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ABSTRACT

This document describes the International Field Studies program on Andros Island, Bahamas. Several sections detail the facilities and financing of the projects. Other sections discuss the general characteristics of Andros concerning the local culture and government. An outline of the environmental studies course used in this program is presented along with a complete workbook. Guides to the environmental and ecological features of the islands and techniques for doing environmental research are also included. (JP)

International Field Studies
1973 Report

To the Bahamian Government

Appendix A

Andros Development Statement

By Tom Taylor
Andros Island Coordinator

INTERNATIONAL FIELD STUDIES

Proposition for Development on
Andros Island, Bahamas

This paper will attempt to describe the proposed operations of International Field Studies on Andros Island, Bahamas, with regards to its future developement and status of the facilities located at Blanket Sound and those which may be located elsewhere on Andros Island. Of primary consideration are the following : I) Financial Support for the Programs; II) Proposed Building Projects and Improvement of Existing Facilities; and III) Cooperation with the Bahamian Government.

I) Financial Support for the Programs :

The programs on Andros Island are designed to be supported primarily from the fees paid by the students enrolled in the programs; however, additional funds will be obtained whereever possible from Federal Projects and various scientific and/or educational foundations who may cooperate with International Field Studies from time to time in order to increase the facilitation of achieving common goals.

In the short run perspective, International Field Studies is planning for twenty student groups to utilize the campsites on Andros Island between July 1, 1973 and June 30, 1974. Each group will run on an average budget of between $3,000 and $4,000. Approximately half of this sum is expended in transporting the students to and from the Island and for insurance in the United States. The remainder of the budget is used for the purchase of food, the payment of Bahamian customs duty, head tax, insurances and licenses, and for the rental fees of the equipment (including boats, trucks, diving equipment, etc.), and for gasoline and oil.

II) Proposed Building Projects and Improvement of the Existing Facilities:

For the coming year, International Field Studies sees four major projects which will begin to improve the facilities at the Blanket Sound Site. These are 1) Construction of a dock; 2) Erection of a metal storage shed; 3) Construction of fresh (potable) water facilities; and 4) The purchase of additional program equipment. The total estimated cost of these projects will be appromimately $5,000.

1) The construction of the dock will make easier the use and maintenance of the boats. This dock is to be built of wood and concrete at the end of the rocky point extending into Blanket Sound immediately south of the Old School House. The estimated cost of this project is $500.

2) A small, metal storage shed, measuring 10 feet by 10 feet will be erected for the storage of tools, automotive and boat parts, and various other equipment. Movement of this material from the School House will permit greater and easier use of the School House for educational and other purposes. The metal walls and roof for this building have been transported to Andros Island, and the project yet requires the construction of a concrete foundation for the building at a cost of approximately $100.

3) The need for potable, fresh water is a critical one at the Blanket Sound Site for drinking and washing purposes. Present plans call for the digging of a well to the west of the main road to Fresh Creek, the erection of a windmill to supply a holding tank, and the laying of plastic tubing to carry fresh water across the tidal pond to the campsite. The estimated cost of this would be approximately $1,400.

4) The need for additional equipment has been demonstrated, and hence International Field Studies is planning to purchase a 25 foot sloop from Mr. Irving Mizzit of Staniard Creek and to purchase 10 to 15 additional complete sets of SCUBA diving equipment. The cost of the boat is $800. and the SCUBA equipment will cost approximately $2,200.

The building and improvement projects are estimated to cost $2,000, while the expenditure for program equipment will approach $3,000, bringing the investment at the Blanket Sound Site to $5,000 for the year beginning July 1, 1973 and ending June 30, 1974.

Besides thses definitive projects, International Field Studies also will negotiate for the donation by the Owens-Illinois Corporation of several port-a-camp structures and other equipment to supplement our present facilities. International Field Studies will furthermore explore the possibilities of establishing and developing additional campsites near the Andros Reef Inn at Stafford Creek and near the Andros Beach Hotel at Nicolls Town. International Field Studies will check into the pros and cons of purchasing a propane-operated freezer to assist in the preservation of food, particularly fish and bread.

III) Cooperation with the Bahamian Government

International Field Studies desires to re-charter in the Bahamas as a Bahamian Corporation with the understanding that upon the dissolution of International Field Studies all equipment and holdings of International Field Studies in the Bahamas would revert to the possession of the people of the Bahamas, excepting that which would be required for the payment of all outstanding debts accrued against International Field Studies beforedissolution.

