Gorakhpur some setts were soaked in sparked water for 20' and others for 10'. When these were grown side by side, the germination was later in the group treated for a longer time; but the tillers were stouter and more vigorous in growth. A small bed of colocasia irrigated with sparked water appeared greener in Mr. Sadhu Singh's garden than the next bed receiving plain water. At Kishni a plot of gourds watered with electrified water had larger number of flowers, and the fruits that had their fruit stalks jacketted were bigger. Sardar Surjan Singh, Principal, Agricultural School, Gorakhpur reported that ash gourds gave him a second crop of fruits as a result of jacketing. He had, however, a different experience with regard to wheat, peas and grams. In a replicated experiment conducted on plots of 1/8 an acre in size, electrical treatments had not produced any effect. (vide statement II).

STATEMENT II

Name of crop.	Yield per acre.		
	Seed sparked.	Seed soaked in sparked water.	Control.
Wheat	15 maunds	13½ maunds	13½ maunds.
Peas	14½ ,,	14½ ,,	13 ,,
Gram	13·11 ,,	13 50 ,,	13·11 ,,

The farm manager, Mainpuri, informed me of a similar experience on his farm with wheat. I might also mention here that Dr. Nehru supplied me with four samples of cotton kapas, two of which were from plots irrigated with sparked water. When they were examined at Coimbatore by the technological assistant for fibre properties, the results of the duplicates were conflicting with regard to lint length; but in the case of lint and seed weights definite improvements were noticed. Sparking would, however, seem to have had no effect on fibre weight and immaturity of fibres.

STATEMENT III

Name of cotton.	Seed weight mgm.	Lint weight mgm.	Ginning %	Lint length in. m.m.	Fidre weight 6 10 gm.	Immaturity %
520 untreated	52·2	32 6	38·4	0·68	2 85	95 – 2
520 treated	66·0	35·8	35·2	0·80	2·52	90 – 3
Comilla untreated	76·4	52·1	43·6	0·79	3·44	98 – 05
Comilla treated	82·5	61·5	42 7	0·75	3·86	98 – 07

At a number of villages like Mangaon, Sujrai, Karhal, Bamrauli, Kusyari and Eka, it was interesting to see sickly and dying mango and citrus trees rejuvenated, and putting forth fresh shoots as a result of jacketing. In some of them the dead cores were yet visible betraying their past history. At Bamrauli, the owner of the orchard narrated to me how he failed previously to get a good stand in his garden on account of alkalinity of the soil and how he succeeded in the last trial with the help of jacketing and application of sparked water. At the time of my visit these young trees were throwing out new shoots. At Labhowa, a Jambulana tree was pointed out to me by the young Zamindar as a specimen which started bearing after the jacketing treatment. Again at Bahraul almost all the mango trees were observed in an orchard to be literally laden with fruits in a season declared bad for fruiting. Such a remarkable condition was ascribed to the electrocultural treatments (jacketing and irrigating with sparked water) practised by the owner. Again in the Raja's garden at Eka two Bael (*Aegle marmelos* Corn) trees growing side by side within a distance of 8' were shown to me as having been in poor condition about six months back. When one of them was jacketed, it commenced to put forth fresh shoots. At the time of my visit that tree had a fairly good growth of healthy leaves, while the untreated tree was bare with no leaves. At Rodain, a few mango and citrus trees were reported by Mr. Dhar, Superintendent of Hunter's Garden, to retain fruits better as a result of Agaskarisation. It was interesting to see at Naglahar, trees fruiting well on a badly alkaline patch as a result of jacketing. Again at Gorakhpur a number of mango trees were brought to bearing at the instance of Sardar Surjan Singh by covering the base of the trunks with iron wire. Besides a small experiment was conducted in duplicate here by Mr. Singh to determine the optimum size of the wire netting required for jacketing citrus trees. It was stated that he chose the best tree for the control and jacketed neighbouring four trees with 4", 6", 9" and 12" wide wire netting. At the time of my visit the control was the poorest signifying the effectiveness of jacketing. Amongst the different widths of jackets, 9" was found to be the best for growth as well as for the total yield. But it was at Turnab farm, that a convincing proof of the usefulness of jacketing was obtained. A series of experiments in replicated plots on peaches and plums were started there, three years ago by Col. Noel and their performances are being carefully recorded by the farm staff. The yields for the past two years were statistically examined. (Vide Statement IV). It is manifest from the analysis of the results that in both years mere jacketing around the base of the trees

has definitely enhanced the yields up to 50%, while jacketing of branches only has failed to induce any appreciable effect.

