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PROEXAG II

EXPORT INDUSTRY TECHNOLOGY SUPPORT PROJECT (AGRICULTURAL COMPONENT)

MONITOR AND ASSIST WITH VERNONIA EXPERIMENTAL PLANTINGS IN LEON, NICARAGUA

Assignment Number: ST-136

PREPARED BY:

Robert E. Perdue

THROUGH

Chemonics International Consulting Division
2000 M Street, Northwest
Suite 200
Washington, D.C. 20036

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UNDER THE AUSPICES OF:

United States Agency for International Development (USAID)
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5a. Ave. 15-45, Zona 10
Edificio Centro Empresarial, Torre 1, 9º Nivel
Guatemala City, Guatemala
Tel.: 502-2-33-7082/83/84 · Fax: 502-2-33-7081

5805 Blue Lagoon Drive, Suite 170
Miami, FL 33126-2109
Tel.: (305) 262-0881 (305) 267-7382
Fax (305) 262-0635

A DEVELOPMENT PROJECT SPONSORED BY USAID/ROCAP AND IMPLEMENTED BY CHEMONICS INTERNATIONAL

NOTES ON TRAVEL TO NICARAGUA AND GUATEMALA
(NOVEMBER 29 - DECEMBER 9,1992)

After our experience in Costa Rica where the wind begins at the end of the rainy season as vernonia seed begin to mature I began looking for a more suitable area. A logical place was Belize where Tom Post, a missionary, achieved the record reported yield of 2699 lbs/acre.

I visited the National Agricultural Library, Library of Congress and AID Library to search for publications and reports that might provide useful information on Belize, especially on soils and rainfall distribution.

At the AID Library I found a Project Report by Chemonics, a Washington, DC based consulting organization, that cited a large unpublished report on the climate of Belize. A series of events beginning with a telephone call to the Chemonics Washington office (in search of that report) led me to Mark Gaskell, an agronomist, at the Chemonics office in Miami, who had been involved in an AID-sponsored Chemonics project in Belize. The objective of that project was to help farmers in Belize with the development of non-traditional crops for export.

Mark indicated that the initial success with vernonia in Belize might be difficult to duplicate because well-drained soils required by vernonia are unusual in that country. Furthermore, it would be difficult to find large areas where vernonia production could be mechanized.

Mark indicated that he had just been assigned to a new project to help farmers in several Central American countries with non-traditional crops. He would be headquartered in Guatemala City and he thought Nicaragua would be suitable for vernonia. I sent him seed which he subsequently used for a trial planting on a farm near Leon, Nicaragua.

In early November Mark telephoned to advise that the planting in Nicaragua looked very good. The plants were vigorous, had good color, were 2.5-3 ft tall and were growing well. He invited me to come to Nicaragua at Chemonics expense, to review progress and to advise on further developments. He would arrange for transportation in Nicaragua and someone to accompany me during the visit.

Initially the trip was planned for January 1993 but in the meantime I had mentioned to Mark that we were looking for a place for a small production planting with seed to be sown by mid-December. He believed the farmer who had established the trial planting in Nicaragua would be receptive to a production planting and with that opportunity we decided to move up the trip to late November.

About a year ago, a person in industry who is very interested in vernonia oil visited here and I arranged a meeting with Dr. John Daly, USAID's Program in Science and Technology Cooperation in Washington, DC. PSTC provides grant funds for research projects in which there is cooperation between US and developing country scientists. The purpose of this meeting was to impress upon Daly that there is serious interest by industry in vernonia oil so as to encourage AID funding of research on vernonia. During this meeting Daly mentioned two scientists in Guatemala who had received PSTC grants and whom he thought would be receptive to submitting proposals to PSTC for research oriented toward a market for vernonia seed meal. There were thus opportunities in Guatemala as well as Nicaragua and I decided to include Guatemala in the itinerary.

Nicaragua

I arrived in Managua on Sunday November 29 and was met at the airport by James Johnson. James was born in Nicaragua. His mother is Nicaraguan and his father is a US citizen. His father came to Nicaragua as an employee of the American Embassy (Security), retired there and became a high school teacher. The family also has a livestock farm in Nicaragua. James is about 30 years of age, served 4 years in the US Army and studied agronomy and animal husbandry at the University of Arizona. James says his first language is Spanish but his English is just as though he were born and raised in the US.

James is employed by APENN (Nicaraguan Association of Producers and Exporters of Non-Traditional Products), a farmer's organization. In Nicaragua non-traditional products means asparagus, cantaloupes, honeydew melons, onions, etc. for export to the US and Europe.