International Field Studies proposes the formation of a Board of Advisors to be comprised of four Bahamians and three Americans whose duty will be to meet once a year at the discretion of the members to review, to analyze, and to propose modifications for the programs carried out at the International Field Studies' campsites. This Board will also audit and review the fiscal budget of the programs carried out. The members of the board would consist of one representive each from the Ministry of External Affairs, the Ministry of Education, and the Ministry of Fisheries and Game; the Commissioner for the District in which the particular International Field Studies' Site is located (in the case of the Blanket Sound Site, this would be the Commissioner of Fresh Creek); the Director of the U.S. Federally funded research project on Andros Island; one representive from International Field Studies' main office; and the Director of the particular Field Station on Andros.

In concise form, this paper has been prepared to outline the present proposals for the development and/or improvement of the field stations on Andros Island by International Field Studies with regard to financial support, building projects, and governmental associations.

Appendix B

Andros Accounting Procedure
(Working Form)

By Barbara White
Financial Coordinator, IFS Main Office

ANDROS ISLAND, BAHAMAS TRIP EXPENSE ACCOUNT

Dates _____ Camping Site _____

Educational Organization _____

Trip Leaders: _____, _____

_____, _____

_____, _____

TRIP INCOME

of Regular Paying People _____ X trip cost _____ = _____
# of People With Discounts _____ X Adjusted Trip Cost _____ = _____
# of People Going-Not Paying _____ = _____
Total Number of People On The Trip _____
Total Amount of Money Taken in for this Trip = _____

TRIP EXPENSES

Number of Vans _____ X .20/mile (15 pass.) X # of Miles _____ = _____ **
_____ X .16/mile (12 pass.) X# of Miles _____ = _____ **

Additional Vehicular Rental (Not necessarily I.F.S.)
Rental _____ X Rental Rate _____ X # of Miles _____ = _____
Gasoline Charges on a Non-IFS Vehicle with IFS Credit Card _____ = _____ **

Trucks on the Island: # Used _____ X $10/day X# of Days Used _____ = _____ **
Truck Gasoline (Paid by Cash) = _____ *
Boat Gasoline (Paid by Cash) = _____ *
Gasoline (From I.F.S. Tank) = _____ **
IFS Boat Rental: With a Captain Provided $50/day X # of Days ___ = _____ **
Without a Captain $35/day X # of Days _____ = _____ **
Other Boat Rentals:
Andros Reef Inn: Large Boat With a Captain $50/day X #of Days ___ = _____ *
Large Boat Without a Captain $35/day X#of Days = _____ *
Other Rentals: Rental Rate _____ X Days Used _____ = _____ *
Rental Rate _____ X Days Used _____ = _____ *

Campsite Rental: (Payable to Andros Reef Inn *)
Blanket Sound Site: $1/person/day X # of People X # of Days _____ = _____ **
Andros Reef Inn Site: .50/person/day X # of People X # of Days ___ = _____ *
Andros Reef Inn Equipment Rental: .50/person/day X # of Days ___ = _____ **

SCUBA Equipment Rental:
IFS Units: $1/person/dive X total # of Dives Taken _____ = _____ **
IFS Safety Vests: $1/Trip X # of Vests Used _____ X # of Days ____ = _____ **
Andros Reef Inn:
Tank and Backpack: $1.50/day X #of Units X Days Used _____ = _____ *
Regulators: $1.50/day X # of Units X Days Used _____ = _____ *

Air: Andros Reef Inn: $1/fill (72 cu. Ft.) X # of Fills_____ = _____*
Small Hope Bay: $1.05/fill (72 cu. ft.) X # of Fills_____ = _____*

Water for Blanket Sound Site: $5/week
Propane: $5/small tank or $17/ large tank (Buy only when needed) = _____*

Food: The average charge is $3/day
Food On The Road
1. Restaurant: Average cost is higher, usually $4.50/person/three meals Total cost of Restaurant Food = _____*
2. Fixed Along The Road: $3/person/day = _____*
Food Taken to Andros (Purchased in U.S.) = _____*
Duty on Food Brought To Andros Island (Figure Roughly 30%) = _____*
Food Purchased on Andros Island. = _____*

