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GEOGRAPHICAL VIEWPOINT**MAN AND HIS ENVIRONMENT¹**

by

DOMINGO C. SALITA²

When I was invited by Vice-President Laus of your Society to be your resource speaker this afternoon, I felt deeply honored for I know that I will be in very good company. As I looked around, I can not fail to notice that the members of the Philippine Booklovers Society are widely read and well informed on all the branches of human learning. Your President, former Senator Imay Pecson who is internationally known as a scholar and civic-leader, is the inspiration of the Society. You are the examples of the true scholars who are lovers of wisdom as you keep on searching for truth and knowledge.

I have decided to share my views with you on a subject that I know little about — Man and His Environment. It is a subject that is often discussed in our daily newspapers as it affects the lives not only of the present but also of the generations yet unborn. It has been said that if one desires to know more about a subject he must have to teach it or discuss it publicly. So he will be forced to read more about it. In this connection it is pertinent to mention what Bishop Fulton Sheen said in his book entitled *Wit and Wisdom*: "If you copy any thing out of one book, it is plagiarism. If you copy any thing out of two books it is research. And if you copy it out of six books you are a professor."

In order not to fall under the category of a plagiarist, I have taken some of the sources of this paper from at least six different books and journals. Because of this, I have found several definitions of what

¹ Delivered before the Philippine Booklovers Society on February 27, 1977.

² Dr. Salita is Professor of Geology and Geography, University of the Philippines.

constitute the environment. One author defines the environment as the unique skin of soil, water, air, mineral nutrients and other organisms that cover the otherwise undistinguished planet earth. Another writer defines the environment as constituting of the natural things that surround us which comprise the air, water, land, plants and animals and the energy coming from the sun. Still, another scholar defines the environment as the aggregate surrounding that influence the growth and development of the life of an individual or population, especially man. The most comprehensive definition, however, considers the human environment as including everything, whether natural or artificially made that is outside of the skin of man. This includes the physical, biological and socio-cultural environment. The physical and biological environment represent the natural systems while the socio-cultural comprises the man aspects of the surroundings. Even poverty is considered part of man's environment. Because of this broad concept, the study of the human environment intersects many disciplines and involves several branches of knowledge — the natural and social sciences as well as the humanities.

What then is the goal of environmental education? The goal of environmental education is to develop a population that is aware of and concerned about the environment and its associated problems and which has the knowledge, skills, attitudes, motivations and commitments to work individually and collectively toward the solutions of current problems and the prevention of new ones.

In the Philippines which is fast approaching an agro-industrial economy, the study of the environment has acquired a very significant role. It is observed that much of the damage to the quality of the environment and to our natural resources can be attributed to ignorance, and because of this the impetus of the movement in environmental studies is getting an accelerated momentum in our country. In response to this demand, in 1973 during my incumbency as Dean, the College of Arts and Sciences of the University of the Philippines instituted the first doctoral program in Asia leading to a Ph.D. in environmental science. This was inspired by the Stockholm Conference in 1972 which focused world wide attention on the human environment. Our program is intended to provide teachers, scientists, researchers and leaders with knowledge in the proper understanding, conservation, utilization and management of our environment. In 1974 the National Science Development Board and the U.S. National Academy of Sciences sponsored a workshop in Manila in education and training needs of the Philippine environmental program. The workshop underscored the importance of education and training in solving environmental problems and recommended that environmental studies be introduced in the elementary, secondary and tertiary levels of education. The contemplated reform

in the educational program is central to the promotion of a new socio-economic order. The basic cause of our environmental woes is man's lack of ecological sensitivity. Unless the youth receives a new kind of education that is ecologically oriented and until the environment is regarded as a responsibility rather than an economic opportunity, the programs and approaches to economic development will only be a short term palliative. The heated debate going on between economic development and the maintenance of an acceptable environmental quality will only slow down the progress of mankind until man can become aware of his fellow organisms and the correspondence between their well-being and his own. Education moulds human values and this makes man more keenly interested not only in his own survival but also in the society where he lives.

Man is the central focus in environmental study for man is responsible for modifying, altering, destroying or conserving his environment. The scientist tells us that early man has evolved to conform with his environment. He was then a captive of his surroundings. Many biological adaptations and changes have taken place ever since man had learned to produce fire and to fashion the tools that will serve his needs. More recently the use of science and technology in place of physical adaptation has made it possible for man to insulate himself from the effects of the natural world by creating artificial environment. Today, man can occupy an incredible variety of ecological conditions without necessity of any structural change in his body. Thus, he can fly to the atmosphere and reach the outer space without developing wings. He can swim under the bottom of the sea without developing gills or fins. We can not however, elude the environment, for even our insulations have had their effects. Consider for example the effects on our health on the much use of motor vehicles with the resulting lack of exercise; consider the incidence of respiratory diseases including cancer due to pollution of the air, water and land which are caused by the wastes coming from factories, fertilizers and pesticides. The pollution of Pasig River, Tullahan River and the Manila Bay are but a few examples of the adverse effects of the improper disposal of the wastes coming from the nearby factories.

Each advance in man's actual evolution seems to have had a greater impact on his environment than the previous ones. As hunting and gathering gave way to herding, agriculture, industrialization and increased technological complexity, man seemed to lose touch with the magnitude of the effects on the natural environment.

Technology is the application of the laws of science to practical problems, frequently involving dexterity and exacting engineering skills. Technology is cautiously being improved and developed to serve the needs,

comfort, convenience and happiness of man. But in the process we disturb the balance of nature. We should not approach the problem of solving the material needs of man by considering only what is economically and technologically feasible. We should also consider the impacts of the products of technology on the environment. Can you imagine what is happening with the indiscriminate cutting of our forests? More floods, landslides, and rapid erosion of our rich soil are some of the adverse effects.

Basic to the study of the complex relationship of man and his environment is the relation between population and the earth resources. Geographers tell us that population is continually growing at an exponential rate while the size of the earth and its capacity to support human beings are limited.

We do not have substantial historical data on which to base estimates of population before 1650. It is thought that the human population at the time of Christ was about 250 million people and that it has doubled to 500 million in 1650. After 200 years the population doubled to 1 billion in 1850. The population again doubled to 2 billion in 1930 after the lapse of 80 years. The growth of population is exponential. The doubling period becomes shorter and shorter. If the present world population growth continues at 2% annually the doubling period is only 35 years and by 2000 the world population will be about 7.0 billion.

In the Philippines, at the time of the coming of the Spaniards, our population was estimated to be half a million. Today with our population of 42 million it is clear that the population has increased by 84 times. At the rate we are growing our population will double by 2000 which will reach 84 million. The size of the Philippines has, however, remained the same, 30 million hectares. This will mean increased pressure on the land. The rapid increase in population is due to increase in the longevity of life, a high birth rate and a reduction in death rate. These were made possible because of our improved knowledge in health and medical sciences. What are the consequences of this rapid growth of population? It means more mouth to be fed, more schools, houses, hospitals and other facilities to be constructed and more opportunities for employment and other comforts of life shall be provided. It means more consumption of energy, mineral resources, water, food and clothing which are finite. The power of the population to grow is definitely greater than the power of the earth to produce subsistence to meet man's needs.

Out of the total surface of the globe, about 70% is water and only 30% is dry land; 20% of this is too steep to be cultivated, 20% is too dry and 20% is covered with ice, so that only about 12% of the earth's surface is capable of being cultivated. With the present world popula-

tion there is only one hectare for every two persons that is available for cultivation. In the Philippines our arable land is estimated to be about 40% of our total land area. With a population of 42 million and an arable land of 12 million hectares, it follows that there are 3.5 persons dependent on every hectare of arable land. And if the population is doubled it means that 7 persons will be dependent for every hectare of cultivable land. How does this compare with the capacity of the land to produce? Has the yield increased as fast as the population? The answer is in the negative.

Some of the most serious land problems affecting land use arise from the competing uses of advantageously located lands. Many of our towns and cities arose from the center of our best agricultural lands, so that some of these valuable resources have been lost beneath highways, residencials, commercial and industrial sites as the urban areas have spread. Look what is happening in Metro Manila. Many of the best agricultural lands were converted into subdivisions and other places of settlements. The green belts and the trees that are needed to maintain the ecological balance are no longer there. Congestion and the lack of adequate living space are the results. The uncontrolled rural-urban migration has complicated the problem. The air, water and land have become polluted endangering the health of the inhabitants. This is the price of urbanization, industrialization and population explosion.

A change in the attitudes of individuals and society is the key to population control and to many other measures necessary for the solution of the environmental crisis. In the Philippines some of our traditions such as considering the number of children as a measure of wealth shall give way in favor of a fewer number to enable the parents to give them the best that they can afford. Changes in our economic, social and political institutions are also essential. The colleges and universities which should be leading the way in education have been too conservative and too compartmentalized. Changes begin in the minds of men. It is time that we institute multi-disciplinary and interdisciplinary education that are problem oriented. The divisions between the physical, biological and social sciences as well as the humanities is only arbitrary. The physical and biological sciences have one thing in common. They both study nature. On the other hand, the study of the social sciences and the humanities have also one thing in common, that is the study of man. In a nutshell, all the branches of human knowledge can be reduced to the study of man and nature. Since man is also a part of nature and not apart from nature, it follows that there is unity of knowledge as truth is one and individual.

Perhaps the greatest potential for reversing the environmental deterioration and bringing population under control lies in the utilization of our legal system. A law may be defined as a "rule of conduct

for a community prescribed by a governing authority and enforced by sanction." Self-discipline and cooperation of the public is also vital. Thus a proper enforcement and observance of our laws governing forestry, fishery, mineral exploitation and prevention on the pollution of water, air and land would do well to conserve our resources and maintain a reasonable quality of the environment. Our laws on marriage should be amended so as to increase the legal age for changing status and to make family planning a compulsory undertaking. Under our present laws, a female can marry at 14 while a male at 16 years, with parental consent. We should discourage teenage marriages. It may be pointed out that P100.00 invested in population control is worth more than P1,000.00 invested in economic growth.

While legal and legislative actions are essential to the solution of population problems and minimize degradation of the environment, it is essential that industries and businessmen should be conscious of their duties to society so that they will take the initiative in cleaning up their effluents before they are discharged to the atmosphere and seas. Better still, the effluents must be treated and recycled so that they can be re-used in the process.

One way in which change in our economic system might be accomplished would be to develop a new economics of the environment. The UN Environmental Program calls this process ecological development or ecodevelopment, in short. It means that in considering the cost-benefit calculations, the destructive effects on the environment should also be taken into account as part of the cost. Industry should be required to abate pollution at the source. Man and Society must be protected. An environmental index should also be established to determine whether the country is more or less habitable from year to year. In this connection I call upon the members of the Philippine Booklovers Society to contribute their knowledge and insight in arousing public consciousness towards a better quality of the environment.

Finally, the question may now be asked: Is man an endangered specie? Considering the rapid exploitation of the earth's resources and the pollution of water, air and land as well as the invention of the weapons of mass destruction through science and technology, there is no doubt that man is an endangered specie. Can he survive the crisis? My answer is — it depends on man himself. Since science and technology have contributed not only to the comforts of man but also to the deterioration of the environment, it follows that it is also through the proper use of science and technology that man can maintain a reasonable quality of the environment for his own survival. In short, a man-made problem requires a man-made solution.

PROGRESSIVE RATHER THAN CENTRALIZED TOURISM: A RECOMMENDATION FOR IMPROVING INTERNATIONAL TOURISM IN THE PHILIPPINES¹

by

WILLIAM L. THOMAS²

Anyone overseas who keeps abreast of current emphases on national development becomes at once aware of international tourism as a gigantic world-wide industry and an envisioned source of desirable external income for developing countries. The Philippines is no exception, and affords an outstanding example for case-study.

A decade ago local writers expressed amazement at the then hotel and tourism "boom" in Manila, a tripling in hotel capacity between 1965 and 1968; and yet five newer and larger hotels, of 300 to 550 rooms each, were then under construction. Viewed from present perspective — this was only the beginning!

The astounding recent growth in Metropolitan Manila of facilities for accommodating and entertaining international tourists has furthered Manila's role as the Philippines' primate city. North from Manila International Airport, the four districts of Makati, Pasay City, Malate and Ermita comprise "tourist land," all south of the Pasig River. A fifth is burgeoning by dredging Manila Bay for extensive landfill and upon it creating an International Convention Center complex. Anyone who has not been in the Philippines since 1974 will not recognize Metro Manila's new southern high-rise skyline which now includes fourteen 5-star hotels of international luxury standards. The hotel-building spree was triggered by Presidential Decree No. 535, called "Tourism Incentive Program of 1974" that provided a drastically liberalized and comprehensive investment scheme for the tourism industry. Among the incentives are:

- 1) deduction from taxable income of 50% of foreign exchange earnings for the first five years from start of operations;

¹ Expanded version of oral paper presented, with Kodachrome slides, on June 23, 1977 at the 40th Annual meeting of the Association of Pacific Coast Geographers, Waiakea Resort Village, Hilo, Hawaii.

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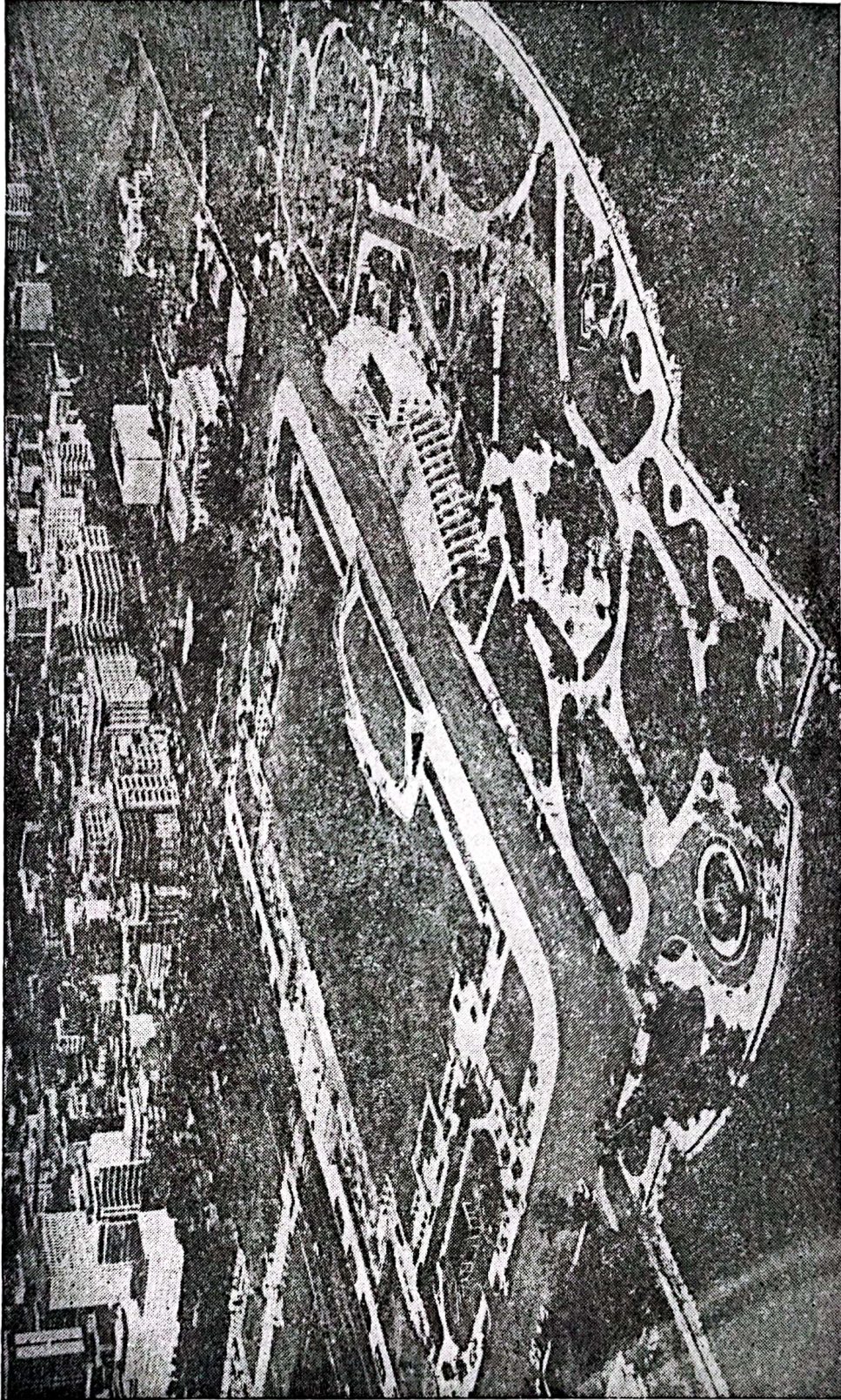


FIG. 1. AIR VIEW OF ERMITA DISTRICT, LOOKING SOUTHEAST TOWARD MAKATI FROM BURNHAM GREEN OVER SHORE OF MANILA BAY.

(PHOTO COURTESY DEPARTMENT OF TOURISM, PHILIPPINES)



MAP 1. THE INTERNATIONAL CLASS HOTELS IN METROPOLITAN MANILA. PRINCIPAL THOROUGHFARES ARE SHOWN FOR THE DISTRICTS OF THE CITY OF MANILA AND ITS NEIGHBOR CITIES.

- 2) carryover of net operating losses in the first ten years to the next six years;
- 3) exemption from real estate taxes on land improvements and buildings for the first five years from the start of operation;
- 4) preference in securing government loans;
- 5) tax exemption on importation of machinery, equipment, and spare parts for seven years from registration;
- 6) tax allowance of 10 per cent for investment;
- 7) exemption from the capital gains held on interest payments on foreign loans;
- 8) tax credits on locally purchased machinery and equipment;
- 9) exemption from capital gains tax of gains invested in tourism enterprise and from withholding tax on dividends remitted abroad;
- 10) tax deduction on reinvested profits to the extent of 50 per cent, if reinvestment is made in Metro Manila, or 75 per cent if outside Manila.