With regard to the improvement of animals by electroculture, my observations were rather very limited. At Sikandarpur, a poultry man showed me two eggs, one from a treated and the other from a normal, hen. The former was distinctly bigger which fetched him 20% more money. At Karhal and Bahraul villages two respectable men showed me pullets, bigger in size than the normal due to the feeding on grains soaked in sparked water. I saw at Chandpura a buffalo said to be fed on sparked straw and concentrates. It looked distinctly healthier and bulkier. At Ruppura where most of the residents are employed in selling dairy products at Mainpuri, I learnt that buffaloes increased their milk yield and yielded a better quality of butter when electrified feed was supplied to them. It would appear that a co-operative society was formed at Sirsaganj for the supply of 'Bijili' ghee (Bijili = electricity) to Calcutta market where it actually fetched, it seems, Rs. 2 extra per tin over the ordinary brand. Unfortunately the prime worker in that society died prior to my visit which precluded me from seeing the actual working of the society.

STATEMENT IV.

Yield of peaches on the Turnab Farm.

Treatments.	Field No. 6 A. Plot I.					Field No. 6 A. Plot II.				
		1935–36		1936–37			1935–36		1936–37	
	No. of trees.	Yield per tree in lbs.	Increase over control.	Yield per tree in lbs.	Increase over control.	No. of trees.	Yield per tree in lbs.	Increase over control.	Yield per tree in lbs.	Increase over control.
			%		%			%		%
1. Jacketing trunk	21	192·2	+31·2	203·0	+40·2	28	184·4	+18·3	176·0	+16·1
2. Jacketing trunk and branches	21	176 2	+20·2	184·5	+28·2	28	176·2	+13·2	157·5	+ 3 8
3. Jacketing trunk	21	146·0	− 0·5	157·1	+ 8·4	28	149·1	−4·2	144·4	− 4·6
4. Control	21	146·7		144·8		28	155·8		151·4	
Critical difference (P=0 05)		14 74		26·7						

Yield of plums on the Turnab Farm.

Treatment.	No. of trees.	Yield per tree in lbs.	Increased over control.	Yield per trees lbs.	Increase over control.
			%		%
1. Control (1935)	8	18·4			
2. Jacketed in 1935	8	28·7	+56·1	35·1	+36·0
3. Control (1935 & 1936)				25·8	
4. Jacketed in 1936.	5			34·0	+31·8

N.B. As the experiments on plums were not done on replicated basis and as proper precautions were lacking with regard to outskirts, their yields cannot be analysed statistically.

In the case of human beings, I happened to see a ryot at Kusyari with a scar about 5" long and about 3" wide reported to be healed entirely by the use of sparked water. Sardar Surjan Singh of Gorakpur told me of his personal experience. He had, it seems, a kind of facial paralysis and rheumatic pain in the body which he was able to shake off by sparking the affected portions from a cycle magneto. On the day of my arrival at Mainpuri, Dr. Nehru got a letter from Sri. Rao Bahadur L. Venkatakrishnan, Superintending Engineer, Tanjore, wherein he described how his old father was saved from acute attack of uraemia by electrocultural treatment at a stage when doctors had given him up.

The visits and reports mentioned above, interesting and instructive as they were, made me feel that some of the treatments advocated by Dr. Nehru had certainly something useful behind them; but unfortunately they were being carried out in such a way that it was difficult to form a decisive opinion about their individual performances.

It strikes me that testing them under conditions of normal agricultural experiments would have given them more reliable background. Provision of more controls and maintaining records of their behaviour would have given greater support to the reports made. I, however, could realise the innumerable obstacles that would have stood in their attempting to do so.

With regard to the theory of the reactions noticed, Dr. Nehru explains that the basic principle in all these experiments is "wherever there is cellular activity electrical energy is developed and conversely wherever electrical energy is applied, cellular activity is increased and better growth is obtained". He considers that by sparking "clogged capillaries become normal and when electrified water is taken in, it is reasonable to expect metabolism to improve, nervous tension to be stabilised, functional equipoise to be regained and in short vital processes to be fastened". He further says that in Agaskarisation "a mild electric field is set up by the sparked water coming in contact with the numerous growing points and as a result cell sap moves more freely". He describes it as 'a reproduction of the natural phenomenon associated with monsoon rains when rain charged clouds are struck by lightning before they burst into showers'. Regarding jacketing very little is known about its mode of action. Dr. Nehru is of opinion that cosmic radio magnetic waves are captured by the wires. In the case of mito-genetic radiation, it is reported to be due to ultra-violet rays of very low intensity emitted by meristematic cells of certain plants. Dr. Nehru is of opinion that when irrigation water is passed through beds growing onions, the water is enriched by the emanations from the onion roots.