Airfare: $35/person/roundtrip X #of People_____ = _____**
Additional Air Freight Costs (Overweight) = _____**
Head Tax upon leaving the Bahamas $3/person X # of People _____ = _____*
Airport Parking = _____*
Tolls = _____*

Insurance: .35/person/day X # of Persons_____ X # of Days___ = _____**

Leader Fees:
Name_____ Salary_____

Name_____ Salary_____

Name_____ Salary_____

Name_____ Salary_____
Total salaries paid_____**

Overnight Expenses:
Place Stayed_____ Rate_____
Place Stayed_____ Rate_____
Place Stayed_____ Rate_____
Place Stayed_____ Rate_____
Total Charges for Overnights_____*

Miscellaneous Expenses:

ITEM	COST

Any items over $10 must have prior approval by IFS.
Total Miscellaneous Expenses_____*

SUBTOTAL_____
International Field Studies Administration Cost 7% of the subtotal _____**

TOTAL_____

CASH TAKEN ON THE TRIP _____

TOTAL EXPENSES ON THE TRIP _____

CASH LEFT OVER _____

ADJUSTMENTS
1. PERSONNEL EXPENDITURES _____
2. EQUIPMENT DAMAGE COSTS _____

TOTAL AMOUNT TAKEN IN FOR THE TRIP _____

TOTAL AMOUNT SPENT FOR THE TRIP _____

MONEY LEFT OVER _____

REFUND _____

* Money needed as cash
** Money paid to IFS

Appendix C

Current Banking Statement

By Phil Gordon
Branch Manager, Ohio National Bank

THE OHIO NATIONAL BANK OF COLUMBUS

Columbus, Ohio

Beechwold Office
4550 North High Street
Columbus, Ohio 43214

August 7, 1973

Ministry of Education
Bahamian Government
Nassau, Providence Island

Dear Sir:

We wish to highly recommend to the organization International Field Studies, Capital University, Columbus, Ohio.

They have banked with us since March 1970 and have maintained a very satisfactory checking account. We have never had an occasion to return a check for non sufficent funds.

We have at various times made them loans to purchase equipment and payment has been made promptly.

We are also well aquainted with the principals and they are highly regarded people in the community and all are in the field of education.

If there should be any futher information you desire, please contact the undersigned.

Very truly yours,

Philip S. Gordon
Manager

PSG/ml

Appendix D

Existing Diving Regulations
&
Training Program Report

By Pete Wolfinger
Diving Coordinator, IFS

SCUBA DIVING AT ANDROS

These general regulations apply to all persons when skin or SCUBA diving under the auspices of International Field Studies. They apply whether diving form a boat or from shore.

A. Any person may engage in SCUBA diving who is currently certified for such depth.
B. Divers shall be divided into three classes: 1. Skindiver
   2. Qualified Diver
   3. Certified Diver

Skin Divers will be given training in the use of fins, mask, and snorkel. and should not attempt to skin dive until properly checked out.

Qualified Divers. SCUBA lessons shall be given on Andros to anyone whose swimming ability meets with the instructor's requirements. Qualified divers will be the title given to persons completing these lessons, and they are not to dive over 30 feet.

Certified Divers must have taken lessons before arriving at Andros and carry a certification card from a recommended national certifying group. (NAUI, YMCA, PADI or equivalent). They may dive to 130 feet, and are entitled to dive deeper only with the approval of the dive master.

C. No person shall dive alone.
D. When diving from the boat and away from shore, all persons shall wear a flotation device (life vest) and carry a snorkel (irregardless of whether they are wearing an exposure suit)
E. No decompression dives shall be made by I.F.S. divers

RECOMMENDED EQUIPMENT

1. fins
2. mask
3. snorkel
4. regulator (if you have one, but they are available)
5. flotation device (limited number available)
6. depth guage
7. knife
8. wet suit (October to March)
9. white shirt, or other protective garment (April to September)
10. gloves (cotten)
11. goody bag or something used for collection