The "boom" had an established deadline, October 4-8, 1976, when some 4,500 persons from 116 countries were to attend the annual conference of the International Monetary Fund-World Bank. The construction of fourteen (14) first-class hotels, with a total of 6,457 rooms was begun in 1974 and proceeded with "break-neck" speed. These, with the 23 first-class hotels already existing with 4,736 rooms, brought the total to 37 hotels with 11,193 rooms. At no time have so many rooms opened at once on any Asian destination! By the time of the IMF-WB Conference only three of the new hotels (Holiday Inn, Mirador, and Regent of Manila) were fully opened; but all 14 shared among the 3,667 rooms reserved for the Conference by opening part of their facilities while construction continued on other floors. Only eight of the older hotels were to be used, for a total of 5,031 rooms. For the delegates the Cultural Center of the Philippines presented a splendid arts festival: seven performances of the Bolshoi Ballet, the pianist Van Cliburn, Dame Margot Fonteyn and the Australian Ballet, Montserrat Caballe of the Metropolitan Opera, plus several orchestral concerts, spectacular exhibits of "Egyptian Art through the Ages: and "Archaeological Finds from the People's Republic of China," two new halls of the National Museum on Philippine prehistory and ethnology, the museum of Philippine costumes, the Metropolitan Museum, Museum of Contemporary art, animal museum, and Nayong Pilipino (an outdoor ethnographic display with cottage industries in action. The Philippine International Convention Center (PICC) is a sumptuous facility, capable of seating 5,000 persons in its Plenary Hall and providing simultaneous interpretation in six languages; plus radio, TV, and satellite transmission. The red-carpeted, crystal-chandeliered Reception Hall can accommodate a sit-down dinner

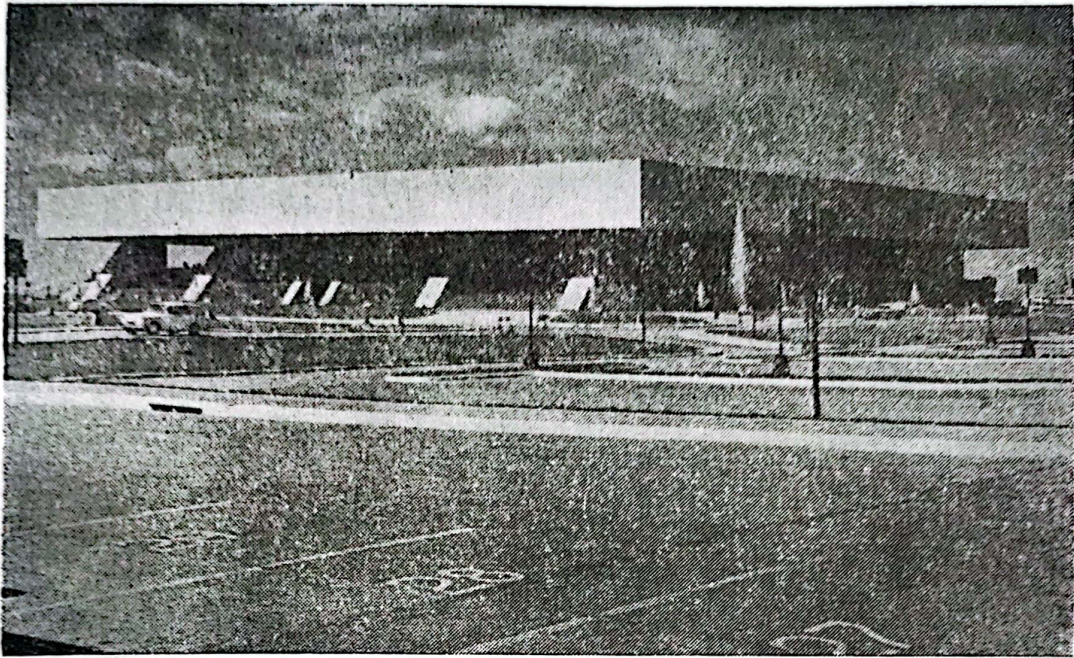


FIG. 2. FOLK ARTS THEATER, ONE OF FIVE HUGE BUILDINGS THAT COMPRISE THE PHILIPPINE INTERNATIONAL CONVENTION CENTER (PICC) COMPLEX BUILT ON LAND RECLAIMED FROM MANILA BAY.

(PHOTO COURTESY DEPARTMENT OF TOURISM, PHILIPPINES)

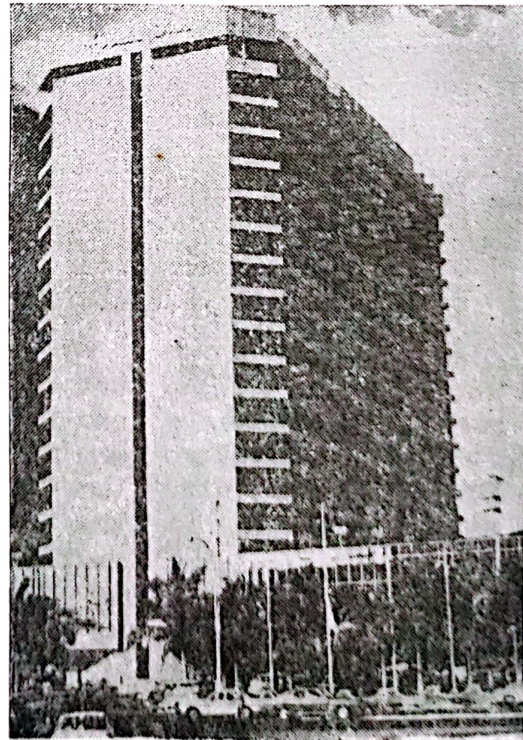


FIG. 3. HOLIDAY INN, ALONG ROXAS BOULEVARD IN MALATE DISTRICT, FACES THE P.I.C.C.



FIG. 4. HOTEL MIRADOR, ON SAN MARCELINO STREET IN ERMITA DISTRICT.

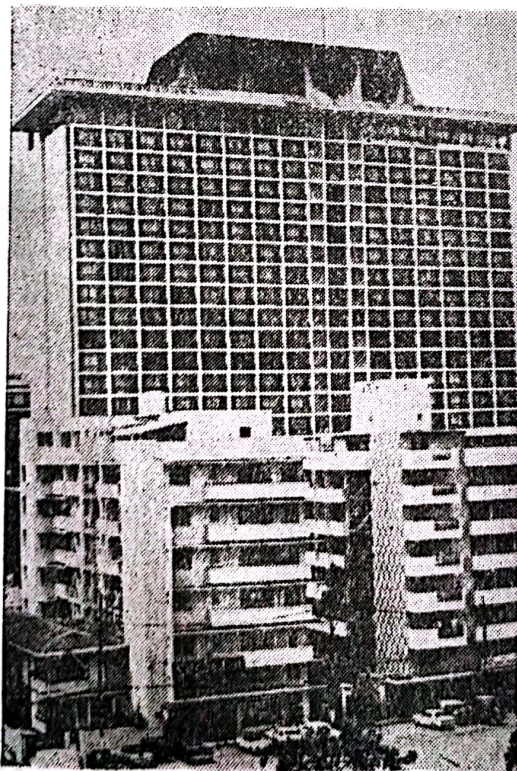


FIG. 5. MANILA HILTON HOTEL ON UNITED NATIONS AVENUE, ERMITA DISTRICT, AS VIEWED FROM THE ROOF GARDEN OF THE DEPARTMENT OF TOURISM BUILDING.

for 4,000 or a cocktail party for 5,700! The Delegation Building provides many personal services; the Secretariat building includes seven other meeting rooms seating from 150 to 514 persons. The PICC opened in September 1976; the IMF-WB was its first guest.

When the IMF-WB delegates arrived, most of its VIPs preferred to stay in the existing, and better known, hotels. Some 1,140 rooms in five older hotels were used and 2,450 in eleven of the new and partially opened. Ironically, the total of 3,590 rooms actually used could have been accommodated in the 4,736 rooms of the 23 older hotels without any new hotel construction at all! A preview of the forthcoming hotel competition soon occurred when five of the deluxe hotels vied to become the site of the regular weekly luncheon meeting of the Manila Rotary Club, the country's most prestigious businessmen's organization. The Manila Hilton won out by being closest to downtown Manila and having plentiful parking space.

There are now 45 tourist-class hotels in Metro Manila: 14 5-star, 8 4-star, 6 3-star, 12 2-star, and 5 1-star. In Ermita are two 5-star (plus two new 4-star hotels), seven are clustered around the convention center on Roxas Boulevard; four are in Makati, and one is at the airport. Having encouraged the establishment of the 14 hotels in line with its program of accelerating the development of the tourism industry, the government gave them a five-year grace period in their debt repayments. Unlike Honolulu, where all hotels were erected with private financing, the bulk of the funds for the new hotels in Manila was provided by the national government. The Century-Park Sheraton, for example, cost P339 million, of which P155.5 million came from the Development Bank of the Philippines. Total funding for all hotels is 1.5 billion pesos (US\$200 million) in the form of loans, with the remaining 30 to 40 percent accounted for by foreign borrowings. At the end of 1976, the foreign debt of the Philippine government stood at 5.5 billion pesos; the hotel investment thus equalled more than one-fourth of the total.

The "beautiful people" of Metro Manila were delighted with a new craze: hotel-hopping for dining and dancing during the Christmas-New Year's season. Each hotel reflects a different style and atmosphere. The revamped *Manila Hotel* is known for its breath-taking lobby, a showcase of Filipino artistry and its tropical fairy palace of a Coral Ballroom. The *Manila Peninsula*, on the other hand, is the hotel for businessmen-travellers and foregoes all trills, except for its 4-story high lobby, 120 ft. on a side as a place to snack and congregate. *Holiday Inn* is family-oriented, with homey charm and a delicatessen. *Hotel Intercontinental Manila* pioneered nine years ago in locating far outside the tourist belt in the rapidly growing commercial center of Makati and is known for its disco, jeepney coffee shop, and seafood restaurant. The *Philippine Village Hotel* adjacent to the International Airport features



FIG. 6. THE MANILA HOTEL IS LOCATED ADJACENT TO THE PORT DISTRICT, AND DATES FROM THE ERA WHEN TOURISTS ARRIVED BY SHIP.

(PHOTO COURTESY DEPARTMENT OF TOURISM, PHILIPPINES)



FIG. 7. THE MANILA PENINSULA HOTEL, AT THE NORTH-EAST CORNER OF AYALA AND MAKATI AVENUES IN MAKATI, TURNS ITS BACK UPON THESE BUSY THOROUGHFARES AND THE MAKATI COMMERCIAL CENTER ACROSS THE STREET. NOTE THAT ALL OF THE FOUR MAJOR HOTELS IN MAKATI INCORPORATE "MANILA" IN THEIR NAMES.

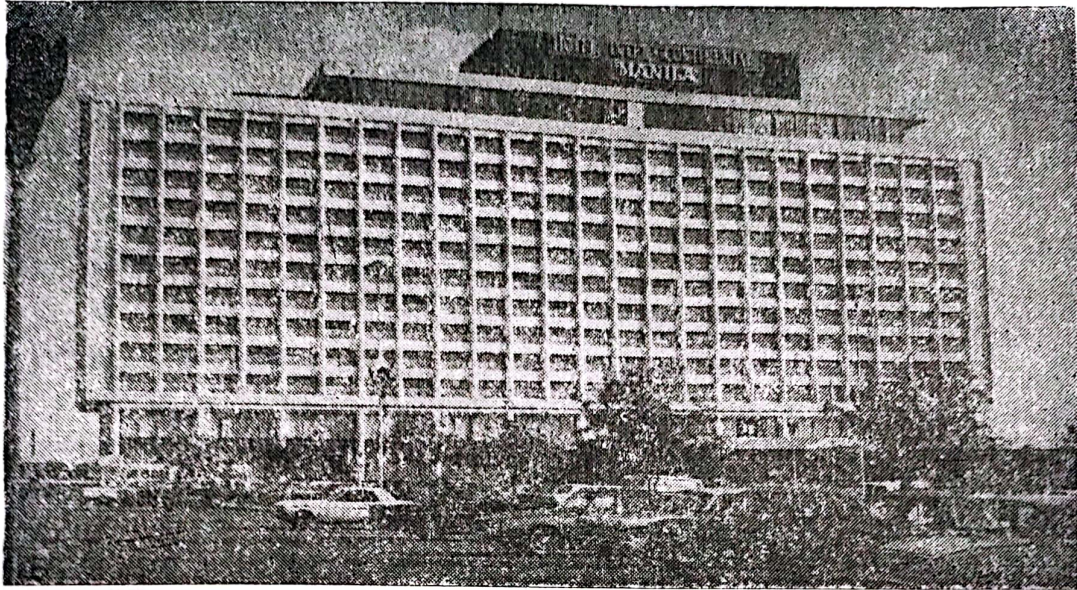


FIG. 8. HOTEL INTER-CONTINENTAL MANILA PIONEERED LOCATING IN MAKATI, OFF AYALA AVENUE AT THE SOUTH-EAST CORNER OF MAKATI COMMERCIAL CENTER.

(PHOTO COURTESY DEPARTMENT OF TOURISM, PHILIPPINES)

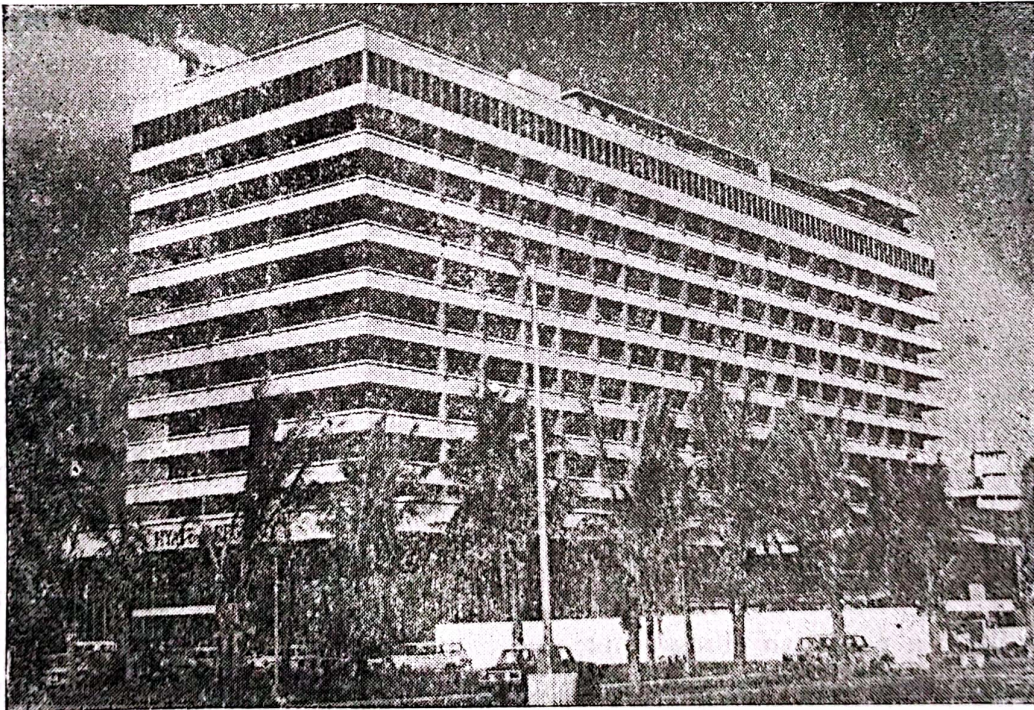


FIG. 9. HYATT REGENCY HOTEL, ALONG ROXAS BOULEVARD IN PASAY CITY, FACES MANILA BAY.

(PHOTO COURTESY DEPARTMENT OF TOURISM, PHILIPPINES)

food and service; it was the site of the 1974 Miss Universe beauty pageant and is the caterer for the President's state dinners. The *Manila Hilton* is the busiest, having originated lunchtime fashion shows, food festivals, the dinner theater, and multiple bars and restaurants, including Port Orient, a honky-tonk seafront dive. After ten years, the *Hyatt Regency* sets the standards by which others measure themselves, from its Hugo's Restaurant to its use of native decor, to its Mandarin restaurant featuring Chinese specialties.

Two four-star hotels, with five-star facilities, are the *Manila Midtown Ramada* and the *Mirador*. The Ramada is the largest hotel in ground-space with a two-story complete shopping arcade, sports center, trade and exhibition hall, and a famed executive chef. The *Hotel Mirador* is the only international-class hotel that is 100 percent Filipino-owned, managed, and staffed, featuring a Mexican-style room, El Pueblo, and a Japanese restaurant, the Golden Kimono.

Visitor arrivals in the Philippines reached 583,000 in calendar year 1976, a 19.4 percent growth over 1975, with earnings reaching US\$230 million. The number of Japanese tourists dropped about 18 percent, reaching only 160,187, as travel agents in Japan played down the Philippines following a series of kidnappings of Japanese when in Mindanao in 1975 and early 1976. Yet the Japanese remain the Philippines' most numerous visitors, as they have been since 1972. In 1976, Filipino "balikbayans" numbered 136,337, and Americans 93,007, whereas Australia contributed 36,000 visitors, as the Philippines constitutes less expensive travel to an English-speaking country than going to Europe. More than 30,000 visitors came from other ASEAN nations, on package tours from Singapore, Malaysia, Thailand, and Indonesia. "Honeymoon" tours have been especially popular.

People are clearly divided on the sizzling issue of hotel-building in the Philippines. One group advocates "Build now, avoid the rising costs of construction in the future, and take advantage of the influx of tourists." Another group believes that the Philippines will never attract enough tourists to make economically viable the existing new hotels, and that government money should have been better invested in other development projects for Filipinos, e.g., agriculture or housing.

The problems of Philippine tourism in 1977 are awesome, now that it is on a par with Hong Kong and Singapore in its capacity to accommodate visitors. To maintain its tourist hotels with 13,000 rooms, Manila has to generate about 800,000 visitors a year, whereas Hong Kong and Singapore are already receiving over 1.5 million visitors each, as in 1976. This will require about 400 plane flights a week, or twice the present number of flights landing at Manila International Airport. An "open skies" air policy has been liberalized to expand the flight fre-

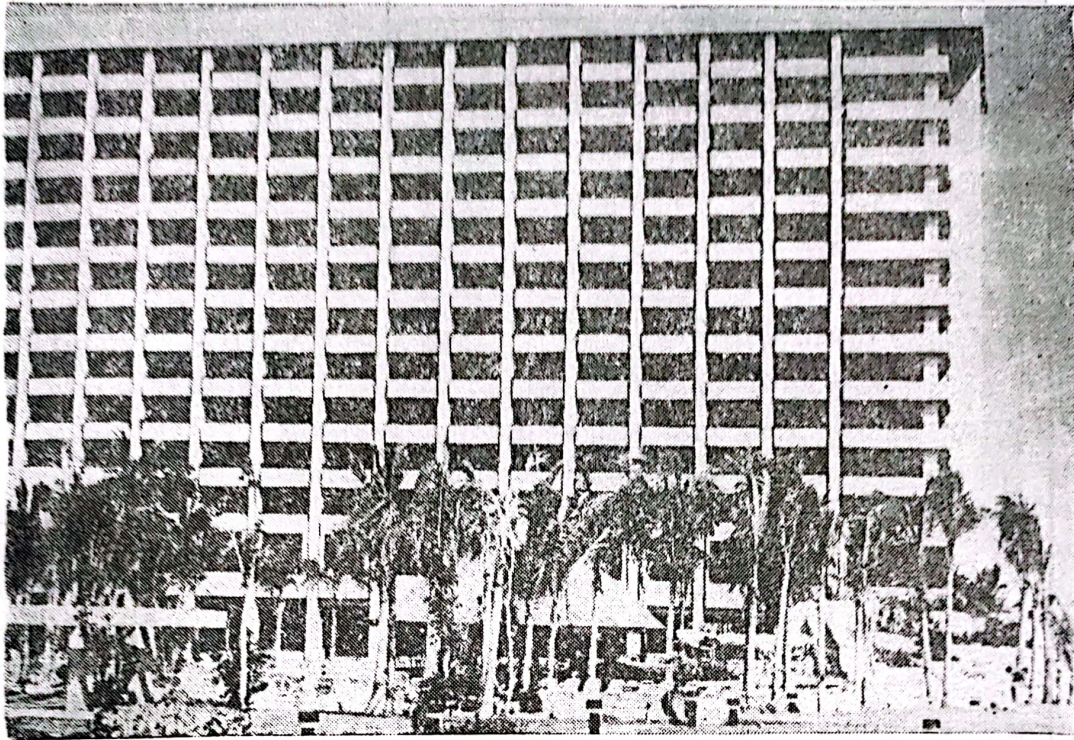
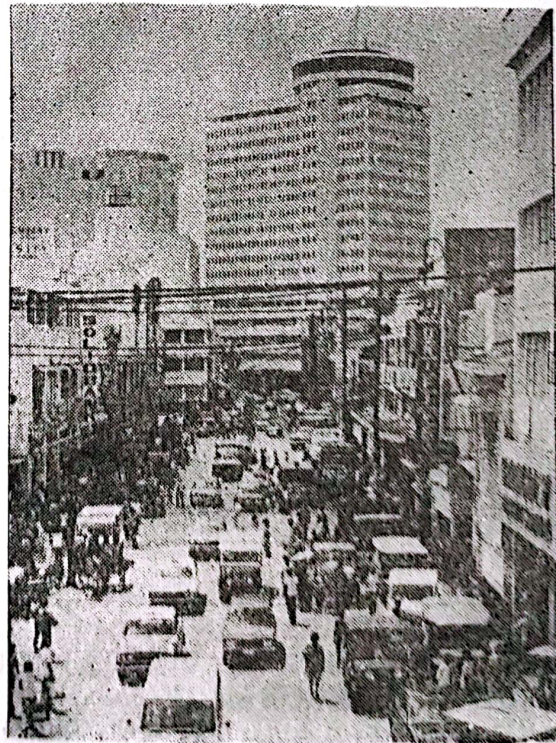
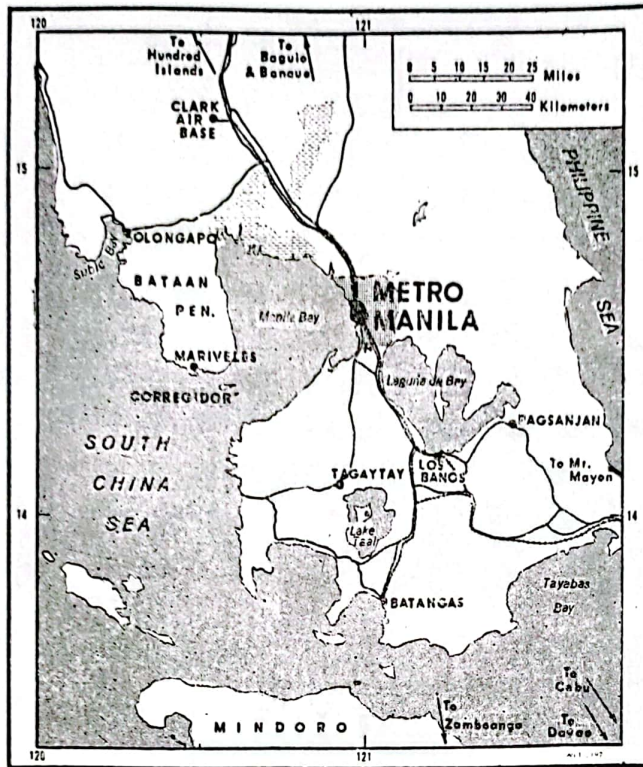


FIG. 10. THE PHILIPPINE PLAZA HOTEL IS NEAREST THE PHILIPPINE INTERNATIONAL CONVENTION CENTER (P.I.C.C.) AND OVERLOOKS MANILA BAY.