My conclusions are that jacketing of trees has some wonderful effects in resuscitating and improving trees, and that sparked water will be useful for the treatment of diseases. But more experiments and observations seem to be necessary before a definite opinion can be offered on the effects of sparking and mitogenetic rays on the improvement of crops.

We are doubtless much indebted to Dr. Nehru for suggesting the method described supra and for bringing the potentialities of electrocultural treatments within the reach of ordinary farmers. He has spent much of his time and money in the midst of arduous duties of a District Magistrate, in devising methods and testing them. The apparatus he now recommends is simple, foolproof and inexpensive. His jacketing idea is original and marvellous. But one only wishes that these experiments have been conducted under more controlled conditions such that greater confidence might be created for saying that the effects will be reproduceable under all conditions. Such a premise is extremely essential especially in a department like ours where a single mistake committed or a single failure experienced as a result of our recommendations will drive away all the confidence and trust reposed on the department by the farmers, and it will take years before the original position is regained. There is also another point to be considered in this connection. In all cases where good results have been achieved, it is certain that the nutrients needed for the extra growth should have come from the soil which in other words will mean that these treatments will result in the exhaustion of the soil. It is necessary to know before we take up the advocacy of the electro cultural treatments, the nature of their after-effects. It will therefore be advisable to test all the methods—barring perhaps jacketing - suggested by Dr. Nehru under more vigorous and controlled conditions and also secure more data on the optimum strength of current needed for each crop, the relative efficacy of different methods, the optimum size of wire netting, the effect of onionised water and on the nature and extent of their after-effects.

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ADDENDUM

Subsequent to the preparation of the above note the following information was supplied by Dr. Nehru.

150' length of Duranta hedge was irrigated with the sparked water once a week for three weeks in succession. Its Growth was one and half times better than that in another portion of the same hedge which received only plain water.

Onions were planted around 12 peach plants in the Government House at Lucknow. After three months, their growth was one and half

imes more than the normal. Further the onion planting revived two of the plants that were about to die.

In an horticultural garden, 5 six months' old papaya plants were jacketed while another set of five was kept as control. After three months, the jacketed trees showed better growth in the size and number of fruits produced. In most of them the fruits were one and half times bigger than in the untreated.

Col. Noel made an experiment of growing wheat in ordinary flower plots as well as in pots made of expanded metal. Both lots were placed on a bed of sand so as to equalise conditions of drainage and evaporation. Wheat grown in pots of expanded metal gave thrice as much yield as in ordinary mud pots. The same experiment was repeated with maize and there too, the cobs produced in the metal pots were twice as big as in the earthenware pots. Again jacketing of trees in Turnab farm had given 30% more yield for the third year in succession.

MANUFACTURE OF SYNTHETIC NITROGENOUS FERTILIZERS IN INDIA

Part II. Comparison of different Processes for the Fixation of Atmospheric Nitrogen.

By C. N. ACHARYA, M. Sc., Ph. D., A. I. C., F. A. Sc.

The three important methods for the fixation of atmospheric nitrogen are, in historical sequence, the arc, cyanamide and the synthetic ammonia processes, though other methods such as the nitride and the cyanide processes have been put forward from time to time. In discussing the relative advantages of these methods we must have certain criteria of judgment, e. g., the capital outlay, running expenses, availability of raw products in the vicinity of the factory and the suitability of the products to the local market.

The arc process requires a much larger outlay and consumes a much greater amount of electricity per unit of nitrogen fixed than the cyanamide and syntheiic ammonia methods. Hence it has been adopted only in countries where electric power is abundant and very cheap, e. g., in Norway, Sweden, Canada, etc. Even these countries have now given up the method in favour of the synthetic ammonia process, which is much cheaper.

Power Requirements of Nitrogen Fixation Processes.

(Partington and Parker)

Fixation Process.	K. w. hrs. per K. gm. N fixed.	K. w. yrs. (8760 hrs.) per metric ton of N fixed	H. P. yrs. per long Ton of N fixed.
Arc (exclusive of steam raising value of furnace gas) ...	73·7	8·41	11·45
Cyanamide	16·5 to 19·5	2·03 to 2·37	2·76 to 3·23
Haber (Assuming power supplied electrically)	3·6	0·435	0·592