I was in Nicaragua 5 days and each day we drove from Managua to Leon, about 90 km northwest of and about 1-hour drive from Managua, to the farm of Ing. Cesar Lanuza (also a visit to ANSCA, the cotton gin) which is about 4 km from Leon along the road to Managua.

Vernonia at the Lanuza farm near Leon

The soil is a deep dark-colored sandy loam of volcanic origin with water holding capacity suitable for flood irrigation and appears ideal for vernonia. It is said to be naturally fertile and rich in organic matter but I suspect the natural fertility has been mined by many years of cotton production.

I observed two trial plantings, one planted August 20-21, the other about a month later. Vernonia was planted on ridges 25-30 cm high with deep furrows between (for flood irrigation) at several distances between rows and different distances between plants adjacent to an asparagus planting. They did not get a good stand with the first planting and there is little I can say about spacing

but clearly the wider rows are too far apart.

Plants in the earlier planting were up to about 1.3 m tall and some were lodging. Plants were flowering prolifically and lodging will become more severe as seed mature and weigh down the tops of the plants. The lodging was due to poor root development. The root systems I examined were spherical and 5 to at most 10 cm in diameter and only one had a distinct tap root and this was only about 15 cm deep. In this soil the root system should be triangular in cross section with a well developed tap root and the tap root should be at least twice as long as the fibrous roots just under the soil surface are wide. The planting had been irrigated each time the asparagus was irrigated and there was clearly too much irrigation for vernonia. Even so the plants looked healthy and I observed no evidence of disease (other than as mentioned below). Seed will be ready for harvest during the last half of January.

Because of the poor stand which resulted in more space between plants than desirable plants were more widely branching than desirable and this too contributes to lodging because of the weight of the branches.

I was told that earlier there had been a rot on the old lower leaves and on the upper young leaves of some plants. This problem developed after a period of several continuously rainy days during which precipitation totaled 10-12 cm. Water filled the furrows and covered the beds. I was told that a sucking insect fed on the young tender parts of the plants and brought in the fungus that caused the rot. The disease was controlled with Benlate (benomyl), a systemic fungicide, and only about 2% of the plants were effected.

This disease problem appears to be the same we experienced at one site at Santa Cruz, Costa Rica where soil was not adequately drained. During heavy rain, water accumulates on the soil; rain drops splash water from the puddles to the lower leaves of the plants; and the lower leaves become infested with a soil-borne fungus and turn black. We observed at Santa Cruz the same blackening of the upper parts of the plants. This was attributed to infestation brought in by an insect.

The diseased lower leaves do not seem to have much effect on the well being of the plants. The tops of effected plants die back but new growth develops from the healthy stem that remains. This is natural topping. Plants seemed to have recovered from this problem but the joint where the branches are attached to the main stem is weak and I expect that some branches will fall to the ground as the plants become heavy with seed.

The landscape here is quite flat and will become more so as land is leveled for flood irrigation during the dry season. The area

reminds me very much of the area around Salisbury on the eastern shore of Maryland which also is quite flat and has a sandy loam soil. In both areas there is poor surface drainage. In such areas on the Eastern Shore farmers dig drainage ditches and I did not notice many such ditches around Leon. I think vernonia production will be enhanced here during the rainy season if surface drainage is improved by ditches.

At 1.3 m tall plants were about the same height as in our last planting (El Pelon) in Costa Rica. On this deep sandy loam, if there is not excessive soil moisture, we will see much deeper root development and roots that will better anchor the plants and reduce the lodging problem. In the future we will probably be better off if the crop is planted at least one month later so that they will be much lower at harvest time. Later planting will also likely reduce or eliminate the problem with the fungus that causes the blackened leaves.

I noticed several plants that had wilted severely for no apparent reason. Death of occasional plants was reported in Zimbabwe and we saw this in Costa Rica. There is no explanation but also no reason for concern.

It will be difficult to harvest seed from such widely branching plants. Plants need to be more dense so the seed will be borne on the upper 1/4 to 1/3 of the plants. Row width needs to be reduced to about 20 cm. with plants no more than about 12 cm apart. Denser planting will also reduce weed problems. The main weed here is nut grass. Our experience in Costa Rica is that vernonia will quickly outgrow this weed.