FIG. 11. THE MANILA ROYAL HOTEL, WITH ITS REVOLVING ROOFTOP RESTAURANT, IS THE ONLY HOTEL OF INTERNATIONAL STANDARD NORTH OF THE PASIG RIVER IN "DOWNTOWN" MANILA, AND HENCE NOT IN THE TOURIST DISTRICTS. LOOKING NORTHWEST ALONG PALANCA STREET FROM THE NORTH END OF QUEZON BRIDGE.





MAP 2. TOURIST LOCALITIES NEAR METRO MANILA IN CENTRAL LUZON.

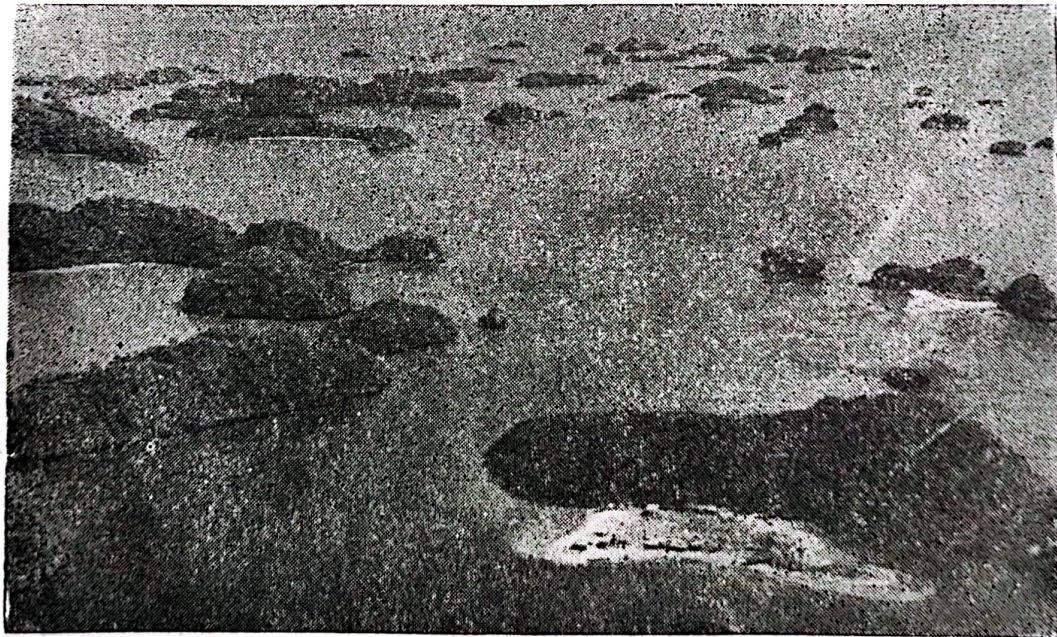


FIG. 12. HUNDRED ISLANDS IN LINGAYEN GULF, NORTH-WESTERN PANGASINAN PROVINCE, ARE UPRAISED CORAL ISLANDS THAT ARE A FAVORITE TOURIST SPOT FOR BOATING, FISHING, AND SCUBA-DIVING.

(PHOTO COURTESY DEPARTMENT OF TOURISM, PHILIPPINES)

quencies of international airlines, including those from the Middle East. But the present airport is ill-equipped to receive even its present numbers. Congestion is terrific now when only two 747's arrive simultaneously! A larger terminal is a vital necessity. And what a terminal it will be! When completed, the new MIA building will be able to service eight jumbo jets (747s), two Concorde (SST) and 15 DC-10 and DC-8 types of aircraft at any given time. But construction is yet to begin.

The Philippines may be the only country in which the government does all of the promotional effort and foots the bills, via its cabinet-level Department of Tourism, created by Presidential Decree No. 189 on May 11, 1973, and prominently housed in its own large and centrally-located building on Agrifina Circle in Rizal Park in Manila. Its promotional projects, complete with travel-fare and accommodation subsidies include "Balikbayan", encouraging overseas Filipinos to return for a visit; the "Reunion for Peace" designed to draw American, Australian, and Japanese veterans of World War II; and "Gateway to the Orient" to divert the North America-Japan tourist flow across the Central Pacific via the Philippines.

Early in 1977 a pessimistic gloom set in about a "room glut", an over-concentration of hotels in Metro Manila. The room shortages of 1975 no longer existed as hotels have to be built before a place can become a popular tourist destination. It was a calculated risk, just as experienced in Hong Kong, Singapore, Taipei, Japan, and Hawaii. To boost the tourism industry, the *Philippine Plaza* hotel was the site of the Western Pacific regional conference of the American Society of Travel Agents (ASTA) from February 17 to 21, 1977 attended by about 100 delegates, the first time that an ASTA conference was held outside of the Americas. But then gloom settled in again, as a mid-May report indicated only a 35 percent occupancy rate in the four and five-star hotels, which is roughly half of the 66 percent occupancy deemed a viable rate. The Manila Hilton, for example, by the end of its first five years had accumulated a 14 million deficit that only the three "boom" years of 1974-76 wiped out. Its occupancy rate in 1976 was 87 percent but this is unlikely ever to occur again for the new hotels.

Metro Manila is the site of the Asian Development Bank, the Southeast Asia center (in Ermita) for the World Health Organization (WHO), the Asian Institute of Tourism (opened at the University of the Philippines in July 1975 to offer a 4-year course leading to a B.S. degree in Tourism, hence produce sorely needed executives for the hotel industry), and the regional headquarters of the World Travel Organization and the Pacific Area Travel Association. The Philippines has been designated the host country for the first World Tourism Congress in 1980, to be attended by 2000 delegates from the government and private sector in international travel, tourism, and aviation.

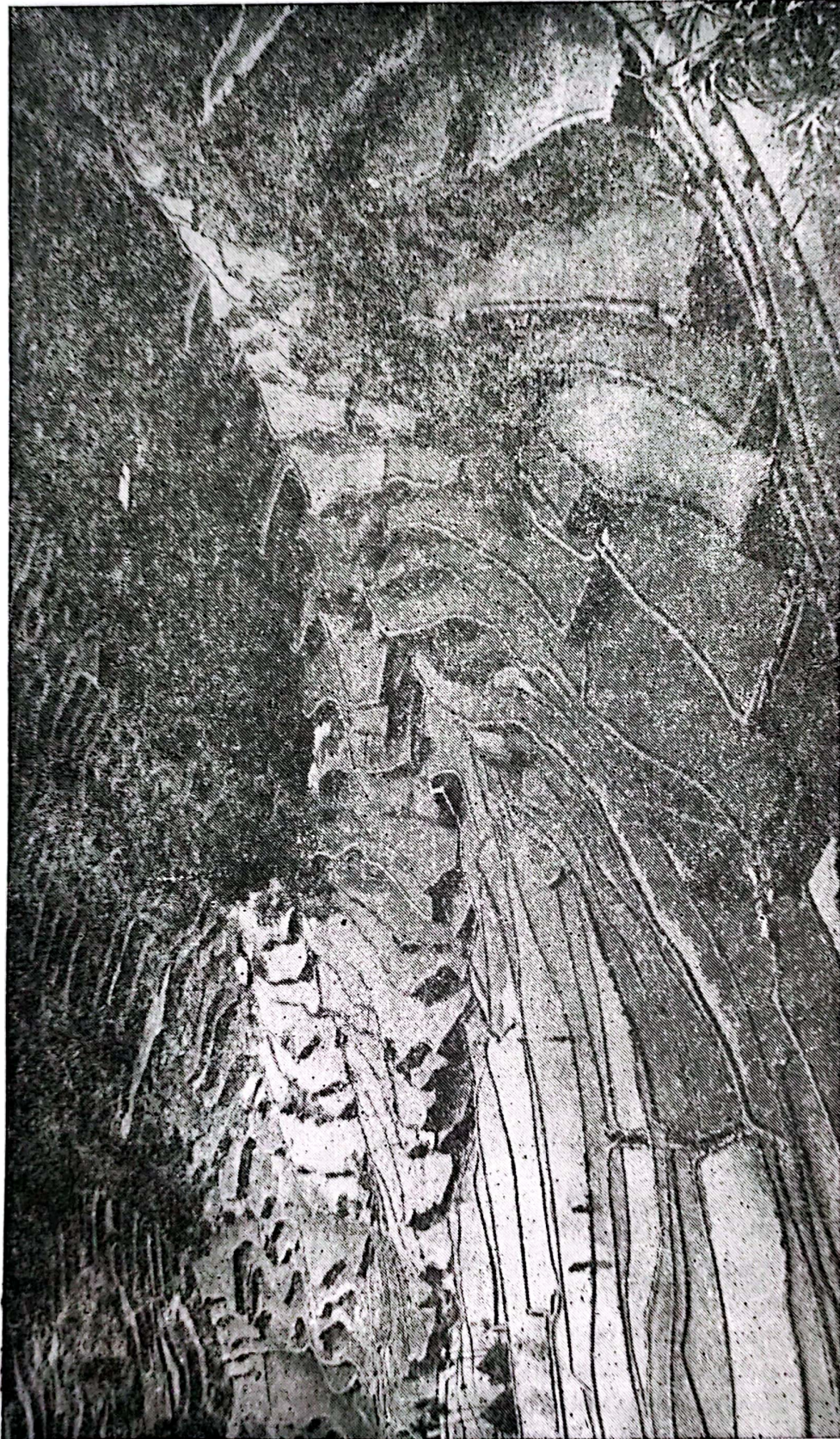


FIG. 13. SPECTACULAR ROCK-WALLED TERRACES, CONTAINING FIELDS OF IRRIGATED RICE, WERE CONSTRUCTED BY THE IFUGAO PEOPLES, NEAR BANAUE IN THE MOUNTAINS OF NORTHERN LUZON.

(PHOTO COURTESY DEPARTMENT OF TOURISM, PHILIPPINES)



FIG. 14. SHOOTING THE RAPIDS OF PAGSANJAN RIVER, RETURNING FROM A VISIT TO PAGSANJAN FALLS, LAGUNA PROVINCE.

(PHOTO COURTESY DEPARTMENT OF TOURISM, PHILIPPINES)

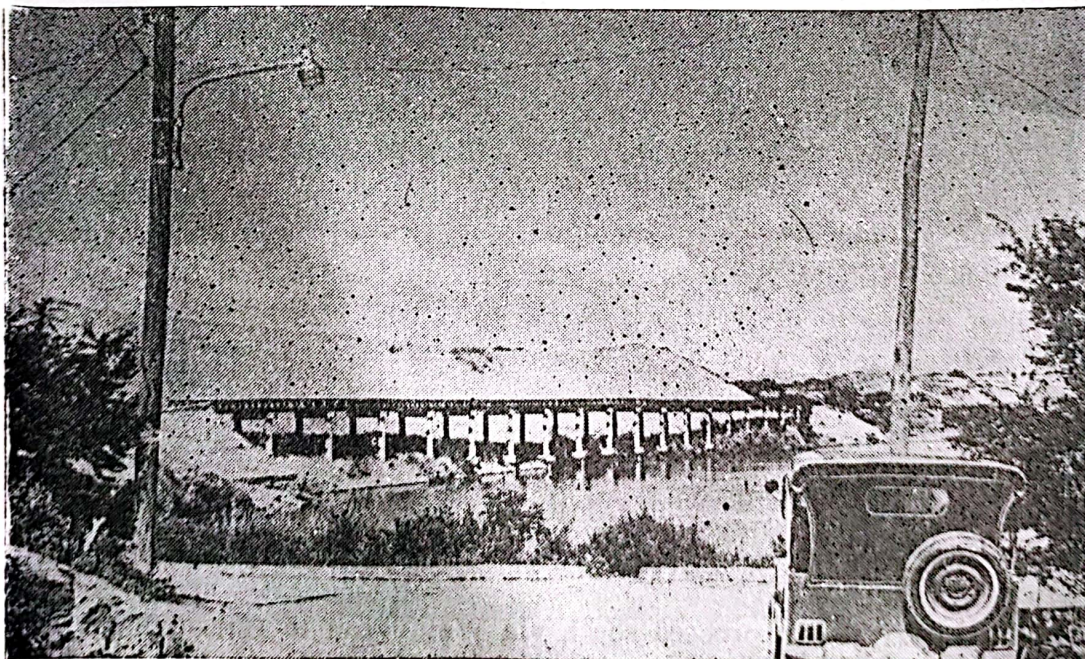


FIG. 15. THE SAND DUNES OF LA PAZ AND THE "LONGEST BRIDGE THAT DOESN'T CROSS A RIVER" ALONG THE NORTH BANK OF LAOAG RIVER NEAR ITS MOUTH.

The national government, through the "centralization" concept as practiced by its Department of Tourism and its edifice-complex focused on the tourist belt of Metro Manila, has intensified congestion in its capital city, already overcrowded with government agencies and most institutions of higher education, banking, trade, transport, and industry. The distance from the Manila International Airport north to the mouth of the Pasig River is only 10 kilometers (6 1/4 miles). But that may be all that the international tourist ever experiences, having flitted in and out of a hotel and having had his "imported" entertainment and souvenirs brought to his culturally-insulated 5-star ghetto, yet return home to claim "I've seen the Philippines." The Philippines is a classic example of Centralized Tourism — all focussed upon a Manila arrival, tours or flights radiating from Manila — on Luzon to Tagaytay, Corregidor, and Bataan, Hundred Islands, Baguio and the Ifugao rice terraces, Antipolo, Laguna de Bay, Pagsanjan rapids and falls, Batangas beaches. Fewer make the cruises or flights south to Cebu, Zamboanga, Jolo, or Davao. But always those who venture outside of Manila must return there, for departure for overseas.

Tourist movements outside of Manila are thus radial, creating local congestion at nearby (one day-visits) scenic spots. The centralization of place for both arrival and departure not only "wastes" tourists' scarce time and money by forcing return travel to Manila, but also directly contradicts other government goals: (1) decentralization, as exemplified by the reorganization of the unwieldy 72 provinces into 13 regions, and (2) local economic development. Tourism should enhance this trend, not contradict it.

I suggest that domestic tourism should be more greatly enhanced. Not only will its development not plunge the nation into further debt by draining the national treasury, but also it will have wide appeal to the kinds of international tourists the Philippines should be attracting — those who are desirous of seeing much of the country, eager and willing to travel farther by ground or sea (not air), stay longer, disperse their money more widely into local economies rather than in Manila, meet more Filipinos, and become truly informed about the Philippines in all of its considerable variety. And so I advocate "Progressive Tourism." Progressive or linear, tourism is standard practice in Japan, where one can enter via Tokyo but travel overland to Nagoya, Kyoto, Nara and depart via Osaka or Kagoshima; or in New Zealand, where an Auckland arrival can proceed south via Wellington to Christchurch and Dunedin and depart to Australia via either southern city. Another example is Indonesia, where one can proceed west from Bali via Jogjakarta to Jakarta on Java and depart from Medan in north Sumatra; or Malaysia, where a route might be Penang and Kuala Lumpur in the west or Kuching and Kota Kinabalu in the east.



FIG. 16. THE MASSIVE BELL TOWER IN LAOAG CITY, PROVINCE OF ILOCOS NORTE, IS THE LARGEST IN THE PHILIPPINES.

(PHOTO COURTESY DEPARTMENT OF TOURISM, PHILIPPINES)