Peter J. Wolfinger SDI 354

Introduction:	Peter J. Wolfinger is co-owner of th[illegible]o Dive Shop. Primary duties are that of SCUBA inst[illegible]ct[illegible]on, Curriculum Director, and Equipment Counselor. Included in this is the training of all assistant instructors, and the chief writer of the Instructor's Manual for The Mid Ohio School of Underwater Techniques.
Teaching Experience:	Four years as certified Leader-Examiner for the YMCA. Four years as certified N.A.S.D.S. Instructor. Four years as certified OCSSI Instructor. One year as certified SDI Instructor for N.A.S.D.S. Staff Lecturer of Mid Ohio School of Underwater Techniques. SDI in charge of all advanced open water instruction. Certified regulator repair for all major brands. Course director of Mid Ohio School of Underwater Techniques. Five years of diving instruction with The Pro Dive Shop.
Diving Experience:	Seven years of sport diving including both salt and fresh water experience. Two years experience in underwater photography. Commericial training in light salvage and underwater dredging. Group leader and Dive Master for diving tours.

CLASS ROOM #1

I. Materials Needed for Class Room:

A. Brief Case, Text Book Safe Scuba
B. Chalk and Eraser
C. Three types Vests
D. Mask
E. Weight Belt

II. INTRODUCTION:

A. Establish Contact

B. Create Interest

C. Value to Student

D. Overview (Notes, questions, reference reading)

III. PRESENTATION:

A. Skin Diving

1. Water Pressure

2. Atmospheric Pressure

3. Boyles Law:
If the Temperature is kept constant, the Volume of a gas will vary inversely as the pressure while the Density will vary directly as the pressure.

4. Body Incompressable, Pressure transmitted freely throughout body.

5. Air Spaces

a. Lungs and Airways
b. Inner Ear
c. Sinuses
d. Stomach and Intestines
e. Air Spaces applies

6. Squeezes

a. Lung
b. Ear Squeeze (Pg.14) Ear Plugs
1.) Hold Nose and Blow
2.) Jaw Wiggling
3.) Yawning
4.) Chewing Mouth Piece

c. Sinuses
d. Mask - Goggles
e. Other Squeezes
1. Stomach and Intestines
2. Tooth

7. Hyperventalation

8. Vest explanation

a. Archmedes Principle
b. Weight Belt - Quick release
c. Breath Control

I. APPLICATION:

A. How much does pressure increase per foot of descent? 1/2 lb.

B. Atmospheric pressure is generated by the weight of air surrounding the earth. What is this pressure? 15 psia

C. The total pressure on a diver is the sum of what two pressures? Atmospheric pressure and water pressure.

D. How many feet must we descend in the water to accomplish one atmosphere of pressure? 33 ft.

E. The human body is basically incompressible. True False

F. According to Boyle's Law, if the pressure is doubled, the volume is reduced to 1/2.

G. Name as many of the air spaces in the body as you can that are affected by pressure on descent. Lungs, Ears, Sinus, Stomach, Intestines, and Mask.

H. Name two ways lung squeeze could be a problem. Below 99' and Exhaling at depth.

I. Name the two main problems involved in an ear rupture. Infection and Vertigo.

J. If you have trouble equalizing the pressure in your ears, you should wear ear plugs. True False

K. The chief symptom of sinus squeeze is pain.

L. Mask squeeze is equalized by exhaling into the mask with your nose.

M. Hyperventilation lowers the CO2 level in your lungs.

N. The best way to extend your breath holding time is to develop good skindiving techniques.

O. Vests are used in diving to serve what two purposes?
1. Surface Resting and Survival
2. Bouyancy Control

P. The floating power or positive bouyancy of a safety vest is 14 to 16 lbs., of a B.C. is 24-26 lbs.

V. SUMMARY:

While free diving, most problems are generated by pressure. This pressure reacts on the air spaces in the body or air spaces applied to the body. If all spaces are equalized so that no pressure differential exists, we don't have any problems. Divers with a good background of knowledge will have little or no problem in taking care of these squeezes.

The proper use and care of a Safety Vest or B.C. is also very important whether it be for Surface Resting or Bouyancy Control. Develop good techniques and habits in skindiving and know your limitations.

TEST:

This material will be included in the final test.

REFERENCES:

Safe Scuba pages 1-30, 36, 54, 55.

ASSIGNMENT:

Safe Scuba pages 50-51, 34, 35, 62-82.