I was told that sheep entered the vernonia plot and knocked over some plants but did not browse the vernonia probably because of the bitter taste of the leaves. According to a report from Haiti goats also do not browse vernonia and we observed in Costa Rica that pigs also avoid vernonia. We need to look into the possibility that sheep, goats or pigs can be used to control weeds.

White fly has been a concern because it devastates many crops. Vernonia has resisted white fly in Belize, Dominican Republic and Guatemala. I was told by Claudio Martinez, APENN agronomist who accompanied me on one trip to Leon, that he has observed white fly on vernonia but it is not a problem. Another person commented that white fly is no longer a problem now that the area in cotton has been greatly reduced.

The best way to sum up other events in Nicaragua is to explain why I agreed to a small production planting (7 manzanas) this month on the farm of Ing. Cesar Lanuza to be subsidized by Ver-Tech. (1 manzana = 1.7435 acres.)

1. According to Mark Gaskell and James Johnson, Ing. Lanuza, owner

of Hacienda San Francisco, is one of the five largest melon farmers in Nicaragua and last season was second in production. He is said to be one of the most progressive farmers in the country. He owns a gasoline station in Leon but that is apparently his only other active business interest. His office, very modest, is in the rear of the service station. He is a farmer first.

2. Ing. Lanuza has an impressive professional staff: university trained agronomist, entomologist, bee-keeper and accountant. He also has a full-time mechanic. A farm manager supervises 130 campesinos (peasants).

3. The Lanuza farm is just 4 km from Leon along the paved highway to Managua. Leon is the second largest population center (about 100,000) in Nicaragua. It is a farming town. There is little if any industry other than that related to agriculture. All services and supplies needed for farming in this area are readily available in Leon if they are available anywhere in Nicaragua. There is a shop where, I was told, any kind of equipment needed on the farm can be fabricated.

4. In this area of Nicaragua there were just a few years ago 400,000 manzanas (697,000 acres) of cotton. It is now down to 3,000 manzanas (5,200 acres) because of excessive use of insecticides. Farmers are desperate for a profitable crop. Cotton was grown on the sandy loam soils required for vernonia so the land available for vernonia is more than adequate. This could become a vernonia breadbasket. There is an abundance of surplus cotton harvesters which can be adapted to harvesting vernonia.

5. Sesame is an important crop in Nicaragua: 45,000-50,000 manzanas (78,000-87,000 acres) and is also grown on the sandy loams. It is a labor-intensive crop at harvest as vernonia will be until we develop harvest technology and is harvested just as we will initially harvest vernonia. The top yield of sesame (rarely achieved, I was told) is 1500 lbs/manzana (860 lb/acre) and the average yield is 700-900 lbs/manzana (401-516 lb/acre). This year the farmer is receiving $.16/lb. (When I visited Nicaragua two years ago the farmer was receiving $.18/lb.) The yield of vernonia here should initially be a minimum of 1,000 lb/acre with the potential of 2,000 lb/acre as we learn more about the crop and the value to the farmer will be at least $.20/lb. The return from vernonia to the farmer should easily exceed that from sesame. Vernonia should easily compete with sesame for land and farmers' interest.

6. Much of the sesame is harvested by hand but Ing. Lanuza and other large farmers have sesame harvesters ("manufactured in some Communist country, we think in Bulgaria") that are run off the PTO of a tractor. A sickle-bar mower cuts a 6 ft swath and a horizontal belt carries the plants to one side where two other belts lift the plants into a "cage". When the cage is full a

"claw" throws the plants to the ground in a bundle (if preferred, the plants are tied in a bundle). I was told they can harvest 15 manzanas of sesame per day with this harvester. They demonstrated the machine for me in a field of sorghum and it was certainly effective. I see no reason why this harvester could not be used with vernonia until we develop the specialized technology we will need and greatly reduce harvest costs below what we experienced in Costa Rica.

6. Farm labor is abundant and at $2.50 per day much less expensive than in Costa Rica. I was told in Costa Rica that Nicaraguans are much better farm workers than Costa Ricans and after what I observed on the Lanuza farm I can believe that. Women are favored for some duties in the melon fields because they are more careful than men and they may be more effective during vernonia harvest.