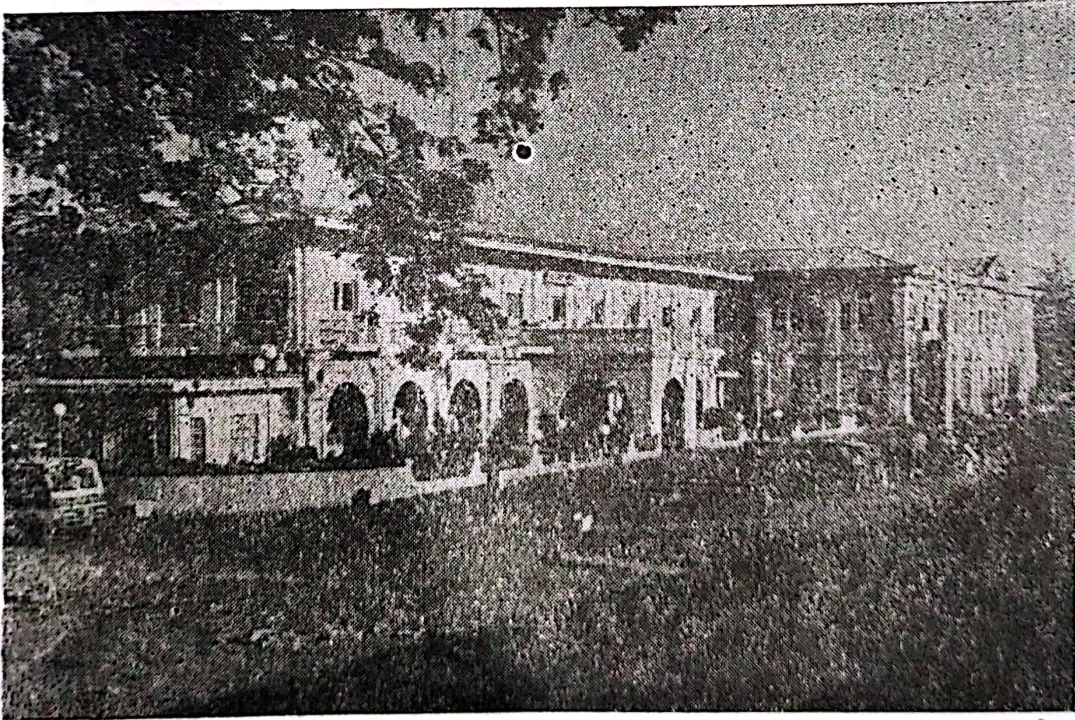
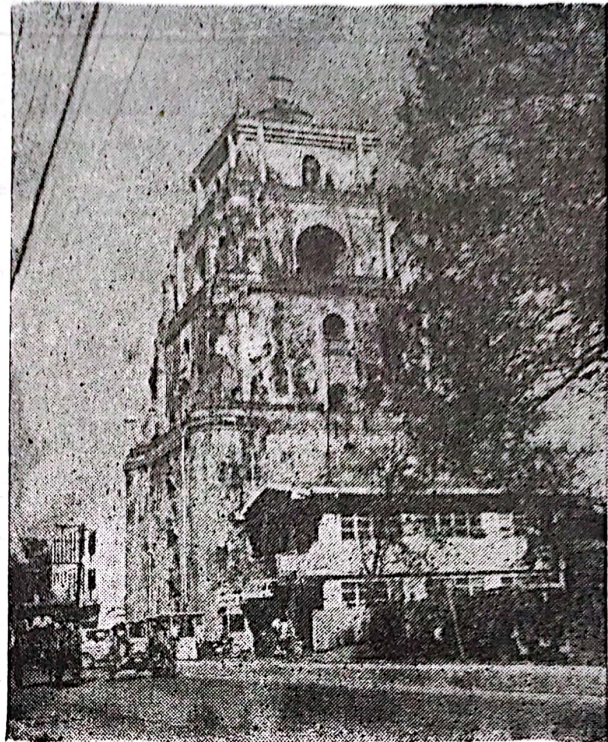
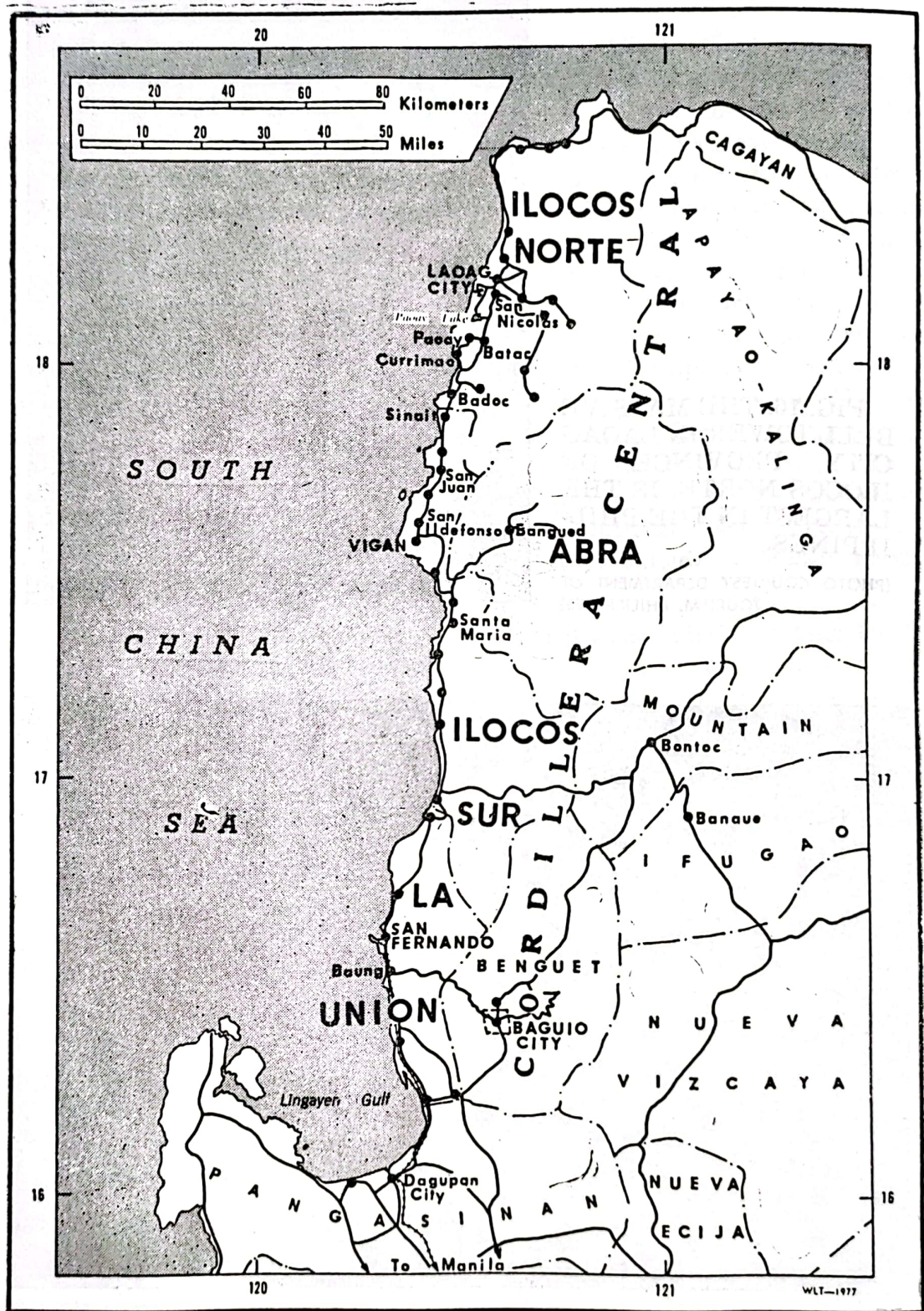


FIG. 17. THE CITY HALL AND MARCOS HALL OF JUSTICE (COURTHOUSE) LINE THE WEST EDGE OF THE PLAZA IN LAOAG CITY.

(PHOTO COURTESY DEPARTMENT OF TOURISM, PHILIPPINES)



MAP 3. ILOCANDIA IS THE NORTHWEST COASTAL SECTOR OF LUZON.

Prior to 1972 in the Philippines, a social and political elite was manipulating a precarious democracy of patronage, privilege, and personal aggrandizement. Politics was essentially competition for public power and privilege among individuals, political parties, and pressure groups and only secondarily a means of promoting the general welfare and public interest. Under martial law, the politics of conflict has been replaced by the politics of integration as managed by technocrats. The Development Plan of the New Society has these objectives:

- To attain a more equitable distribution of income and wealth;
- To expand employment opportunities;
- To promote social development;
- To stabilize economic growth; and
- To promote regional development and industrialization.

Tourism fits all of these objectives and is considered an important economic resource. The national government has only just begun to activate a program of regional development for tourism, since only 30 per cent of funding over the next four years will go to areas outside of Metro Manila. The Tourism Incentive Priorities Plan (TIPP) for 1977-1981, as approved in May 1977 by the National Economic and Development Authority (NEDA) and the President, maps out the provinces qualified for government support, thus concentrating scarce resources on a few selected places, called "reserve areas." These are:

- Region 1 (Ilocos Sur, Benguet, and La Union), 16 percent, in which La Union will be entitled to loans to set up new hotels in the three to five-star categories;
- Region 4 (Cavite, Laguna, Batangas and Quezon) 8.8 percent;
- Region 4-A (Metro Manila) 69.9 percent, but closed as an investment area, with all new project proposals in Metro Manila having been shelved; and
- Region 9 (Zamboanga del Sur) 4.9 percent

The investment total of P1.8 billion already has P1.3 billion committed in closed areas, leaving 27 percent or P508 million for investment in the open areas.

Opening the international airport at Zamboanga to foreign arrivals and departures will enhance tourism to the Moslem area of the southern Philippines from the Islamic countries of North Africa, southwest Asia, Pakistan, Malaysia, and Indonesia, but unless such tourists move northward beyond Mindanao, then Zamboanga will be yet another base for centralized tourism.

My recommendation for improving international tourism in the Philippines, and the prime thesis of this paper, is that progressive rather than centralized tourism should receive the stimulus of incentives, since

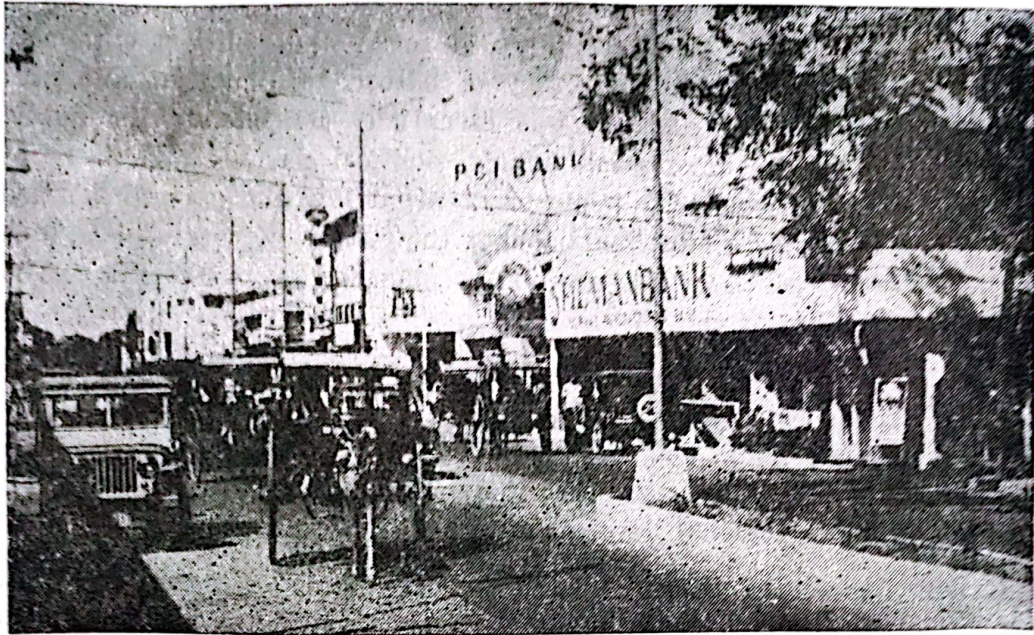


FIG. 18. RIZAL STREET, WEST OF THE PROVINCIAL CAPITOL IN LAOAG CITY, IS "BANKING ROW." NOTE THE PREVALENCE OF CALESAS (HORSEDRAWN PASSENGER VEHICLES FOR HIRE).



FIG. 19. THE SUNDAY MARKET ALONG ABADILLA STREET ADJACENT TO THE LAOAG SUPER MARKET IN LAOAG CITY.

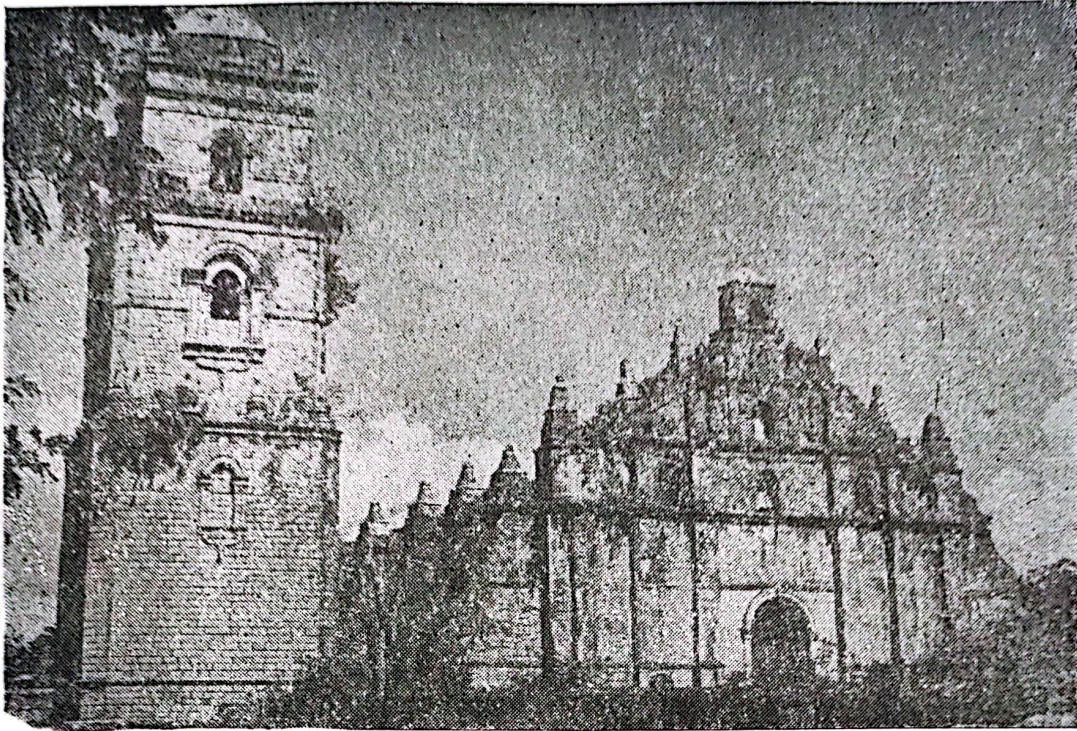


FIG. 20. ROMAN CATHOLIC CHURCH AND BELL TOWER (MADE OF CORAL BLOCKS) IN THE TOWN OF PAOAY, PROVINCE OF ILOCOS NORTE. NOTE THE HUGE BUTTRESSES ALONG THE WALLS AND STUPA-LIKE PINNACLES ALONG THE EDGE OF THE ROOF.

(PHOTO COURTESY DEPARTMENT OF TOURISM, PHILIPPINES)

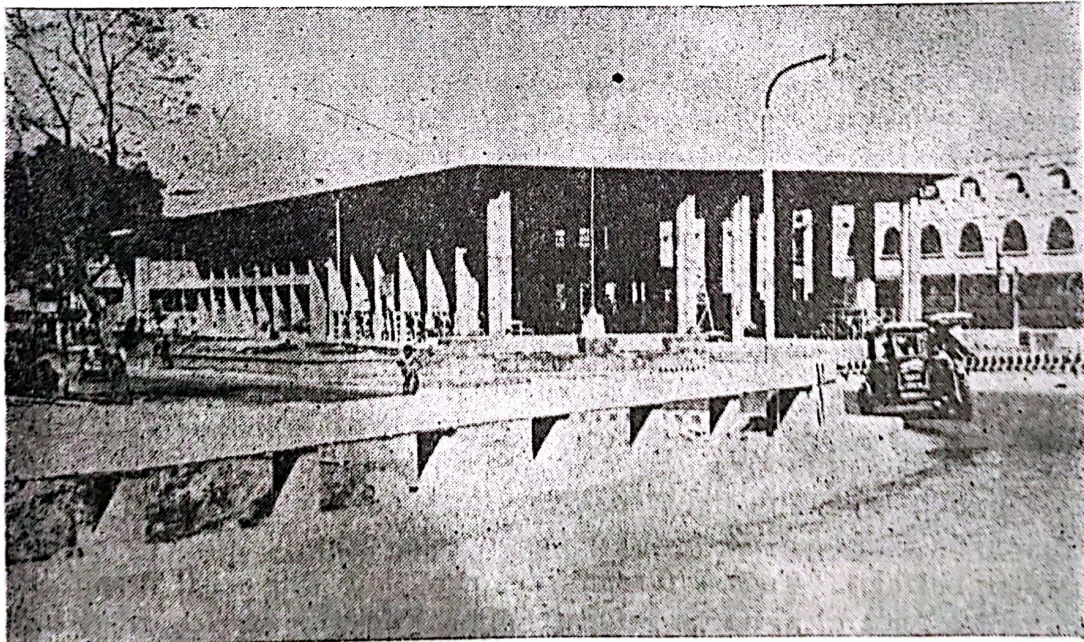


FIG. 21. TOWN HALL AND CONCRETE-ROOFED OPEN-AIR AUDITORIUM IN THE TOWN OF BATAc, PROVINCE OF ILOCOS NORTE.

it will better effect a more equitable distribution of income and wealth, accelerate economic growth, and promote regional development. As an example, a brief scenario is hereinafter sketched that involves two northern Provinces, Ilocos Norte and Ilocos Sur.

The first advantage of Ilocos Norte is locational: closest to Hong Kong and Japan, the prime sources of tourists coming to the Philippines. Why should the Chinese and Japanese overfly the Ilocos provinces to reach Manila 300 miles farther south? Ilocos Norte already has an alternate international airport on the coast near Laoag City. Why not expand and open this to international tourist flights (if only on a selective basis at first) to test the viability of "progressive tourism"? Tourist arrivals could be received, guided, and bussed from Laoag City south via Vigan to the beach resorts of La Union, thence to Baguio, and finally to Metro Manila. Others from Metro Manila could journey northward and depart from Laoag City, and none would ever be forced to retrace their routes, now a wasteful practice of time and energy. The appeal would be that more of the Philippines could be viewed and experienced; the result would be a lengthened duration of stay, now calculated at three days per visitor on the average.

At the Laoag City airport in Gabu tourists could be met by calesas or jeepneys for a short ride to the end of the runway at the south bank of the Laoag River where motorized bancas could take the venturesome ones across the river to La Paz, the great sanddunes, and the "longest bridge that doesn't cross a river." Then, on a paved road it is only a ten-minute ride south to Paoay Lake National Park, where the two-story brick "cottage" of President Marcos overlooks the lake on which he has the only motorboat. A 15-minute ride brings one to Laoag City proper, where the new Marcos bridge crosses the half-mile wide Laoag River. The plaza at end of the bridge evokes the Spanish founding of the city in 1586, adjoined by the original Roman Catholic *convento*, now a girl's high school, thence St. William's cathedral facing west toward the plaza, across from which is the City Hall, erected in Spanish-style in 1908, and Marcos Hall of Justice (the courthouse). Plazas throughout Ilocos Norte are dominated by huge acacias or monkey-pod trees. Laoag City is a town of 32 thousand, with a lively commercial area, and 14 banks, the most of any place north of Metro Manila, with the Public Market extremely crowded and a fascinating human experience to witness, especially on Wednesday and Sunday mornings. In the countryside, the basic crop is irrigated rice, with plowing by carabao (water buffalo). Tenant farmers are rare, but still exist, despite the current efforts at agrarian reform. Many varieties of rice exist, carefully scheduled for planting and harvesting at different times, to spread the workload. Transitions to modernization include gasoline-powered waterpumps and long plastic pipe. The long dry season, from mid-October to mid-May presents a sere landscape, when Ilocos Norte lies

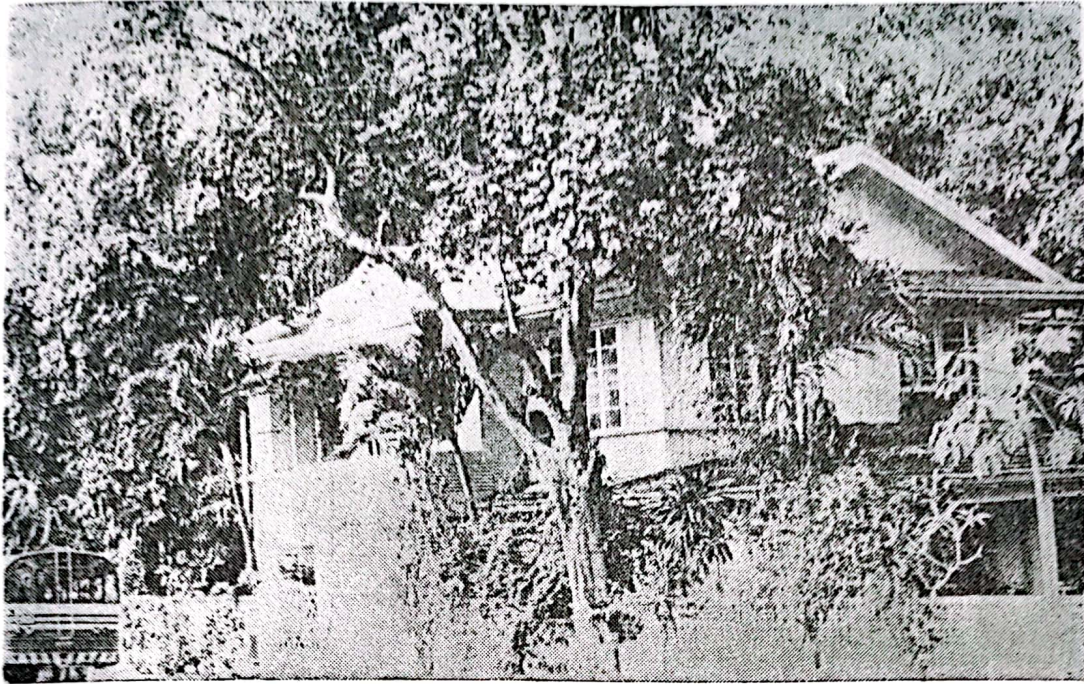


FIG. 22. THE BOYHOOD HOME OF PRESIDENT FERDINAND E. MARCOS IN THE TOWN OF BATAAC, PROVINCE OF ILOCOS NORTE.