See you in the pool! (Give directions)

E. MASK and EAR CLEARING

1. Instructor explain both (Finger wells, purge valve)
2. Instructor Demonstrate
3. Work individually with each student. (Keep them moving)

F. VEST USE

1. At this time Instructor demonstrate only.
   Demonstrate all three types of vest (Dacor, Scubapro, B.C.)

G. PRACTICE SESSION

1. Split into four groups, help each one individually with problems.
   Use strong people to help slower ones.

H. ASSIGNMENT

1. Bring sweat shirt to wear under tank harness. Be sure and bring mask, fins, snorkel, and arm bands. (See you next Sunday)

itle: Medical Aspects #1 and Tank Safety

aterials:
1. Tank with Back Pak
2. 2 Regulators - Single and Double hose
3. Spare "O" Ring
4. Chalk and Eraser
5. Regulator Posters

NTRODUCTION:

1. Establich Contact
2. Create Interest
3. Value to Student
4. Overview (Two Distant Parts)

PRESENTATION:

A. Tank Safety and Assembly Proceedures

1. Scuba Tank
   a. Explain Volume (2250=65 cu. ft.)
   b. Never Leave a Tank Standing Unattended.

2. The REGULATOR
   a. Diagram (On blackboard)
   b. Air = To Surrounding Pressure

3. Coupling The Two Together (Single and Double Hose)
   a. Checking Regulator (Check 1 and 2)
   b. Disassembly Proceedures
   c. Maintenance (Brief description)

4. Back Pack
   a. Harness and Quick Release

B. Embolism and Treatment

1. Air = To Surrounding Pressure
2. Review Boyle's Law (Blackboard)
3. Boyle's Law in Reverse (Page 32, S.S.)
4. Overpressurization of the Lungs
5. Embolism (And associated diseases Pg. 35 S.S.)
6. Treatment (Chamber)
7. Symptoms and First Aid for Embolism

C. Conditioned Reflex (Habits):

1. Examples of Reflexes

   a. Walking ... Running
   b. Playing Musical Instrument and Marching
   c. Playing Sports (Basketball, Boxing)
   d. Driving a Car

2. Training Reflexes
   a. Practice and Repetition

3. Subconscious Body Guards
   a. Safety is Automatic

D. Breathing Correctly:

1. Never Hold Your Breath While Using SCUBA

2. Breathe all the Time (When you're not inhaling, you're exhaling)

3. Exhale while Ascending

4. Stop, Think, Get Control, Go (Pg. 37 S.S.)

APPLICATION:

1. When a standard Scuba tank is filled to it's working pressure of 2250, it has about 65 cu. ft. of air.

2. In the interest of safety, the position of a tank when not attended should be laying down.

3. Before going into the water, your regulator should be checked. First to see if it's going to Leak Water and second, to see if it's going to Breath Air.

4. When removing the regulator from the tank, make sure to release or purge the air from the first stage.

5. The waist strap on a back pack should have a quick release buckle, the same as the weight belt.

6. The regulators used in sport diving are designed to deliver pressure equal to surrounding or the depth of the dive at all times.

7. The one thing you should never do while breathing with Scuba is Hold Your Breath.

8. Holding your breath and coming up in the water could cause an Air Embolism.

9. The treatment for Air Embolism is Recompression.

10. The first aid for Air Embolism is 1.) Remove from water, 2.) Treat for shock, 3.) Call the Highway Patrol.

11. Your best protection against lung accidents is Breathe all the time, Exhale while ascending.

12. If you should encounter an unusual situation, you should think: Stop, Think, Get Control, Go.

SUMMARY:

The demand regulator truly balances the air pressure in the lungs with the surrounding pressure. This balancing takes place every time you take a breath. It will at all times be equal to ambient pressure regardless of whether you are at 2' or 200'. Upon ascent, air must be released in proportion to the decreasing pressure. Breathe all the time. When you're not inhaling, you're exhaling. Develop good subconscious bodyguards and when safety is automatic.

REFERENCES: Safe Scuba pages 62-82.

TEST: This material will be covered in the final test.