7. One of my major concerns was the possibility of desiccating dry-season winds and I raised this question at every opportunity in both Nicaragua and Guatemala. A dry-season wind is characteristic of the Pacific Coast of Mexico and Central America but nowhere is it so severe as in Guanacaste and I now think our last crop in Costa Rica was in the windiest part of Guanacaste. Ing. Lanuza has two sons in school in Costa Rica and frequently travels along the Pan American Highway, right by El Pelon where we had our last crop. He described the wind problem there accurately and says wind near Leon is no where near so severe. I raised the question about wind with four people in Nicaragua and they were all in agreement. The wind begins later in the dry season, is nothing like Guanacaste, and importantly, unlike in Guanacaste, wind at night is very unusual. I learned that Guanacaste wind is so severe because of its proximity (about 50 km from) Lake Nicaragua. The lake is about 175 km long and 75 km wide and there is little to protect Guanacaste from the winds that sweep across the Lake.

As a precaution Ing. Lanuza will never-the-less plant wind breaks of Taiwan grass (called King grass in Costa Rica where it is also used as a windbreak in melon fields) and the land will be levelled for flood irrigation. I am reasonably confident wind will not be a limiting factor in Nicaragua because it will not be so severe as in Guanacaste and irrigation will be much more effective than in Guanacaste because the land will be level and the irrigation pump will have much higher capacity than the one used in Guanacaste.

8. Ing. Lanuza and other growers export their melons in 40-ft refrigerated containers. Melons are loaded in containers on the farm and containers are trucked to Puerto Cortes, Honduras. According to James Johnson, the cost of moving a 40-ft refrigerated container from Leon to Wilmington, DE is $3,700-4,000 and the cost is $600-700 less for a non-refrigerated container. This is less than the cost of transporting our last shipment of seed from Costa Rica. Transport costs will be very reasonable if we move vernonia seed in amounts (40,000+ lbs) adequate to fill a 40-ft container.

9. James Johnson tells me that Chemonics is supportive in many ways and this was confirmed by Mark Gaskell. For example, he indicated that if we need to bring in an engineer to advise on harvest problems Chemonics can arrange this and cover the cost. Chemonics can also arrange for soil analyses, and insect and disease identifications, etc., if and when needed. The support of Chemonics was a very important factor in my decision to agree to a production planting.

10. James Johnson and or the other APENN agronomist visit each farmer member of APENN every 4-5 days so we have someone other than the grower and his staff keeping an eye on vernonia in Nicaragua.

11. James advised me that he will be available and can provide transportation any time I need to come to Nicaragua.

12. Ing. Lanuza already has an Export Contract. I did not have time to explore the perks of an Export Contract in Nicaragua but was advised it is much the same as in Costa Rica - no duty or reduced duty on equipment imports, export bonus (currently 15% for Ing. Lanuza), etc.

Our agreement with Ing. Lanuza specifies the following:

a. He will grow 7 manzanas of vernonia.
b. Seed will be planted during December 1992.
c. The irrigation pump to be reconditioned at a cost of $2,000 to Ver-Tech will be available for vernonia production as needed during the next 10 years.
d. The 7 manzanas of improved land will be available for vernonia production during the next 10 years.
e. Ing. Lanuza will provide as needed an additional 100 manzanas of land near the irrigation pump for vernonia production.
f. Ing. Lanuza will continue to support vernonia production with staff and equipment as needed.
g. Ver-Tech will make the decision as to how much seed will be retained in Nicaragua for future planting and how much seed will be shipped to the US for oil extraction.

After we discussed the terms of the agreement Ing. Lanuza commented that if we are successful he will install a large permanent irrigation pump. A small perennial lake on his farm will be the source of water for irrigation. I was told that he has 300 manzanas of land suitable for vernonia that can be irrigated from that point and that his immediate neighbor has a large area of suitable land that can be irrigated from the same source.

Seed cleaning facilities

Vernonia seed need to be debearded to remove most of the hairs on the seed. At the cotton gin I saw equipment, currently not in use, that can possibly be modified to debeard the seed. Alternatively,

a debearder similar to the corn sheller we used for this purpose in Costa Rica can be fabricated locally. A new clipper cleaner (New Generation 668) is being installed at the cotton gin for cleaning sesame seed - capacity 6,500 lbs/hr. It will not be difficult to set up a seed cleaning operation at Leon.

Irrigating vernonia:

I was asked to advise on irrigation practice for vernonia. The best advice I can offer is to irrigate deep and less often rather than shallow and more often and strive for a deep tap root.

An attachment shows three types of vernonia root systems I have observed.

A. This is a normal healthy root system on a friable well-drained sandy loam like the soil at Leon and is the kind of system the grower should strive for. Place a shovel in the ground near a well developed plant (that has reached the stage where seed are beginning to mature) to loosen the soil; then pull up the root. There should be a strong tap root that breaks at least 20-25 cm below the surface. The root system should be trangular in cross-section. With a root system like this there will be no lodging even when plants are heavy with mature seed.