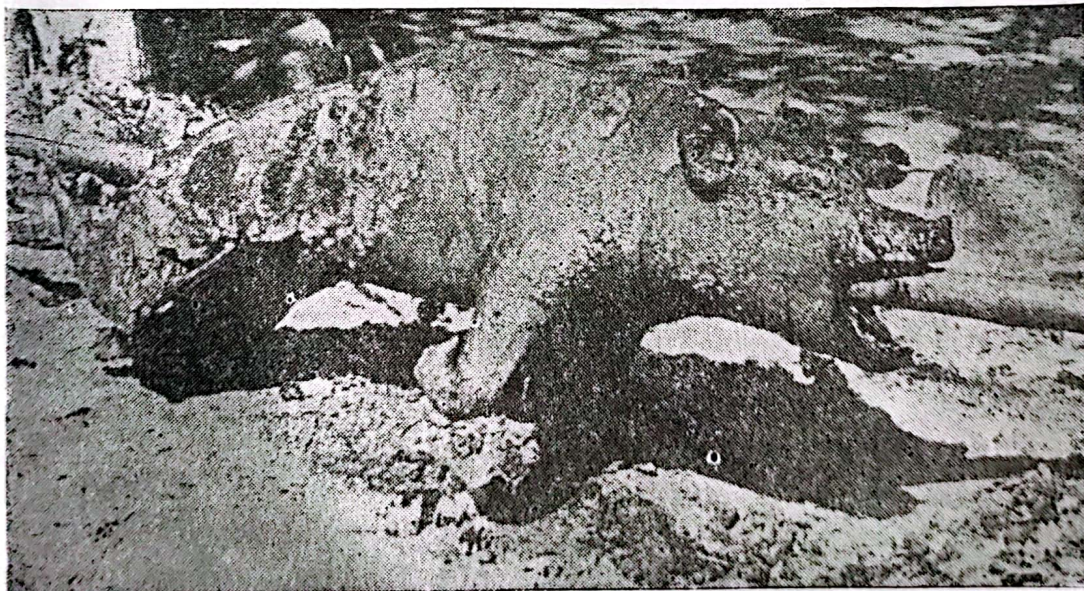


FIG. 23. THE PRIZED FEAST FOOD AMONG FILIPINOS IS A SUCKLING PIG (*LECHON*) HERE BEING ROASTED ON A SPIT OVER AN OPEN FIRE.



FIG. 24. THE COTTAGE INDUSTRY IN THE TOWN OF SAN NICOLAS, PROVINCE OF ILOCOS NORTE, IS POTTERY-MAKING. HERE VASES OF VARIOUS DESIGNS ARE BEING SUN-DRIED AT THE EDGE OF A STREET BEFORE BEING FIRED IN A PIT.



FIG. 25. THE ANTIQUITY OF VIGAN, THE CAPITAL OF THE PROVINCE OF ILOCOS SUR, IS REFLECTED IN ITS NARROW STREETS LINED BY MASSIVE SPANISH-STYLED HOMES THAT COMBINE THE USE OF BRICK AND WOOD.

in the lee of the Central Cordillera when Northeast Trades prevail. Clouds billow over the mountains, only to evaporate, and drying winds descend onto the west coast. Another fascinating contrast are the old homes from the Spanish period and the most modern of brick and many-hued in paint.

South from Laoag City, places to visit are Paoay, with its famed huge "earthquake baroque" Roman Catholic Church of the early 17th-century (note the large buttresses, and the stupa-like pinnacles on the roof-top), and Badoc with its redecorated 18-century church. Ilocos Norte is the only lowland Christian province in the Philippines that is *not* predominantly Roman Catholic; there are numerous churches of the Philippine Independent Church whose founder was Gregorio Aglipay, a native of Batac, Ilocos Norte, where his birthplace is now a historic park. Batac town has also experienced revival: in the modernization of its Roman Catholic Church, in the construction of the nation's largest town hall for a place with less than 10,000 residents, but explainable because Batac is the site of the boyhood home of President Ferdinand Marcos. For barbecue lunch, the main feastfood is *lechon* (roast suckling pig), whose crisp skin is a prized delicacy. The nearby towns, south of Laoag City offer much of interest in their cottage industries. In San Nicolas, the skills are in earthenware pottery, first formed and sun-dried, then fired in pits before being cleaned and taken to market. In Paoay it is weaving, where there is reputedly "a hand-loom in every house", on which cotton is woven into colorful chenille towels, bathrobes, and blankets. Farther south, Currimao is the only port town and sheltered fishing harbor where on the beach sand, seines are laid out to be dried and mended. The southernmost town of Badoc presents an imaginative and ornately decorated plaza, converted into a public park. Thence, via the concreted National Highway, the Ilocos Norte boundary is reached and the Province of Ilocos Sur is entered. Sinit, its first town, has its image of the Black Nazarene; San Juan its shellcraft factory, Marine Gems; San Ildefonso its *bibingka* or coconut-flavored glutinous rice cakes, but the principal attraction is Vigan, the provincial capital. There isn't a more historic site in the Ilocos region than the 403-year old town of Vigan, founded by Juan de Salcedo as Villa Fernandina. With its narrow streets and many old homes it has kept intact its colonial air, albeit now being intruded with gas-propelled vehicles (trucks, cars, tricycles) and electricity (lights, radio, television), but many calesas still remain to evoke the less-frenzied pace of the past. To be visited are: (1) the Vigan cathedral, erected by Augustinians in 1641 facing Plaza Salcedo, and now furnished with elaborate chandeliers imported from Europe, is the seat of the Diocese of Nueva Segovia; (2) Plaza Burgos and the Ayala Museum, restored as when it was the home of Padre Jose Burgos, a martyr to the cause of Filipino secularization of the church, and (3) the old stone Syquia Mansion, which

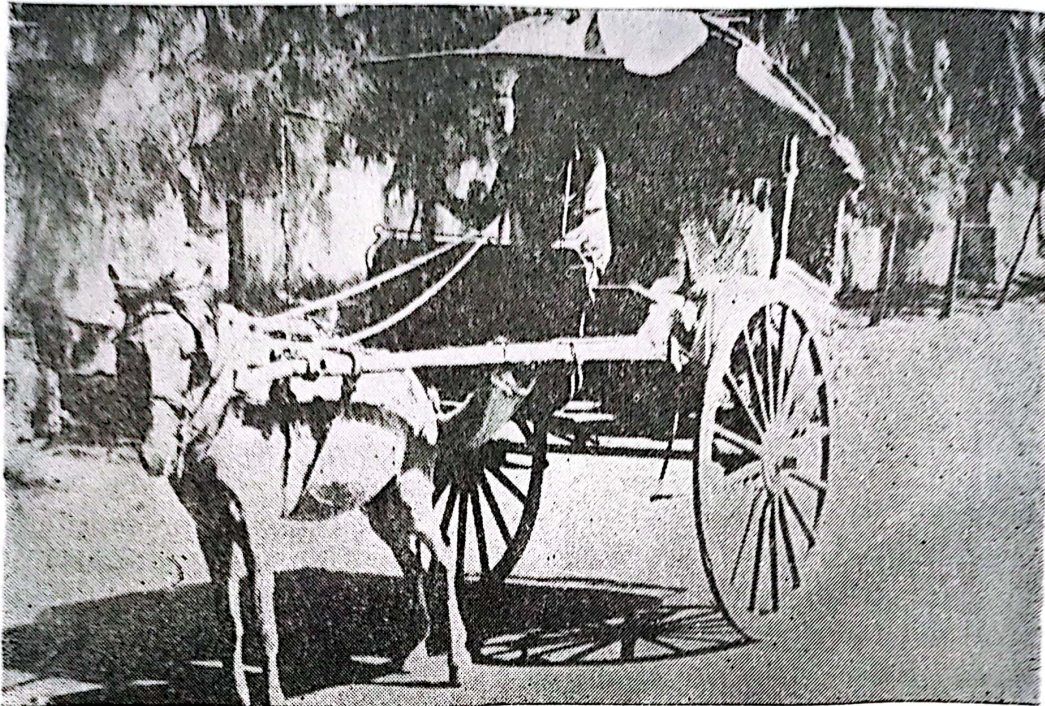


FIG. 26. THE CALESA, A SPANISH-TYPE HORSE-DRAWN VEHICLE. IN ILOCOS SUR STYLE. IN ILOCOS NORTE, PASSENGERS ENTER VIA A DOOR AT THE REAR AND SIT ALONG THE SIDES.

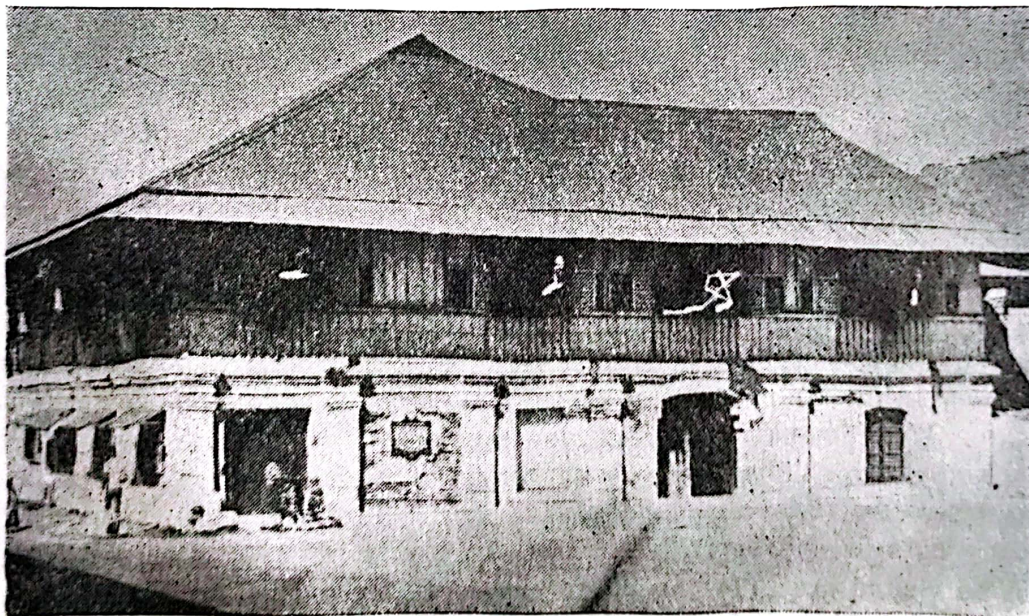


FIG. 27. THE FORMER HOME OF PADRE JOSE BURGOS IN VIGAN HAS BEEN RESTORED AND OPENED TO THE PUBLIC AS THE AYALA MUSEUM.

became the residence of President Elpidio Quirino, with its azotea of glazed tiles, the dining room with old china and high-backed chairs, and its religious images of ivory, clothed in gold and silver. Before departing Vigan for points south, a rest stop for refreshments should be made at the "Cool Spot," a large open-air pavilion next to the Vigan Hotel in the northeast corner of town.

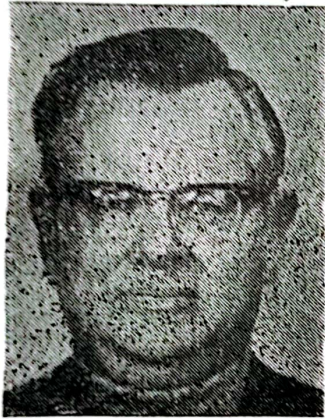
On the way to La Union, Santa Maria church, with its 90 steps to its hill-top site, is a favorite attraction. The late afternoon destination for this progressive tour south from Laoag City are the beautiful beaches and beach resorts of Bauang, in the Province of La Union. A series of resort hotels and inns provide varied accommodations, dining, and entertainment, but all have facilities for swimming, snorkelling and scuba diving, boating, fishing, pelota, and swimming pools. A restful stay here is in order before proceeding inland on a 2 1/2-hour drive up to the pine-clad mountain resort of Baguio City.

None of the Ilocos region here described is ever seen by the average tourist to the Philippines. The Ilocano people deserve better. I trust that a case has been made for progressive tourism that begins or ends in Laoag City!

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University, New Jersey; 1950-57 Assistant to Associate Professor of Geography, University of California, Riverside; Fall of 1968-69 Visiting Professor of Geography, University of Toronto, Canada; 1974 March-November, Fulbright Senior Scholar, University of Western Australia.

In 1976-77, he was Visiting Research Associate, Institute of Philippine Culture, Ateneo de Manila, Quezon City. Dr. Thomas is a well-travelled man. In 1953, he was in Italy, France, and England; 1954 in Panama, Colombia, Ecuador; 1974 in Australia, New Zealand, Fiji, Tonga, Western Samoa and Tahiti.

He is member of the Honor Society of Xi Gamma Xi and Pi Kappa Mu. In 1961 he was recipient of citation for "Meritorious Contribution to the Field of Geography," awarded by the Association of American Geographers. He is included in *Who's Who in America 1958-59* and subsequent volumes of *American Men of Science (Social Science Volume)*. Dr. Thomas is a prolific writer. The 71 items to date includes 13 maps, 14 articles, 26 book reviews, 2 brochures and 15 books. Some of the books are *Cultural Geography; An Evolutionary Introduction to our Humanized Earth*. Co-authored with J.E. Spencer; *Asia, East by South: A Cultural Geography*, 2nd Edition. Co-authored with J.E. Spencer; and many others.

A STUDY ON THE APPLICATION OF INFRARED COLOR AERIAL PHOTOGRAPHY IN DETERMINING DRAINAGE CONDITION IN SUGAR CANE FIELDS¹

by

ROME C. BRUCE²

INTRODUCTION

Aerial photographs have been used to map plant communities, identify species and study the changes that take place due to normal plant succession or such influence as man, or pest and diseases. The use of conventional color and infrared color photography has placed greater emphasis upon the spectral differences among plant species and the spectral changes that occur because of maturity or stress condition. Conventional color photography allows qualitative comparisons between the colors on the photos and the spectral characteristics of the material, since our eyes and the film are both sensitive to the same portion of the spectrum. However, the interpretation of infrared color aerial photography is more difficult because infrared color film is sensitive to both the visible and infrared wavelengths.

OBJECTIVES

Aerial photography of about 33,000 hectares sugar cane fields in the BISCOM district in Binalbagan, Negros Occidental was taken by Certeza Aerophoto Systems, Inc., in August 1975 using Ektachrome Infrared Film Type 2443.

The objectives are as follows:

1. To determine and delineate sugar cane crop growing on various soil drainage conditions.
2. To study the sugar cane crop grown on various haciendas in terms of soil drainage, manner of fertilizer applications and other management practices which affect the growth of sugar cane crop.
3. To delineate the complete stream and waterway network and develop a concept plan of improving the drainage of the soil.

The report presented here is based on the interpretation of infrared color photographs taken at 5,000 feet flying using RC-8 aerial camera with 6-inch focal length. The photograph has a scale of approximately 1:10,000.

¹ Cooperative Research of BISCOM, Certeza Aerophoto Systems, Inc. and UP Training Center for Applied Geodesy and Photogrammetry.

² Professor of Photo Interpretation, University of the Philippines.

THE ELECTROMAGNETIC SPECTRUM

The acquisition of information through conventional aerial photography or through remote sensors depends upon electromagnetic energy. Electromagnetic energy (radiation) is all around us. It is normally measured by its wavelength and frequency. The entire range of wavelengths and frequencies is termed the electromagnetic spectrum.

The electromagnetic spectrum has been divided into regions according to the development of methods for detecting, measuring and producing the radiation. These regions or bands are illustrated in Figure 1.

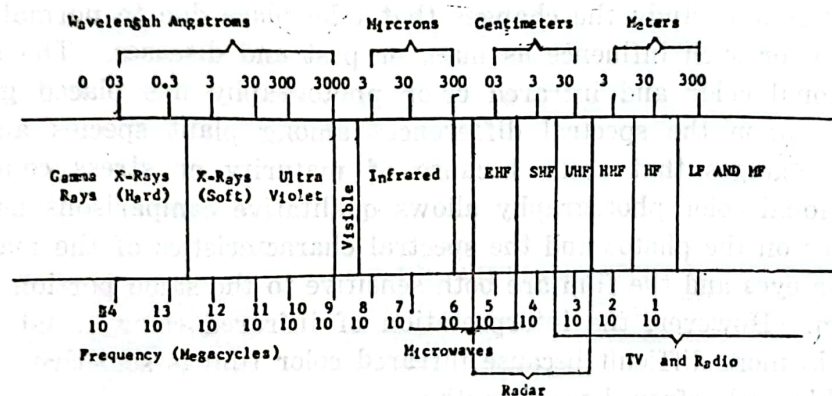


FIG. 1. THE ELECTROMAGNETIC SPECTRUM

FUNDAMENTALS OF LEAF REFLECTANCE

The portion of the electromagnetic spectrum shown in Figure 2 indicates that up to 3 microns wavelength we are concerned with reflective phenomena due to the range of responses of solar energy. Suits (1960) stated that solar reflectant power is decreased with increasing wavelengths until the radiation emitted by the object becomes dominant at approximately 3 microns. The energy recorded in the 3 to 15 microns portion of the spectrum is due to the radiation emitted from the surfaces in the far infrared region.

The typical spectral reflectance of a green leaf is presented in Figure 3. The 0.4 to 2.6 microns portion of the electromagnetic spectrum can be roughly divided into three areas:

1. Visible wavelength region in which plant pigments, especially the chlorophyll dominate the spectral response of the plant.
2. Region from approximately 0.72 to 1.3 M where there is very little absorption by a leaf and most of the energy impinging upon the leaf must be either transmitted or reflected.
3. Water absorption region from approximately 1.3 to 3 microns.

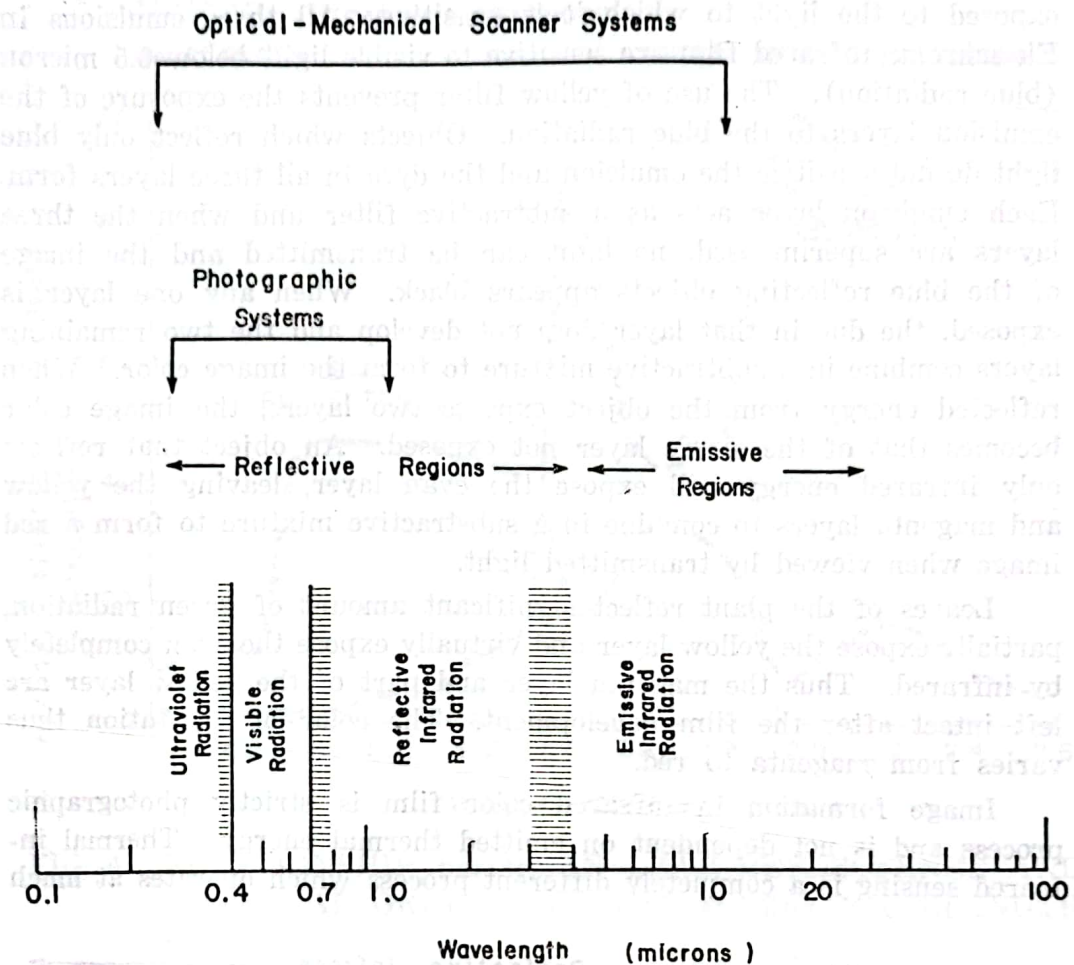


FIG. 2. PORTION OF THE ELECTROMAGNETIC SPECTRUM

As indicated in Figure 3 a normal green, healthy leaf has four primary absorption bands — two in the visible wavelength caused by chlorophyll absorption and two in the infrared wavelengths caused by water absorption. Figure 4 shows the relationship between leaf reflectance and water absorption in the 0.4 to 2.6 microns wavelength region.