ASSIGNMENT: Safe Scuba pages 38-47

FINAL NOTE:

1. Buddy System Today
2. Assign Buddies
3. Assign Group #1 and 2 to Instructors.

Group #1

A. Dressing and Undressing the Tank

1. Regulator Checks
2. Harness Adjustment

B. First Check with Scuba (Shallow end)

1. Putting the Tank on
   a. In the Water (Shallow)
   b. On the Deck (Buddy Help)

C. Group in circle, Sit down, and Breathe

1. Breathe all the Time

D. Group Surface (Pick out People who are not breathing correctly)

1. Explain Regulator Clearing (2 ways)
2. Submerge and do Exercises one at a time (Watch Breathing)

E. Group Surface

1. Explain Buddy Breathing
2. Assign Buddies
3. Submerge and Buddy Breathe
   Watch for Bubbling

F. Group Surface

1. Review Ear Clearing
2. Take entire Group to Deep End
3. Clear Regulator, Clear Mask (35 min. time limit)

Group #2

A. Review Skin Diving Skills

1. Each Student Demonstrate
   a. Flutter and Dolphin Kick
   b. Surface Dives - Ear Clearing
   c. Snorkel Breathing
   d. Mask Clearing
   e. Head Up, Hand Up

(Fill in for 1st group snorkel, buddy breathing) 35 min.

Alternate Groups

Instructor's Note:
Be sure to take notes on individual problems.
Use arm band numbers for identification.

TITLE: Medical Aspects #2

MATERIALS: Henry's Law Film
Projector
Spare bulb

INTRODUCTION:
Establish Contact
Create Interest
Value to Student
Overview (Bends - Nitrogen Narcosis)

PRESENTATION:

A. Bends (History)

1. Dalton's Law (Air Content)
   a. 80% N2
   b. 20% O2
   c. Metabolism (Brief explaination - in O2, out CO2)
   d. N2 Inert

2. Henry's Law

   a. Soda pop
   b. Film (12 min.)

3. Nitrogen Saturation

4. Nitrogen Desaturation

5. Table 1-6 (No Decompression limits)

6. Repetitive Dives (Residule nitrogen - brief explaination - 12 hrs.)

7. 60' a minute (Smallest Bubbles)

8. Decompression Meter

9. Symptoms

10. First Aid

11. Treatment

B. Nitrogen Narcosis

1. Rapture of the Depths

2. Review Dalton's Law

3. Danger Zone 100' +

4. Recognizing Symptoms

5. Cure

APPLICATION:

1. According to Henry's Law, the amount of Nitrogen that will be absorbed by the tissues depends upon what two things?
   1.) Time spent at depth.
   2.) Depth - pressure.

2. The situation in which most sport divers encounter problems with the bends is due to Repetitive Dives.

3. The gas involved in tissue saturation is primarily Nitrogen.

4. How much time must be allowed between two dives without considering it a repetitive dive? 12 hrs.

5. The best way to avoid problems with decompression is to stay within the No Decompression Limits.

6. The chief symptom of the bends is (localized) pain.

7. The treatment for the bends is Recompression.

8. Nitrogen Narcosis starts to affect most people after they have reached a depth of 100+ ft.

9. To make the effects of Nitrogen Narcosis subside, you would ascend to a shallower depth.

SUMMARY:

When diving, using SCUBA, the lungs, blood, and tissues are exposed to higher gas tensions than normal. Nitrogen, being inert, presents the most problem. Every time we take a breath, the higher nitrogen tension is exposed to the blood which serves as transportation for the gas. When the blood reaches its dumping off place, at the tissue, the nitrogen tension in the blood is higher than the nitrogen tension in the tissue. The difference between these two tensions is called the Driving Force. The deeper we go and the longer we stay, the more nitrogen will be absorbed by the tissues. When coming up, thus reducing the pressure and at the same time reducing the nitrogen tension in the lungs, the process happens in reverse. If the pressure is released too rapidly, or if the difference of nitrogen tension is beyond the tissues' ability to hold it in solution, the gas will form bubbles blocking any further blood supply from that area. In order to prevent this from occuring, we never ascend faster than 60 ft. a minute, and always stay within the limits prescribed by the U.S. Navy in tables 1-5 and 1-6. These limits may require us to stop at various levels in order to allow the nitrogen tension to drop below our body's ability to hold it in solution. If these tables are followed when we surface, we are within safe limits as far as body tolerences are concerned; but, our tissues contain considerably more nitrogen in solution than when the dive began. It may take as long as 12 hours to once again reach a state of equilibrium with surface pressure. Any dive taken within 12 hours of a preceding dive must be considered a repetitive dive, and this residual nitrogen must be taken into account. Nitrogen Narcosis, or Rapture of the depths, affects a diver's awareness when the partial pressure becomes great enough. This usually happens somewhere around 100 ft. To make the effects subside,

ascend to a shallower depth. Be completely aware of your new environment and the rewards are fantastic.