B. This is the kind of root system we see on more shallow soils or on compacted sandy loams that were not plowed deep enough. The tap root may only be 5-10 cm deep and the laterals extend out from the stem 12-15 cm or even more. The plants are fairly well anchored in the ground and there will be little if any lodging. Fairly frequent irrigation or rainfall will be needed, especially late in the season, to assure a good seed crop.

C. This is the type of root system we get with excessive soil moisture, a tap root only 5-10 cm deep and the lateral roots forming a ball only about 10 cm in diameter. This is the type of root system I observed at Leon. With roots like this lodging will be a real problem, especially as the plants become heavy with seed.

The best guidance I can provide on irrigation is this: Irrigate deep before planting. Plant and keep the surface soil moist until seed germinate. Many seed will germinate in 3-5 days after planting and emerge about 4-6 days after planting. Periodically check depth of roots. Let the surface soil dry out to encourage deep root development. When plants are about 15 cm tall the roots should be at least 7.5-10 cm deep. When roots reach a depth of about 10 cm allow the upper 4 cm of the soil to dry before the next irrigation.

The time to encourage deep root development is during the first 6 weeks before flower buds begin to form. If drought stress during this period is more than desirable the plants can still recover.

After flower buds form, and especially after the first lavender flowers appear, more water will be needed to assure seed set and a good yield. In a mid-December planting flower buds should be evident about 6 weeks after seed are sown and plants should be in full flower after about 8-10 weeks.

The first flower bud will be a terminal on the main stem. The stem will branch and form terminal flower buds on the lateral branches after which there will be further branching with more terminal flower buds. This can continue more or less indefinitely so long as soil moisture is available. Three to four months after planting irrigation should be stopped so the plants will slowly dry up and mature the seed that have been formed. We will make a judgement on this (that is, when to stop irrigation) when next I visit Nicaragua.

Guatemala

I left Managua for Guatemala City on Saturday, December 5, a day earlier than planned so I would have time to attend the AgriTrade Fair in Guatemala City.

On Sunday afternoon I met with Mark Gaskell, the Chemonics agronomist responsible for my trip and Karl Ufer, his local assistant.

On Tuesday morning I met with Dr. Ricardo Bressani (a contact suggested by John Daly, USAID). He has been with the Institute of Nutrition of Central America and Panama but is moving to another position where he will continue his research. His new address:

Instituto de Investigaciones
Universidad del Valle de Guatemala
18 Avenida 11-95, Zona 15
Vista Hermosa III
Apartado Postal 82, 01901
Guatemala City

Tel.: 380-336 -40
Fax: 380-212

He will be looking for grants. I gave him a copy of a paper on the chemistry of vernonia meal published by the group at Howard University. He thumbed through the paper (scanning the tables). "Good, good, good. The amino acid pattern is encouraging". I encouraged him to apply to AID's PSTC program for a grant for research on vernonia meal and will send him a generous supply of defatted seed flake (the product that remains after oil is pressed from vernonia seed) and solvent extracted seed meal. (Research on these two products to establish a market for them is urgently

needed.)

That afternoon I met with Dr. Jose Calzada:

Head, Applied Research Division
Central American Research Institute for Industry (ICAITI)
Avenida La Reforma 4-47, Zona 10
Guatemala City
Tel.: (502) 2-31-06-31 -35
Fax: (502) 2-31-74-70

He replaced Dr. Carlos Rolz (recommended to me by John Daly) who has moved on to another position at the Institute. Dr. Calzada is a chemical engineer with many interests. One is herbicide and pesticide applications an area where he suggested vernonia oil and meal might be of interest.

Dr. Caldaza said he would consult with Dr. Bressani and see if they can come up with ideas for a proposal to AID's PSTC.

Follow up:

I am to send these items to contacts in Nicaragua and Guatemala:

Video, "Vernonia, Princess of Serendip", in VHS format to Gaskell and Johnson, in Beta format to Lanuza.

Script of video to Gaskell and Johnson for possible translation to Spanish.

Small plastic containers with vials of vernonia seed, meal and oil, and epoxidized soybean oil to Gaskell, Johnson, Lanuza, Bressani and Calzada.

Paper on chemical characteristics of vernonia meal to Gaskell, Johnson, Bressani and Calzada.

Vernonia bibliography to Bressani and Calzada.