THE EKTACHROME INFRARED AERO FILM

The infrared color film commonly used is a false color emulsion that was originally developed by the military to distinguish between the natural green and healthy vegetation and the painted green of camouflage. The Ektachrome infrared film emulsion consists of three layers — the top layer is a cyan (blue) — forming layer which is sensitive to near infrared radiation, the middle layer is yellow-forming layer, sensitive to the green visible radiation and the bottom layer is magenta-forming layer, sensitive to the red visible radiation. The sensitivity curves of the three emulsion layers of Ektachrome film is shown in Figure 5. Because of reversal processing during film development procedure, the dye of an emulsion layer does not form if the layer was

exposed to the light to which it is sensitive. All three emulsions in Ektachrome infrared film are sensitive to visible light below 0.5 micron (blue radiation). The use of yellow filter prevents the exposure of the emulsion layers to the blue radiation. Objects which reflect only blue light do not sensitize the emulsion and the dyes in all three layers form. Each emulsion layer acts as a subtractive filter and when the three layers are superimposed, no light can be transmitted and the image of the blue reflecting objects appears black. When any one layer is exposed, the dye in that layer does not develop and the two remaining layers combine in a subtractive mixture to form the image color. When reflected energy from the object exposes two layers, the image color becomes that of the single layer not exposed. An object that reflects only infrared energy will expose the cyan layer, leaving the yellow and magenta layers to combine in a subtractive mixture to form a red image when viewed by transmitted light.

Leaves of the plant reflect significant amount of green radiation, partially expose the yellow layer and virtually expose the cyan completely by infrared. Thus the magenta layer and part of the yellow layer are left intact after the film development. The color of vegetation thus varies from magenta to red.

Image formation in infrared color film is strictly photographic process and is not dependent on emitted thermal energy. Thermal infrared sensing is a completely different process which operates at much

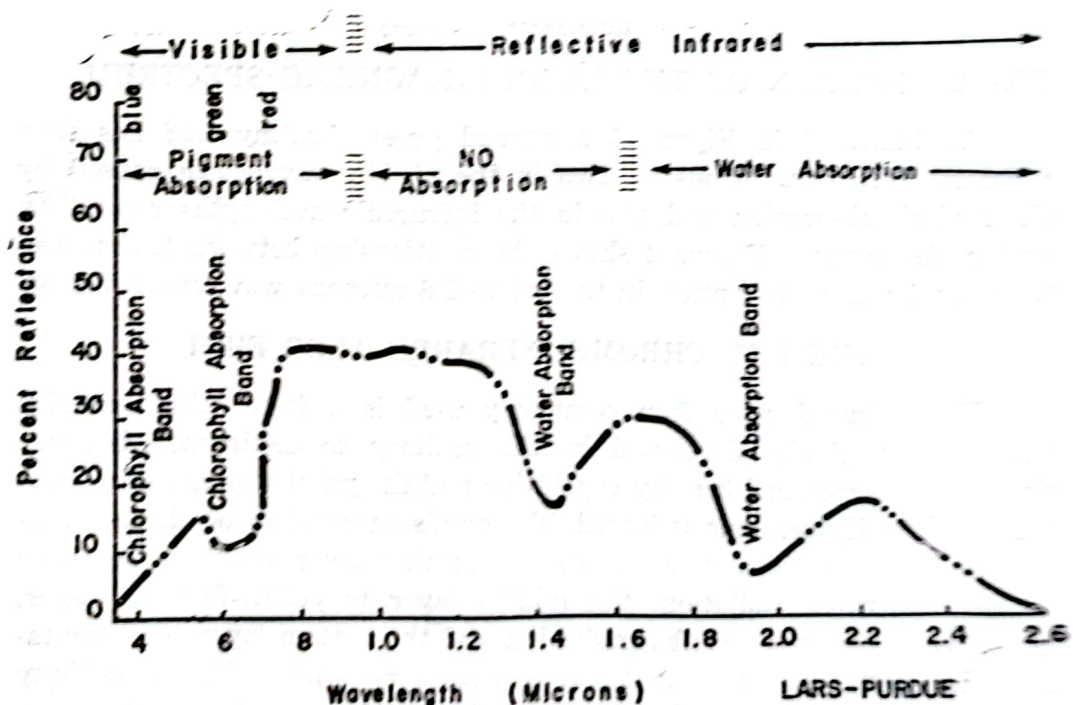


FIG. 3. THREE PRIMARY REGIONS OF RESPONSE IN RELATION TO LEAF REFLECTANCE

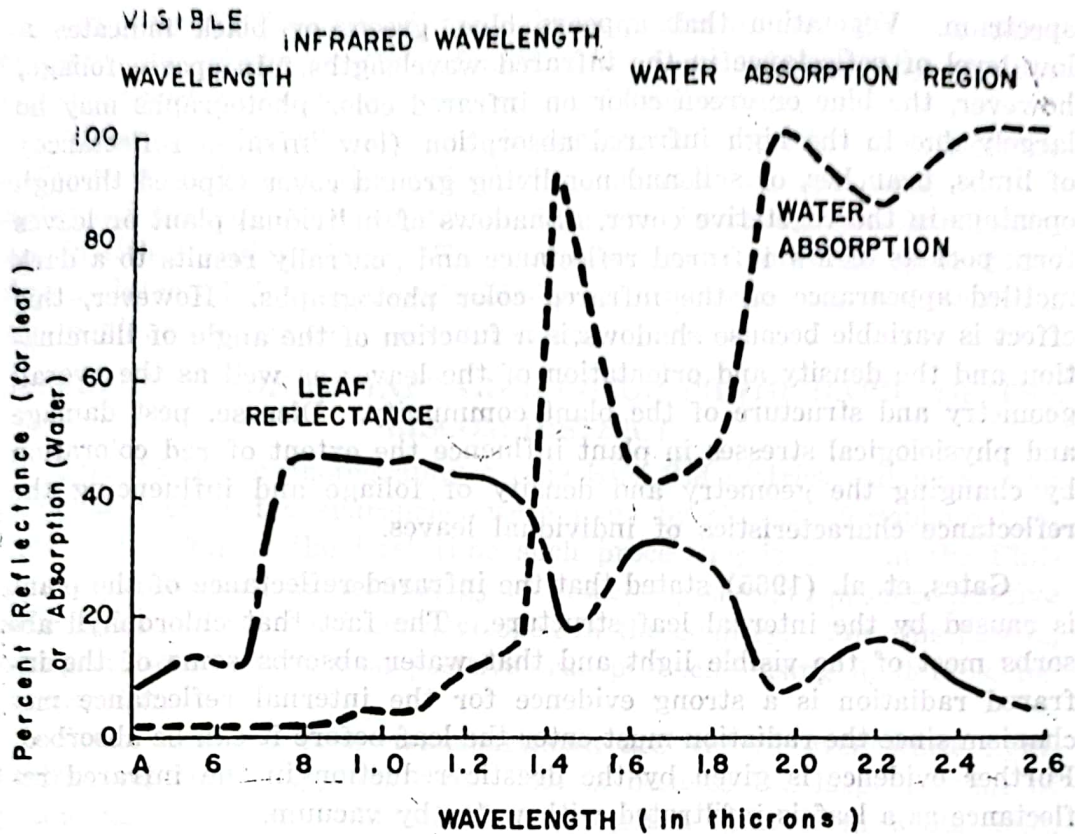


FIG. 4. RELATIONSHIP BETWEEN LEAF REFLECTANCE AND WATER ABSORPTION IN THE 0.4-2.64 WAVELENGTH REGION

longer wavelengths, about 3 to 5 microns to 14 microns where object and surfaces of ambient environmental temperatures emit radiation energy.

APPEARANCE OF VEGETATION ON INFRARED COLOR PHOTOGRAPHS

The spectral sensitivity range of Ektachrome infrared aerial film is 0.5 to 0.9 microns and it is the leaf reflectance properties in this region that need to be considered to relate leaf reflectance to color formation on the film. Healthy green leaves have a low visible and high infrared reflectance and characteristically appear bright red on color infrared photographs. It was found that in infrared color photography senescing leaves of plants appear light pink color caused by the increase in the reflectance of the leaf in the visible spectrum. A high level of reflectance in the infrared as well as in the visible spectrum is required to produce the color of the senescing leaves.

In general, the foliage colors of red, pink, white, yellow, orange, and brown on aerial photographs made from Ektachrome infrared film are all caused by relatively high levels of reflectance in the infrared spectrum and by variable levels of reflectance in the visible portion of

spectrum. Vegetation that appears blue, green, or black indicates a low level of reflectance in the infrared wavelengths. In sparse foliage, however, the blue or green color on infrared color photographs may be largely due to the high infrared absorption (low infrared reflectance) of limbs, branches, or soil and non-living ground cover exposed through openings in the vegetative cover. Shadows of individual plant or leaves form pockets of low infrared reflectance and generally results to a dark mottled appearance on the infrared color photographs. However, this effect is variable because shadows is a function of the angle of illumination and the density and orientation of the leaves as well as the overall geometry and structure of the plant community. Disease, pest damage and physiological stresses in plant influence the extent of red coloration by changing the geometry and density of foliage and influencing the reflectance characteristics of individual leaves.

Gates, et. al. (1965) stated that the infrared reflectance of the plant is caused by the internal leaf structure. The fact that chlorophyll absorbs most of the visible light and that water absorbs some of the infrared radiation is a strong evidence for the internal reflectance mechanism since the radiation must enter the leaf before it can be absorbed. Further evidence is given by the drastic reduction in the infrared reflectance as a leaf is infiltrated with water by vacuum.

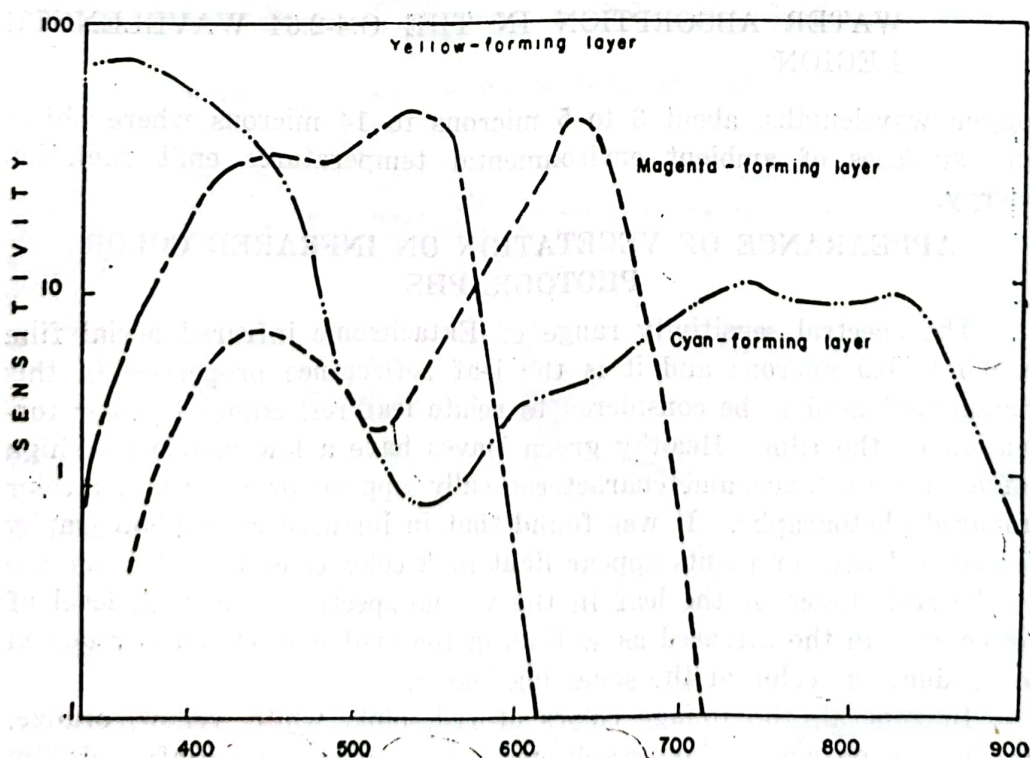


FIG. 5. SENSITIVITY OF THE THREE EMULSION LAYERS OF EKTACHROME INFRARED AERO FILM

Knipling (1969) stated that the deviations from the red color of the plant foliage on the infrared color aerial photography are not always caused by an increase in the visible reflectance.

Since the infrared color film integrates and records the reflectance differences in both regions of visible and infrared spectrum, it is a better indicator of stress conditions than are the reflectance characteristics in either region alone. This is a very important feature of Ektachrome infrared film and undoubtedly is responsible for its successful use in plant disease and pest detection.

INTERPRETATION OF INFRARED COLOR PHOTOGRAPHS OF THE BISCOM DISTRICT

Infrared color photography of the BISCOM district and processing to positive color transparencies were done by Certeza Aerophoto Systems, Inc. This is the first time such processing is done in the Philippines. However, the technology of processing them to produce positive color print has not yet been developed in the country. For this reason, interpretation was done on positive transparencies using light table for illumination.

When infrared color transparencies are viewed over white light, healthy vegetation appears red. This is because the large amount of yellow magenta dyes subtract blue and green light from white light, respectively. The lack of cyan dye permits red light to be transmitted to the eye.

Water exhibit blue color depending on clarity and depth. Dry, bare soil appear light pink but moist or wet, bare soil appear bluish. For example, lowland rice paddy appear blue with very faint or mottled red color. The mottled red color represent young rice plant. As the rice plant grows it develop more tillers, more green leaves and appear red in infrared color transparencies. As the crop gets mature the leaves begin to lose green color and appear pink or light pink. When panicles develop and leaves become brownish the crop appear very light pink or faintly red on infrared color air photo. When completely dry the crop appear almost white.

Young cane in the BISCOM district (2 months old or younger) appear blue with barely visible red spots. The red spots represent the growing cane plants while the blue background represents the soil. The red hue increases as the cane becomes older and the spot where the seedling did not survive appear blue resulting in very irregular red color on the field. At flowering stage sugar cane crop exhibit light red color mottled with light spots or streaks.

Field verification indicated that sugar cane crop grown on waterlogged areas appear light red or light pink on infrared color transparencies. However, good stand of sugar cane because of good soil drainage, uniform fertilizer application and good seed germination appear uniform bright red on infrared color air photos.

The relation of physical and chemical properties of leaves with the image formed on infrared color film is a complex subject. There are many factors affecting the leaf reflectance in the photographic infrared region. One of the most important is maturity of the leaf. A young leaf with compact mesophyll has lower infrared reflectance and appear lighter red than a mature leaf with a loosely-arranged mesophyll. Assuming, the same age, stressed leaves usually have lower infrared reflectance than non-stressed leaves because stressed leaves remain smaller with a more compact mesophyll than non-stressed leaves. Consequently, stressed leaves (diseased, moisture, stress, salinity, etc.) appear very light red on infrared color air photos.

Pest and diseases, chemical excess or deficiency, moisture stress, poor soil drainage or waterlogged condition for sugar cane may cause premature yellowing and abscission of leaves, burning of leaf tips, bronzing, wilting, cupping of leaves or other abnormalities. If these abnormalities occurred in a stand of normally-growing plant, most of them could be detected by infrared color aerial photography.

SOILS IN THE BISCOM DISTRICT

There are three major soil types in the BISCOM District:

1. Isabela clay
2. Silay clay
3. Gimbaloan loam

Isabela clay occurs in the level to nearly level areas of the district. This soil is distinctly black, friable and soft when moist, but very sticky and hard when it is wet. The lower horizon of this soil is too clayey and impedes water percolation making the profile very poorly drained. When sugar cane is growing on Isabela clay, soil drainage become the most important problem which affect the growth of the crop. It is in this area that integrated drainage canals are necessary.

Silay clay occurs also in level to nearly level areas mostly in Hinigaran municipality. This soil area was formerly devoted to lowland rice culture but at present greater part is utilized for sugar cane. Like Isabela clay, Silay soil is very difficult to work with when wet. It is also very poorly drained due to compacted subsoils and substratum.

Gimbaloan clay occurs in rolling and undulating upland areas of the BISCOM District. It has friable loam top soil underlain by gravelly loam subsoil. Boulder rocks are common in the substratum. On the eastern portion of Isabela town boulders are common on the ground surface. Sugar cane is also grown on this soil type although other upland crops is also common. In the uncultivated portion cogon grass predominates. Bamboo grove lined the gullies and drainageways dissecting the area. This soil is considered to be moderately well-drained soil.

MAPPING SUGAR CANE VIGOR BY INFRARED COLOR AERIAL PHOTOGRAPHY

Sugar cane vigor may be limited by diseases, insects, poor soil drainage, soil moisture stress, insufficient soil nutrient, etc. In general, diseases are not a major problem of sugar cane crops in the Philippines. Varieties are now grown that are resistant to various diseases. Consequently, insects or pests are of minor economic importance to sugar cane crops in Negros Occidental. Soil nutrient is not a problem since whatever nutrient used up by the crop is replenished through the application of fertilizer. One of the most important problem adversely affecting the growth of sugar cane in the BISCOM district is poor soil drainage. Greater part of the district is situated in the valley with elevation ranging from 0 to 10 meters. The low elevation and the level topography of the area has resulted to very slow movement of surface water to the sea. The flow of the river emptying the area is sluggish and overflow resulting to damaging flood during heavy rainfall period. Many sugar cane fields are flooded and water stays on the ground for weeks. The inherent poor internal drainage condition of the soil aggravates the problem of draining the area. Other problems affecting the growth of sugar cane crop in the BISCOM district are poor seed germination and uneven fertilizer application.

With extensive, uninterrupted area of sugar cane in the BISCOM area and in Negros Occidental, in general, delimiting accurately the sugar cane fields and areas of poor seed germinations and or uneven fertilizer application become one of the important aspects in the management of sugar cane plantation.

Infrared color aerial photographs at the scale of approximately 1:10,000 were utilized in mapping sugar cane vigor in the BISCOM district.

The following areas were delimited and mapped based on the interpretation of infrared color positive transparencies and field verification:

1. MW — Sugar cane growing on moderately well drained soil.
2. SP — Sugar cane growing on somewhat poorly drained soil.
3. VP — Sugar cane growing on very poorly drained soil.
4. GP-VP — Sugar cane field with evidence of poor seed germination and growing on very poorly drained soil.
5. UF-VP — Sugar cane with evidence of uneven fertilizer application and growing on very poorly drained field.
6. SP-UF — Sugar cane with evidence of uneven fertilizer application and growing on somewhat poorly drained soil.
7. GP-UF-VP — Sugar cane crop growing on very poorly drained area with evidence of poor seed germination and uneven fertilizer application.
8. PF — Areas devoted to fish pond.
9. PRF — Areas utilized for lowland rice production.