TEST: This material will be covered on the final test.

REFERENCES: 38-47 Safe Scuba

ASSIGNMENT: 83-99 Safe Scuba

Final Note: Bring towel with you to the pool.

MATERIALS NEEDED:

1. Vests and B.C.
2. Tanks and Regulators
3. Weight Belts
4. Personal Gear
5. Spare towel

GROUP #1

(Shallow end water work) (Deep end deck demonstration)

A. First Aid Mouth to Mouth Resuscitation

1. Instructor explain why the technique is the best. (Emphasize water resuscitation and head carry.)
2. Each student with buddy make several breath exchanges on pool deck.
3. Instructor demonstrate water technique.
4. Each student with buddy make several breath exchanges and learn water tow.
5. Help slower ones.
6. Answer questions!

GROUP #2

A. Explain Vests

1. Harness systems
2. How to fill
3. Make sure everyone is wearing a weight belt (4#).

B. Explain Two Exercises to be Done:

1. Bouyancy Control
   a. Swim to deep end, form circle
   b. Put air into the vest by exchanging the regulator and oral inflator.
   c. Save half a breath so you'll have enough to clear the regulator again.
   d. Each one in turn, put air in and out of their vest.
   e. Try to establish a neutral state of bouvancy.
   f. Mention breath control
2. Surface Survival
   a. Surface, and fill vest completely with air and Rest.
   b. One at a time, take tank off by releasing the shoulder harness and waist buckle.
   c. Push the tank out in front of them toward the side of the pool.
   d. Instructor take the tank and put it on the deck.
   e. After everyone has completed this, explain how this can be used to get into a boat easier.

Switch Groups

MATERIALS NEEDED:

1. Projector
2. Spare bulb
3. Environment and Marine Life Film
4. Chalk and Eraser

INTRODUCTION:

1. Establish Contact
2. Create Interest
3. Value to the Student
4. Overview (Environment and Marine Life) Test

PRESENTATION:

1. Film (30 min.)
2. Test (30 min.)

POOL SESSION #4

MATERIALS NEEDED:

1. Tanks
2. Regulators
3. Personal Gear

Group #1

A. Tank up, Swim to deep end and form circle

B. Monkey see, Monkey do. Should include:

1. Mask Clearing
2. Regulator Clearing
3. Buddy Breathing
4. Buddy Breathing, Mask exchange

Group #2

A. Surface Test

1. Fin Kicks (Flutter, Dolphin)
2. Surface Dives (Jackknife, Vertical)
3. Entries (Giant step, and forward roll)
4. Snorkel Breathing

Final deck question and answer session.

Stay Wet and have a good trip.

Appendix E

General Andros Information

By Wendy Holl
Trip Leader, IFS

I. F. S LIFE ON ANDROS ISLAND

THE ISLAND

1. Go to Andros with the idea that you will enjoy it.

2. Treat the Bahamians with courtesy. We are their guests on the island and they can make us leave if they so desire. Avoid all arguments with strangers.

3. All the fruits on the trees are not public property. Most of the fruit trees and cocoanut palms belong to the villagers and so we can not just take what we want.

4. Do not remove any wood or goods that might belong to an Andros Islander. Things obviously washed up on the beaches usually belong to the finders.

THE REEF

Do not over-collect the area. The supply of living coral, starfish, and large mollusks is great, but not inexhaustible. I. F. S may have to restrict collecting if abuses are not stopped. Do not collect anything you cannot take careof properly. For instance, there is a trick to preserving large starfish.

Most marine biology laboratories forbid any collecting in the area immediately around the station, because this is the area of highest use, but the area of greatest need for observations.

OUR SITE

We hope that this site can be used by many people from many groups. We would like each group to go with the idea that they will improve the site for the next group.

Most trip leaders seem to take from the site whatever they need with very little effort put forth to make things better, neater, or more convenient for the next group. If that attitude prevails we will only have trouble for IFS and for the trip leaders. Rules will become more rigid, and freedoms for individualized trips will be reduced. We may have to resort to requiring an I. F. S. representitive on each trip. This can be avoided by present trip leaders.