Report on vernonia in Zimbabwe to Gaskell and Johnson.

Samples of press cake and solvent extracted meal to Gaskell and Bressani.

Several copies of "Vernonia - bursting with potential" (reprinted from AGRICULTURAL ENGINEERING) to Lanuza.

Copies of February 1992 issue of INDUSTRIAL FINISHING to Gaskell and Lanuza (of interest primarily because of the eye-catching cover; vernonia was the cover story).

Vernonia "overview" (questions most often asked about vernonia with answers) to Gaskell and Johnson.

"Chemical evaluation of defatted Vernonia galamensis meal" by Ologunde etal (reprinted from Journal of the American Oil Chemists Society) to Gaskell, Johnson and Calzada.

Report on rice drying in Viet Nam to Carlos Velasquez, ANSCA.

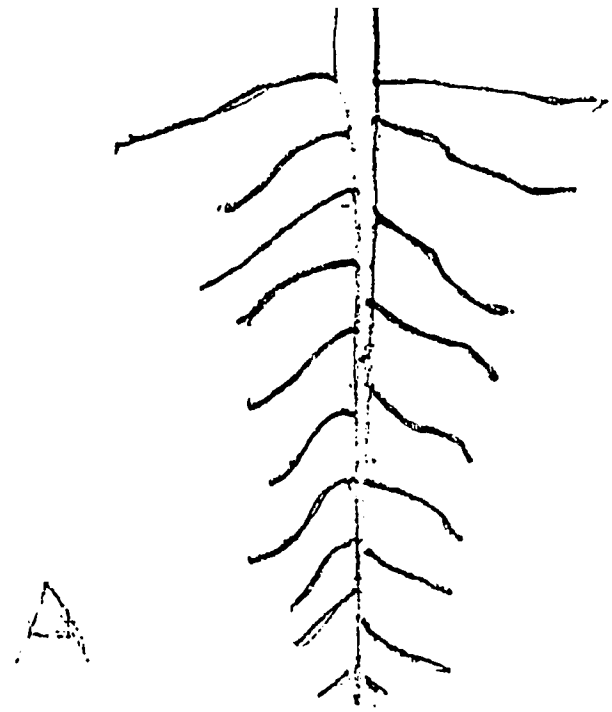
Information on guar to Johnson.

Information about market for marigold flowers (for chicken feed) to Johnson.

If I have overlooked anything, please call that to my attention.

Robert E. Perdue, Jr., President
Ver-Tech, Inc.
11000 Waycroft Way
North Bethesda, MD 20852

Tel.: 301-881-7030
Fax: 301-984-7372



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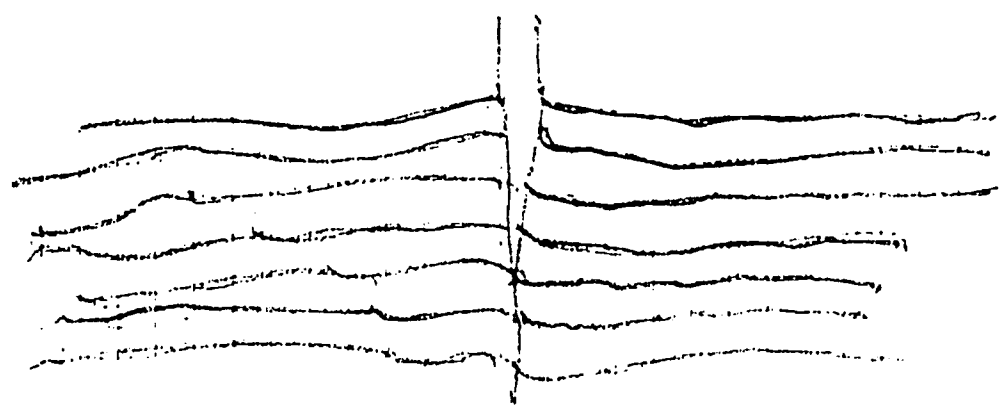
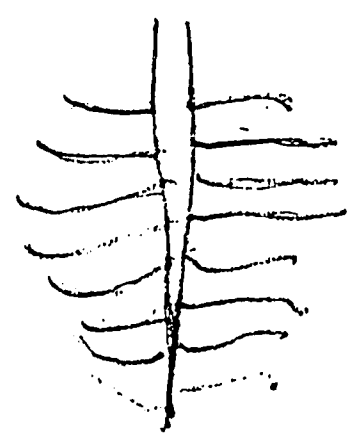
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