The parcellary plans of different haciendas in the BISCOM district were plotted on the interpretation map in order to determine the vigor of sugar cane crop growing on the farm. Not all haciendas in the district were studied. Only those haciendas with parcellary plans in the BISCOM office and where area is not less than 50 hectares were studied. A total of 118 haciendas were plotted on interpretation map. The information on sugar cane vigor were estimated in terms of percentage of the total area of the farm with sugar cane crop. For example, Hacienda Carmen has a total area of 60.56 hectares. Of these area about 6 hectares was utilized for fish pond and about 54 hectares was grown to sugar cane at the time of photography. Analysis of infrared color photography indicated that all sugar cane on fields in Hda. Carmen was growing on very poorly drained soil; and 52% or 25 hectares showed evidence of poor seed germination. The complete list of 118 haciendas and data on sugar vigor of each of their haciendas is available at the BISCOM office in Binalbagan, Negros Occidental.

Results of the study indicate that except for the upland areas and very few scattered spot of moderately well drained soils the whole BISCOM district has very poorly drained soil. This condition adversely affect the sugar yield per unit area. Many areas are waterlogged and water stays on the ground for a period of time after the rain. Poor seed germination was common in many poorly drained and waterlogged sugar cane fields. In few haciendas evidence of uneven fertilizer application were seen on infrared color positive transparencies and field verification show this condition to be true.

PROPOSED DRAINAGE SYSTEM IN THE BISCOM DISTRICT

The existing drainage channel system in the district is inadequate to drain the water within the soil profile and the water on the surface. Drainage channels are made by individual farm owner/operator and in all cases these channels are very small because the purpose is to drain only the surface water that accumulate in their fields. While it is true that drainage canals are constructed in many farms, these canals are not integrated, small, not well maintained and improperly designed. The soil in the district is inherently poorly drained and drainage system must be planned and designed to remove the internal water from the field and have them flow and join the river. To accomplish this the drainage channels must be well integrated with natural waterways.

A map showing the complete stream/waterway network in the district was prepared at the scale of 1:10,000. Analysis of aerial photographs showed that the gradient of the river and many stream tributaries is big enough to handle the amount of water that can be removed from the fields. Drainage system should be designed for the whole district and not on a piece of meal or farm basis only. The "canalitas" prepared by the farmers during the rainy season are not enough to drain the water from the soil. These "canalitas" or small canals are constructed

to remove the water on the surface and not the water from within the soil profile. They are not integrated, narrow and very shallow to improve the soil drainage in the area.

The coordination among the hacienda or farm owners is necessary in the construction of drainage system in the district. A topographic map of the district with 1 meter contour interval is prerequisite to planning and design of drainage system in the area.

CONCLUSION

Interpretation of infrared color aerial photography of sugar cane crop in the BISCOM district during 1975 growing season indicated that infrared color film registers in terms of various hue of red color depending on the drainage condition of the soil on which the sugar cane are planted. The sensitivities of the emulsion layers of the infrared color film and the color balance of the dyes enhance and amplify color differences that on conventional color photography may be overlooked. The resulting red color associated with the sugar cane foliage are brighter and lighter in tone than the normally dark shades of green on conventional color photography. They are generally more pleasing to human eye.

The differences in red color of vegetation can be more readily spotted in infrared color positive transparencies than the difference in green color on conventional color photography.

As with most of the other uses of air photos, it would be a mistake to insist that infrared color aerial photography replaces ground survey method of sugar cane and other crops. One should use such photos to the maximum possible extent because of speed, economy and added accuracy they offer. However, one should always verify and augment the photo data with direct on-the-ground observations.

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THE SUNFLOWER SAGA

by

C. JOANNE GARRETT

INTRODUCTION

The common name "sunflower" is applied to the annual and perennial herbs of the genus *Helianthus annuus* L. There are over sixty species in the *Compositae* family (*Compositae*), but the three main species are the "wild" sunflower, *H. annuus* ssp. *lenticularis*; the "weed" sunflower, *H. annuus* ssp. *annuus*; and the *H. annuus* ssp. *macrocorpus*, the so-called "giant" sunflower which is cultivated for its edible seeds.¹ Cobia and Zimmer² note that cultivated sunflowers are of two basic types: non-oil and oilseed. The oilseeds are used primarily as a source of vegetable oil and high protein meal, and the non-oil types are used primarily for human food.

Although sunflowers are presently considered a minor crop in the United States,³ the first commercial production of sunflowers for oil having occurred in 1967, sunflowers rank as one of the world's leading oil seed crops. World production of sunflower seed oil amounted to approximately 3.55 MT in 1971 and constituted one-sixth of the total world production of edible oils. Only soybean oil and peanut oil exceeded sunflower oil in importance in 1971; during the period 1962-1971, sunflower oil production increased at an average annual rate of 6.2 percent, compared with 6.3 percent for soybean oil and 1.6 percent for peanut oil.⁴

This paper examines the nature of sunflowers, their origin and their historical migrations, as well as the production and consumption of sunflower products.

THE NATURE OF SUNFLOWERS, THEIR ORIGIN AND MIGRATIONS

Plant nature.—Generally, the cultivated sunflower is unbranched and bears a massive head with numerous yellow rays and large achenes. Botanically, the sunflower fruit is referred to as an achene, which includes

¹ Heiser (1955:161).

² Cobia and Zimmer (1975:1).

³ *Ib'd.*

⁴ *Potential for Oilseed Sunflowers in the United States* (1973:1).

the seed proper with the pericarp, or hull, around it.⁵ Sunflower achenes may be yellow, brown, purple or striped in color. Some of the taller growing forms, such as *H. annuus*, *H. giganteus*, and *H. maximiliani*, may reach heights of 3.66 m. The large solitary blossom, achenes and rays, may grow to 30.7 cm to 61.5 cm in diameter.



HELIANTHUS ANNUS L.

The name "sunflower" was doubtless applied to the plant because of the daily orientation which the head, or "flower", makes to the sun. This orientation is caused by differential growth of the stalk or stem. In conditions of unequal light, auxin accumulates on the shaded side of a plant. Auxin is a hormone produced by plants which regulates their growth.⁶ Unequal accumulation of auxin in sunflowers causes the darker side of the plant to grow faster than the sunlit side. As the darker side of the plant grows, the elongating section of the stem bends toward the sun.

Origin and migrations. — Heiser reports that "the cultivated sunflower is of particular interest because it is one of the few crop plants to have been domesticated in temperate North America and it is one of the few plants whose wild progenitor is definitely known."⁷ He continues that achenes of the *annuus* ssp. *lenticularis*, the common wild sun-

⁵ Heiser (1955:161).

⁶ Of course, there are also synthetic auxins and growth stimulants such as gibberellin used to create "giant" plants.

⁷ Heiser (1955:161).

flower, were gathered by many Indians of the western United States for use as food, for medicine, and for ceremonial use. Mangelsdorf, MacNeish, and Willey⁸ write that "there can be little doubt that the agriculture of the New World (North America) is an indigenous development." Harm de Blij⁹ observes that archeological evidence places man in North America (theoretically via a land bridge from NE Siberia to Alaska) at least 20,000 years ago and Mangelsdorf *et al.* add that "agriculture had not yet been invented in the Old World and, if it had, it would not have been extensively practiced in northeastern Asia, . . . or successfully carried across the barren tundras of the Strait (Bering) into a not much more favorable area of what is now Alaska."¹⁰ These authors feel that at the time there were few plants in the region now the northwestern United States and southern Canada which could have been successfully domesticated. Although its domestication may have come relatively late, the sunflower proved to become one of those few plants to be domesticated.

Collection of wild sunflower seeds was a natural process for the new migrants. Dutton, in writing of the American southwest Indian groups, notes that "Each day man had to derive his existence from the plant and animal world about him, and so these things were of the utmost significance."¹¹ It was for this reason that the Indian geared his life to his surroundings; the result was "a culture that integrated the natural phenomena and biota of his world with mankind."¹²

Washburn has written about the Anasazi (a Navajo term for "the ancient ones"), a Pueblo group who lived in the four corners of Colorado, Utah, Arizona, and New Mexico. He notes that after 1000 BC, and perhaps around 700 BC, these people "ate maize, squash, and beans, as well as a wide variety of wild plants, including roots, bulbs, grass seeds, pinyon nuts, acorns, berries, cactus fruits, amaranths, chenopods, Indian rice grass, and sunflowers."¹³ Wild sunflowers, as observations in historic times have demonstrated, were "a particularly prized source of food"¹⁴ for many groups like the Anasazi.

Wild sunflowers were often eaten raw, or, more frequently, they were pounded into a sort of flour and made into flat cakes or mixed with other substances. They were also used medicinally, especially as a cure for chest pains.¹⁵

⁸ Mangelsdorf, MacNeish, and Willey (1971:488).

⁹ de Blij (1974:102); see map 3-1, "Dominant Pre-European Subsistence," p. 103; see also Downs (1972:5-20), Unit 1, "Evolution of the Navajo People."

¹⁰ Mangelsdorf *et al.* (1971:488).

¹¹ Dutton (1975:3).

¹² *Ibid.* See also chapters 7 "American Agricultural Origins: A Consideration of Nature and Culture" (pp. 121-141) and 11 "A Geographic Sketch of Early Man in America" (pp. 197-245) in Sauer (1974).

¹³ Washburn (1975:110).

¹⁴ Heiser (1955:161).

¹⁵ *Ibid.*

Heiser¹⁶ notes that man's use of the plant doubtless contributed to its spread as a weed, and both the use of the wild plant and its spread were necessary steps toward its eventual domestication.

Although prehistoric agriculture in the American southwest was well developed, there is no archaeological evidence of cultivated sunflowers. There is, however, evidence of pre-Columbian cultivated sunflowers at a number of sites in the eastern half of North America. Heiser reports that "at most of the sites the sunflowers are found with maize, but it is possible that the sunflower was in cultivation before the Indians had maize and the other food plants which originated elsewhere."¹⁷

Heiser notes that the sunflower is mentioned in the creation myth of the Onondago (a tribe belonging linguistically to the Iroquoian family and residing principally in central New York State) and adds that such mention might indicate that the plant had been used for a long time.¹⁸ This is a viable hypothesis; complimentary to Heiser's hypothesis is the idea that the sunflower found its way into Onondago myths because of its perceived importance. A third hypothesis would be a combination of these two: the plant was perceived as a vital food crop and had long been used by the group.

There are records of utilitarian uses for the sunflower. Again in the southwestern United States, the Hopi used the purple achenes for a purple dye, and an even more important yellow dye was extracted from the rays.¹⁹

Sunflowers have been known in Mexico since at least the sixteenth century. Today, the Mexican plant is called "maiz de teja." While Heiser notes that this could lead one to suppose that the plant was already there, he adds that two other names, "chimalacatl" and "anthilion," also refer to sunflower and neither are derived from the word maize.²⁰

Heiser reports that the first published record of the sunflower in Europe was Dodonatus' 1568 account and illustration.²¹ One type of sunflower, *H. tuberosus*, was cultivated for its roots, which may be eaten boiled, stewed, or baked in pies. De Candolle notes that *H. tuberosus* reached Europe in the seventeenth century. The following account by de Candolle was published in 1883:

In 1616, European botanists spoke of this composite (Jerusalem Artichoke-*Helianthus tuberosus*, Linne) for the first time. The large root was considered better for animal nourishment than human. Columna saw it in Cardinal Farnese's garden and named it *Aster*

¹⁶ *Ibid.*

¹⁷ *Ibid.*, p. 163.

¹⁸ *Ibid.*

¹⁹ *Ibid.*, 165.

²⁰ *Ibid.* See also "Lexicostatisticus" in Barnonn (1971:62-64).

²¹ Heiser (1955:165).

peruanus tuberosus. Other writers of the same period gave it names indicating their belief that it came from Brazil, Canada or India, meaning, of course, the new world of America. Linne adopted the Canadian origin from Parkinson, though he had no proof of it. I have previously shown that there are no species of *Helianthus* in Brazil, yet they are numerous in North America.

Schlektendal, after having observed that the Jerusalem artichoke withstood the rigorous winters of central Europe, asserted that this fact was supportive of the Canadian origin and contradictory to the southern. Dicaisme could cut out several quotes from the synonymy of the *Helianthus tuberosus* which proposed South American or Mexican origin. Like American botanists, he recalled what early travelers said about certain customs indigenous to the northern United States and Canada. In 1603, Champlain saw roots in their hands which they cultivated and which tasted like artichokes. Lescarbot spoke of roots that tasted like cardoon and proliferated in the area. He brought some back to France where they were sold under the name *Topinambaux*. The natives, he said, called them *Chiquebi*. Dicaisme also cited two French horticulturists of the 17th century, Colin and Sagard, who spoke of the *Topinambour* and said that they came from Canada. Note that at this period, the name Canada was used in a very general sense and included much of the northern United States as we know it. Gookin, an American author of indigenous customs, said that the natives put pieces of the Jerusalem artichokes in their soup.

Botanic analogies and contemporary testimonies agree, as we see, on the origin of the Jerusalem artichoke in the north-eastern part of the American continent. Doctor Asa Gray, seeing that the wild plant could not be found, supposed it to be a form of Lamarck's *Helianthus doronicoides*, but it is now said that it is a native plant of the state of Indiana.

The French name, *Topinambour*, seems to have come from some real or supposed name derived from the American languages. The English name, Jerusalem artichoke, is a corruption of the Italian, *Girasole* (Sunflower), combined with an allusion to the root's artichoke flavor.²²

Heiser²³ notes that there is little doubt that the sunflower entered Europe from North America via Mexico and the Spanish explorers and from the plains via the French and English. In Europe, the sunflower became a curiosity and a favorite garden flower, and it spread rapidly. It spread rapidly and reached Russia sometime previous to the nineteenth century.²⁴ In Russia, the sunflower was provided with a remarkably rich environment in the black chernozem soils of the northern steppe. It became a "spectacular success."²⁵

²² de Candolle (1883:34-35); this section translated from the French by Carol Ann Bally, Vanderbilt University, Nashville, Tennessee 37235.

²³ Heiser (1955:165-166).

²⁴ *Ibid.*, 166.

²⁵ *Ibid.*

Lydolph²⁶ notes that the chernozen soils are the best in Russia and some of the best soils in the world. The black earth belt begins in the western Ukraine and runs east-northeast across the middle of the Volga and southern Urals then into southwestern Siberia and northern Kazakhstan where, Lydolph continues, it narrows to a belt some 242 km wide, straddling the 55th parallel of latitude. Today, the chernozem soils are the heart of Soviet farming and sunflowers, wheat, corn, and sugar beets are all important crops.

Heiser notes that when it was introduced into Russia, however, both the social and physical environment were important for its development. The rich black earth formed the required physical setting, and the Holy Orthodox Church furnished the required social backdrop.²⁷ At the time of the introduction of sunflowers into Russia, the Church "...observed very strict regulations regarding diet during Lent and the days preceding Christmas."²⁸ Meat and many oil goods were prohibited, but sunflowers were recently introduced and were overlooked by the Church. The oily sunflower seeds became very popular and the USSR is today the world's foremost producer of sunflowers.²⁹

In the late 19th century, the plan was re-introduced to America and was often known as "mammoth Russian" or "giant Russian." Heiser continues that most American sunflowers now cultivated are derived from European, not Indian, stocks.

There are, however, still wild sunflowers on the American prairies. Allen, writing in 1870, described some of the primitive flora on the prairies of northern Illinois and central and western Iowa. He observed various species of sunflower: *Helianthus rigidus* Desf., the *H. giganteus* Linn., the *H. giganteus* Linn., the *H. grosse-serratus* Mart., the *Actinomeris heliantheides* Nutt., and the *Lepachys pinnata* T. and G.³⁰

Once sunflowers were reintroduced to the United States as a commercial crop, experimentation began. For many years United States production was limited in scale to the whole-seed market, and production was largely confined to the large seed or medium large seed varieties for the birdseed, nut and confectionery markets.³¹

Then, as noted, the first commercial production of sunflowers for oil seed occurred in 1967 when high-oil varieties which developed in the USSR were introduced. This oil seed production has been concentrated in the Red River Valley area of Minnesota and North Dakota.

²⁶ Lydolph (1970:22).

²⁷ See Vassadsky (1961) for an excellent and comprehensive study of Russia.

²⁸ Heiser (1955:166).

²⁹ *Ibid.*

³⁰ Allen (1870:579-582).

³¹ *Potential for Oilseed Production* (1973:2).

MODERN PRODUCTION

Sunflowers are favored by growers for several reasons. Primarily, their inclusion in farming can lengthen rotation and minimize risks associated with limited crop agriculture. Additionally, they are drought tolerant and can be successfully grown in drought-prone regions. As seedlings, they are more tolerant to frost and high winds.³²

Other advantages include their favorable response to fertilizer nitrogen applied on poor soil and the relatively low cost of seeds for production. As a row crop, sunflowers increase weed control and reduce weed seed carryover³³ to the next planting.

However, sunflower production also has its problems. In addition to being a favorite among birds, several insects and diseases attack them.³⁴ Additionally, because of the crop residue, the rotation to another crop requiring a clear field or clean bed may be difficult.

Sunflower Meals

Through the introduction of new varieties of sunflowers and the changes in seed processing, the composition of sunflower meal has changed markedly in the past few years. Of this change, the most notable improvement has been the lowering of crude fiber content in sunflower meal brought about through advances in meal processing and oil extraction.³⁵

The crude fiber content of the meal varies in relationship to the proportion of hulls present and the refinement process itself. Today's sunflower meal has a far lesser proportion of hulls left in the meal than was evident one or two decades ago. Studies have shown that there are energy values of 4820 and 4864 Kcal./kg and metabolizable energy values of 1907 and 2603 Kcal./kg respectively for whole sunflower meal and soybean meals.³⁶ Although research needs to be updated, it can be assumed that the metabolizable energy will be directly related to the levels of crude fiber and oil in the meal.

As with other oilseed products, the nutritive value of sunflower meal is greatly affected by its processing. It has been suggested that its relatively poor quality protein is due to excessive heat during processing and that a reduction in temperature during processing produces a meal of superior nutritive value.³⁷

³² Cobia (1975:4).

³³ *Ibid.*

³⁴ Among these are varieties of moths, beetles and weevils as well as leaf spots and mildew. See Cobia (1975) for a discussion.

³⁵ Smith (1968:unnumbered).

³⁶ *Ibid.*

³⁷ *Ibid.*

Nutritive value in animal feeds.—Numerous experiments have been conducted on the nutritional value of sunflower meal in poultry, swine and cattle feeds. The result of many published experiments comparing sunflower meals to other common protein supplements are often distorted by many factors, such as variations in the nutritive value of the tested substances, the composition of the materials, existing environmental conditions, and so forth. However, various researchers have reported that sunflower meal may satisfactorily replace its protein equivalent of meat meals in amounts up to 14% of the total ration (which means a total substitution of sunflower meal for the meat meal) in poultry feed.³⁸ In experimentation with all types of animal feed, it has been found to be most successful with additional amounts of amino acids lysine and isoleucine. However, most studies show adequate if not good results when sunflower meal is included as a protein substitute in poultry feed.

Where success was not indicated with experimentation in swine feed, poor palatability was often to blame. Thus, it has been found to be most successful as a swine food ingredient in combination with another protein source, such as fish, soybean or peanut meal,³⁹ to increase its palatability.

According to the United States Department of Agriculture Economic Research Service, some researchers have reported that often finely ground meal is dusty, thus hampering its inclusion in feeds. This can be corrected by either adding fat to the meal or by pelleting the feed.

Generally, sunflower meal has been well received by farmers and feed manufacturers in the U.S. The market value for sunflower meal for feed use largely depends on its nutritive content and nutrient availability in comparison with other protein sources and will vary for different classes of livestock and poultry.⁴⁰

Use in human foods.—Use of sunflower meal in human food is an interesting possibility. The absence of toxins is an advantage to its use in human foods as several other important oilseed meals contain toxins that must be dealt with. Another advantage is the familiarity of the sunflower seed in today's diet.⁴¹

As noted in the above section, sunflower meal would be more desirable if additional amino acids were added. The major problem limiting its use for human consumption, however, is a color change which takes place in the meal. The color changes from white to green or brown upon oxidation of its chlorogenic acid; this darkening may affect

³⁸ *Ibid.*

³⁹ *Ibid.*

⁴⁰ *Potential for Oilseed Sunflowers* (1973:24).

⁴¹ *Ibid.*, 25.

its acceptability in food products. It has also been found that there is a change in the pH level as this change takes place, from acid to alkaline.⁴²

One problem which one does encounter in human consumption of sunflower meal is rancidity. Sunflower seeds are extremely rich in oils, and though they are low in toxins, as soon as they are ground into meal and oxidation begins, the meal itself begins to deteriorate. Within the span of a few days, sunflower meal begins to become rancid and may become somewhat harmful.⁴³ Therefore, natural sunflower meal is best used freshly ground for human consumption.

The most popular use of sunflowers for human consumption is in a refined or processed product, however. The seeds are marketed roasted in the shell or unshelled as a snack item and are packaged and distributed as a snack item. Commercial food manufacturers and bakers use roasted nutmeats in candies, cookies, and other snack items.⁴⁴ (See Table I for an analysis of nutritive values of sunflower seeds).

TABLE I. NUTRIENTS IN THE EDIBLE PORTION OF
450 GRAMS OF PRODUCT AS PURCHASED

	Sunflower Seed Dry, in Shell	Sunflower Seed Hulled	Sunflower Seed Flour/Meal (partially defatted)
Refuse (percent)	4.6	20	80
Food Energy (calories)	1372.0	2540	1538
Protein (grams)	58.8	108.9	205
Fat (grams)	115.8	214.6	15.4
Carbohydrates (grams)	48.7	90.3	171
Calcium (milligrams)	294	544	1579
Phosphorous (milligrams)	2050	3797	4073
Iron (milligrams)	17.4	32.3	59.9
Sodium (milligrams)	73	136	254
Potassium (milligrams)	2253	4173	4899
Vitamin A (International Units)	120	230	—
Thiamin (milligrams)	4.80	8.90	16.33

⁴² *Ibid.*

⁴³ Airola (1971:101).

⁴⁴ ———

Riboflavin (milligrams)	.57	1.05	2.11
Niacin (milligrams)	13.3	24.7	124.0

Source: Figures based on nutritive equivalents provided by the United States Department of Agriculture Handbook #8, 1963.

Sunflower Hulls. — A byproduct of the seed-crushing operation, the hulls accounts for 22 to 28 percent of the total seed weight. Hulls have been utilized in livestock feed, poultry litter, binders, packing material and fireplace logs. In eastern Europe and South America, they have been burned to generate steam for the processing plants.⁴⁵ The most promising use appears to be as a roughage ingredient in livestock feed. In a finely ground state, hulls can be used to add bulk to a feed ration and in farm research hulls have been fed to various ruminants with good results and with no palatability problem.⁴⁶ (See Table II).

Sunflower Seed Oil. — Sunflower oil is a high quality oil. When refined, it compares favorably with other edible vegetable oils. A pale yellow, the refined oil has a distinctive but pleasant flavor and odor. The oil is low in saturated fatty acids and has a relative low solidifying point. Thus, it has a slow development of rancidity (as compared to other seed oils) and has excellent keeping qualities.⁴⁷

TABLE II. COMPOSITION OF SUNFLOWER HULLS AND MEAL OBTAINED BY VARIOUS OIL-EXTRACTION METHODS

Product and Oil Extraction Method	Moisture	Percentage of Crude Protein	Fat	Fiber
sunflower hulls ¹	11.5	3.5	3.4	22.1
sunflower meal: ¹				
screw-press method	3.5	37.6	8.7	13.9
screw-press method	7.1	44.6	6.3	12.1
prepress-solvent method	8.6	35.2	0.8	15.8
direct-solvent method	8.6	47.1	1.5	3.2
direct-solvent method	10.9	51.5	2.1	5.0

SOURCE: *Potential for Oilseed Sunflowers in the United States*
U.S. Department of Agriculture Economic Research Division,
1973, p. 22.

¹These analyses were obtained from 1968 production samples. The variation between and within processes suggests the importance of feed tag analysis. Analytical values may change with additional processing experience.

⁴⁵Cobia (1975:51).

⁴⁶*Potential for Oilseed Sunflowers* (1973:25-6).

⁴⁷*Ibid*, p. 9.

Sunflower oil is suited for a variety of uses: as a salad oil and a cooking oil; in the manufacturing of margarines and shortening.⁴⁸ Sunflower oil is a desirable frying medium because it does not thicken and darken as do some oils. Because of these properties, it has been a standard frying oil used by potato chip manufacturers and seems to be particularly well suited for use in the growing snack food industry.⁴⁹ (See Table II).

CONCLUSION

The Sunflower is unique for several reasons: it is one of the few crops whose wild progenitor is definitely known, and it is one of the few crops to have first been domesticated in the temperate North America. The sunflower saga is a fascinating one. The plant was foraged by the American Indian, domesticated, and became a camp follower which was used as a food stuff, in dyes, for ceremonies, and in some areas, was incorporated in the Indians' myths and religions.

Then, as Heiser notes,⁵⁰ with the introduction of maize, sunflowers lost their dominant position in the Indian culture. White explorers carried the plants to Europe and into Russia where they found a ready home. Eventually, seed varieties were introduced to North America again and, in 1967, the oil-seed variety went into commercial American production.

Initially considered a supplementary food source and then as garden ornaments, sunflowers have become the second leading oil seed crop in the world. Additionally, the development of a strong human food and bird seed market has resulted in further production increase. Although they are still considered a minor crop, the rapid progress made in varietal improvement suggests that they are an increasingly important alternative crop.⁵¹

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⁴⁸ *Ib'd*, p. 16.

⁴⁹ *Ibid*, p. 18.

⁵⁰ Heiser (1955:166).

⁵¹ Cobia (1975:112).

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DEVELOPING MARINE FOOD RESOURCES OF ASIA

by

RUFINO S. IGNACIO

Aquaculture covers all activities related to the production of economic value. It involves the application of farming techniques to the breeding and rearing of aquatic species in captivity. The method offers viable prospects in the search for sources of low-cost animal protein. Today, despite the traditional techniques being used, aquaculture accounts for ten percent (roughly six million metric tons) of the world's total fish production.

POTENTIALS AND CONSTRAINTS

The Indo-Pacific region supplies at least 75 percent of the world's fish production through aquaculture. It is estimated that Southeast Asia alone holds some 630,000 hectares of operational fishponds with over 12 million hectares of swamplands, tidal flats and protected coves. Tapping these potential areas for aquaculture production could very well contribute to global efforts to stave off hunger and malnutrition.

The full development of aquaculture resources is presently hampered by a number of factors. The present practice is for fishermen to catch the fry along the coasts and sell them to pond operators, for eventual stocking in ponds. The volume of fry catch depends upon seasonal changes and weather conditions. At certain times of the year, fry are hardly available and therefore expensive.

Another major constraint to aquaculture development is lack of knowledge about parasites and diseases affecting aquatic animals. When infected with diseases, the animals in the ponds are at the mercy of Mother Nature. Low productivity may also be due to faulty pond construction and inadequate knowledge about breeding habits and feeding requirements of aquatic species at different stages of growth.

REGIONAL FRAMEWORK

The Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC) is conducting integrated scientific research to harness the aquaculture potentials of the region. Its primary objectives are: (a) to promote, undertake and coordinate aquaculture research; (b) train researchers and technicians in aquaculture; and (c) disseminate aquaculture information to Southeast Asian countries.

Formally established in July 1973, it is one of the three Departments organized under the SEAFDEC agreement involving Japan, Malaysia, Thailand, Singapore, Vietnam and the Philippines. The two others are the Marine Fisheries Training Department in Bangkok, Thailand and the Marine Fisheries Research Department in Singapore. A Secretariat headed by a Secretary-General based in Bangkok coordinates the functions and programs of the three departments.

The Department operates in accordance with rules and regulations approved by the governing SEAFDEC Council, which consist of Fisheries Directors from member countries. As an expression of Philippine Government support, President Ferdinand E. Marcos issued PD 292 providing the Department with tax exemptions, immigration privileges and other immunities generally granted to international and treaty agreement organizations based in the country. The President also signed Presidential Proclamation 1246 reserving about 40 hectares of the public domain at Tigbauan, Iloilo to serve as site of the Department's main station.

RESEARCH BREAKTHROUGHS

One year after it became operational, the Department succeeded in the mass propagation of sugpo fry in its hatcheries at Tigbauan. This accomplishment was followed by the completion of the prawn life cycle with the maturation and rematuration of the sugpo which had been based in the hatcheries. The latter was attained by adopting "unilateral eyestalk ablation," a simple technique involving the pinching of one eyestalk to induce prawn sexual maturation. These accomplishments will lead to the stabilization of the supply of spawners and stimulate the establishment of more sugpo hatcheries to develop fully the prawn industry in the country.

Sugpo culture could be a major export-oriented, dollar-earning industry, particularly for the Philippines which has 174,000 hectares of operational brackishwater ponds. Assuming that 20 percent of this available area is developed into prawn ponds (35,000 hectares) at an average yield of 1,000 kilograms per hectare per harvest at two harvests per year, the total prawn production would be 70 million kilograms. At the prevailing export price, it would mean \$350 million in foreign exchange earnings for the country per year.

The Department has likewise made considerable headway in milkfish research with partial success in the spawning of adult milkfish or sabalo, matured female sabalo spawned under controlled conditions at the SEAFDEC station in Pandan, Antique. Unfortunately, the male sabalo in the tanks were not ready for synchronized fertilization.

In preparation for this year's spawning season (February to May), SEAFDEC researchers have used liquid nitrogen to preserve milkfish milt for ready use as soon as a female sabalo in the canvas tanks spawns.

Very little information is available on the biology, habitat, migration patterns and spawning habit of the milkfish. It was only recently that studies on milkfish breeding are being done in Taiwan, Hawaii and the Philippines. The Aquaculture Department has perfected the techniques of domesticating the sabalo which is an extremely wild animal. It has also developed methods of capturing, tranquilizing and breeding it in captivity to unravel the mystery surrounding the milkfish life cycle from juvenile to adult stages.

These modest advances in milkfish research could lead to the expansion of the milkfish industry. The three major countries culturing milkfish on an extensive scale are Indonesia, Taiwan and the Philippines. Taiwan produces about 2,000 kilograms per hectare per year, while Indonesia and the Philippines produce only 340 and 600 kilograms per hectare per harvest per year, respectively. As in the prawn culture, the milkfish industry is hampered by the lack of fry supply for stocking. In the Philippines alone, there is a need for 1.3 billion fry and only 600 to 700 million fry could be gathered from the wild. With the breakthrough in milkfish spawning in captivity, there will be a more reliable supply of milkfish fry for stocking in ponds and pens.

RESEARCH PROGRAMS

The Department is undertaking for a major research programs on the following general problem areas: prawn, milkfish, seafarming and freshwater fisheries. The programs are aimed at the eventual elimination of the need to capture wild spawners or fry from their natural habitat through complete domestication of cultivable species. Specific research projects are being conducted under each program.

The main research thrust at present is on three species — milkfish (*Chanos chanos*), jumbo tiger prawn (*Penaeus monodon*) and the green mussel (*Mytilus smaragdinus*). Priority areas of studies include: (a) artificial propagation of milkfish; (b) increasing the survival of prawn fry in the hatchery; (c) development of milkfish and prawn broodstock; (d) development of artificial diets for milkfish and prawn; and (e) transplantation techniques for mussels.

Included as part of the over-all research design in each priority species are certain corollary problems. Of utmost importance in the propagation of both milkfish and prawn are the control and prevention of disease in the hatchery, feed for the larval stages, and water quality. Equally important is the socio-economic profile of the entire aquaculture industry from fry gathering to cultivation and marketing. Such a profile provides benchmark information with which to evaluate the impact of any technology developed by the Department on the aquaculture industry.

Seafarming of finfish, shellfish and other aquatic animals and plants of economic value is one of the promising ventures in the Southeast Asian region. This is especially applicable to the Mindanao and Sulu archipelago of the Philippines in view of its extensive atoll lagoons, coves, tidal flats and estuarine areas.

The Department's Seafarming Program is currently conducted in its main seafarming station in Igang, Guimaras Island. Pilot demonstration centers are at present being established in Mindanao, in cooperation with the Philippine Bureau of Fisheries and Aquatic Resources (BFAR) to serve as a venue for the transfer of technology to existing and prospective fish farmers.

TRAINING AND EXTENSION

The Department conducts an interrelated training and extension program. The training program aims to produce the appropriate technical manpower for the development of the aquaculture industry. The extension program seeks to hasten the transfer of aquaculture technology to improve fish production, generate employment opportunities, and increase rural income, particularly in fishing communities.

The first 10-month Regional Training Program in Aquaculture Research was launched by the Department in April 1976, to be repeated every year thereafter. It is open to participants from developing countries of Asia, particularly those from SEAFDEC member countries. The training program includes basic aquaculture and research methodology. As a requirement, each participant must conduct an independent research in aquaculture.

The Cooperators' Training Program involves the private sector as active partners in the search for improved aquaculture technology and facilitate the transfer of fisheries technology to the industry, through lectures and discussions on fry production, pond culture, harvest, treatment and transport. Since June 1975, the Department has conducted a series of five one-week sessions involving 330 participants, mostly from the private pond caretakers and BFAR extension workers.

The Technician Training Program, intended primarily for private pond technicians, hopes to generate interest in the adoption of improved methods in prawn culture, provide requisite knowledge and information, and equip the technicians with the necessary skills and expertise on the rearing and culture of prawns. A series of 10 sessions has already been conducted at the Tigbauan Main Station.

The training on Pond Construction and Management Program is sponsored by BFAR, Western Visayas Federation of Fish Producers, Inc., and SEAFDEC Aquaculture Department. The first two sessions

were participated in by more than a hundred fishpond owners from the economically-depressed areas of Zamboanga del Sur, Cotabato and Lanao Provinces.

GRADUATE PROGRAM IN AQUACULTURE

To alleviate the acute shortage of manpower in aquaculture research in the Philippines and Southeast Asia, the Department in cooperation with the College of Fisheries of the University of the Philippine System, is engaged in a graduate program, leading to the degree of Master of Science in Aquaculture. Started in June 1976 with an initial input of 20 students, the program uses the facilities of and equipment of the Department's Tigbauan and Leganes stations for the regular lecture and laboratory sessions. Senior researchers of SEAFDEC are given affiliate faculty status by the UP to enable them to teach specialized courses in aquaculture. Courses offered under the program include Aquaculture, Fish Nutrition, Fishpond Engineering, Fish Diseases and Hatchery Management, and others.

The Department is expanding the graduate program in Aquaculture to emphasize on fish nutrition and reproductive physiology. Initial consortium arrangements have been made with Victoria University and the University of Guelph in Canada which will provide experts to the program. Under consortium arrangements, graduate students take courses in affiliate universities abroad and conduct their research work at SEAFDEC. A number of universities in Southeast Asia and other parts of the world have signified interest in joining the consortium as affiliate universities.

Last year, the Department launched a staff development program to enhance its own research and administrative capability. The program involves 240 man-years of scholarship grants aimed at producing 60 M.S. degree holders and 40 PhD's in the next seven years. This program is dove-tailed particularly with the graduate program in Aquaculture in which a number of SEAFDEC researchers are at present pursuing advanced degree.

RESEARCH STATIONS

The Department's main station at Tigbauan is about 26 kilometers west of Iloilo City. Its present facilities include the hatcheries, nursery ponds, laboratories, administration buildings, library and training hall, physical plant, dormitory, apartments for trainees and researchers, cafeteria, staff cottages and guest houses. The feeds and nutrition laboratory is scheduled to be constructed this year with support from the Philippine and Japanese Governments. The main collection on milkfish constitutes around 85 percent of the world's possible literature on this specie.

The Department operates a 96 hectare pond system at Leganes, Iloilo, some 17 kilometers northeast of Iloilo City. The ponds are used to demonstrate the feasibility of producing hatchery-bred sugpo and other aquatic species on a commercial scale. Due for completion in May this year at Leganes is a field laboratory which will house the research and auxiliary service facilities.

The milkfish research station in Pandan, Antique, is about four hours overland ride from the Tigbauan Main Station. It was set up as part of the research project on milkfish spawning and cultivation which is partly supported by a grant from the International Development Research Center (IDRC) of Canada in the amount of \$826,000.

Facilities have been set up in Igang, Guimaras Island, about half an hour boat ride southeast of Tigbauan. Cages and pens have been installed and coves fenced for broodstock purposes. With assistance from the Government of New Zealand, the Department is conducting studies on mussel, or tahong, as part of the seafarming program, with studies on oysters, clams and other related species.

A 45-hectare site in Tapao Point, Binangonan, Rizal, along the coast of Laguna de Bay, is being developed for studies on the culture of catfish, carp, eel and other freshwater species, including the development of milkfish seedbank and the management of the lake eco-system. The Danish and West German governments have expressed interest in supporting the Department's freshwater aquaculture program.

INTERNATIONAL CENTER FOR AQUACULTURE

Since its establishment, the Aquaculture Department has received funding assistance from the SEAFDEC member-countries, notably Japan and the Philippines. Under the SEAFDEC Agreement, the Philippines as host country is committed to provide the Department with the necessary physical facilities and operating funds. Japan, on the other hand, provides research and laboratory equipment, experts and training grants.

The department has been authorized by the SEAFDEC Council to seek financial support from non-member governments and international organizations, particularly the Canadian International Development Agency (CIDA), Danish International Development Agency (DANIDA), Canada's IDRC, the Asian Development Bank, the Australian, West German and New Zealand Governments, and others.

The Technical Advisory Committee (TAC) of the Consultative Group on International Agricultural Research (CGIAR), a grouping of international donor institutions, has for sometime been considering the Aquaculture Department as an international research and development center. In its meeting in Rome in February 1977, the TAC has identified the Department as the possible international aquaculture center. This would mean international recognition of the Department as a viable research organization and a steady source of foreign funding, especially for the research, equipment and manpower needs of the Department.

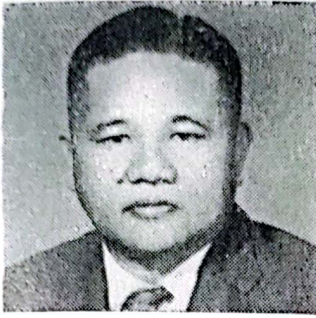
There is a need to approach the multifarious problems of aquaculture development on a cooperative basis to unravel the food potentials the seas, the lakes, the rivers and the streams. For in the final analysis, the waters are the last frontiers of man's survival. The SEAFDEC Aquaculture Department is committed to achieve its objectives in the shortest time possible, as the race against hunger and malnutrition must be won at all costs.

Source: Countryside Banking, March 1977,
Volume III, No. 3 — pp. 17-21.

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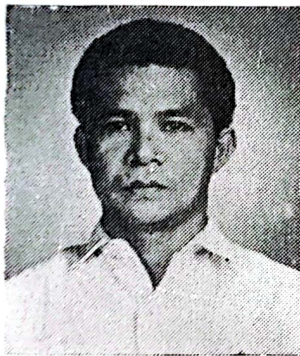
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Aside from his work in the University, Dr. Salita is also Vice Chairman of the National Committee on Geographical Sciences, NSDB since 1968 and he is presently Vice-Chairman of the Executive Board and concurrently Chairman of the Division of Social Sciences, National Research Council of the Philippines. He has written several scientific papers and articles and represented the country in several international conferences. His main contribution is in the field of environmental and geographic education. He is the author of the book entitled *Geography and Natural Resources of the Philippines* which was published by the College of Arts and Sciences, U.P. in 1974.



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and Land Use Planning. His researches have been with the Inventory of Water Resources and the Utilization of Satellite Imagery.



JOANNE GARRETT is regular contributor to the Philippine Geographical Journal as co-author with her better half Larry Garrett. This time her paper is about a very promising plant now being grown in the Philippines — a very good source of edible oil, "The Sunflower Saga." Mr. and Mrs. Garrett are prolific researchers and writers. In fact this summer, they will be off to Brazil and will study a certain kind of palm and its industrial and agricultural uses. This will be published in the Philippine Geographical Journal.

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