Our suggestions follow for basic maintenance and security.

1. Keep the house clean to discourage mice.

2. All items on the walls are to remain there. The trip leaders are

reponsible for all items lost or damaged due to carelessness.

3. Whenever all people are gone from camp, the windows and doors should be locked.

4. Do not burn garbage or cans in the campfire area. Do not bury it near camp because the dogs just dig it up again. All garbage should be taken to the dump, either at Archie's Andros Reef Inn, or on the way to Small Hope Bay.

5. When closing the site down to leave the island:

a. Empty all water containers.

b. Throw away all perishables or give them to the villagers.

c. Collect and dump all the garbage.

d. Take an inventory of all food goods left on the island. Don't bring things back home unless it's worth what you paid in the duty to bring it.

e. Record any items that are missing, broken or need replacing. (oil, white gas, first aid supplies, paper products, etc.)

f. Inventory kitchen knives, cups, plates, & utensils. These items frequently are lost, stolen or strayed.

g. Disconnect and shut off burners.

h. Make sure everything is clean! This includes stoves, cookware, tools, floor, and grounds.

i. Put <u>all</u> moveable equipment inside the schoolhouse before locking it up. This means tents, stakes, boat equipment, diving equipment & anything else that might be inclined to wander.

j. Tour the ground s several times for trash and once more for lost and found items hanging on bushes or hiding underneath them. Any lost and found items not claimed are usually given to the villagers.

k. Clean out the fire pit.

l. Store the boat keys & extra house keys in a coffee jar. Give the other keys (truck keys & one house key) to the immigration officer to keep for the next group.

m. Leave the trucks behind the ESSO gas station next to the airport.

6. There is to be no drinking of alcoholic beverages at the campsite and none anywhere by students who are under age. It is up to the trip leader to control all the people under his or her charge. Drunkenness or rowdyness are unacceptable anywhere.

EQUIPMENT

Boat

1. Use high test gasoline & Johnson's motor oil, 50:1.

2. Loading the boat is a delicate balancing problem. Be careful. The boat can hold 12 passengers with diving gear. Load & unload in front of camp.

3. Remember to drain the bilge before or during your week on the island.

4. When going through the reef, especially while towing the raft, use th Pigeon Cay or Staniard Rock Channels unless the water is flat and you know where you are going.

5. In rainy times, never go out in the boat without a compass. Rain quickly reduces visibility t) a couple of ~~100~~ feet and landmarks are invisible.

6. When the motor has been run awhile, and then shut off; when you restart it, avoid choking too much, it will flood quickly.

7. Never beach the boat or raft except when your stay is over. Always moor it out and secure it well. There are two mooring posts for the raft, south of the boat mooring post.

8. Always lift the motor when the boat is moored; it may rest on the bottom during some low tides. Allow enough rope to float up for the high tides.

9. The 200 ft. line and anchor belongs to the boat.

10. When putting the boat away at the end of your trip:

a) Back the trailer down to the water and pull the boat onto it.

b) Take the battery out and store it on top of a non-conducting box or bucket in the schoolhouse.

c) Remove the gas cans and store them in the schoolhouse.

d) All ladders, ropes, and anchors should be stored in the schoolhouse or locked up under the seat. (The keys are on the boat key chains). Do not use the lock while operating the boat as the salt corrodes it easily.

e) Rinse the engine cooling system out with fresh water when it is taken out of the water for awhile.

f) Rinse the trailer off if possible. (With fresh water)

g) Put the seat covers on the seats and consol. During your trip they should be stored in the schoolhouse.

h) Take the front seat off the snaps, take it apart, and dry it out in the schoolhouse when you leave.

i)Store the boat at Archie's Andros Reef Inn when you leave. It goes by the old trailer and junk cars are. If you are in doubt, ask Foley.

Raft

1. When tying the raft and the boat together, use bumpers and when the transfer is completed, tie the raft off with 6-8' lines (already made) on the starboard side of boat and port side of raft. The raft does not need to be anchored, just the boat. (This procedure is for diving, not towing.)

2. Do not overload the raft. It can carry 15 divers only if they are evenly distributed.

3. Do not tow more than 6-8 people and tanks on the raft.

4. Use the 25 foot towline for the raft.

5. Tow at ½ - 3/4 throttle, it takes 15 minutes longer but it saves much gas.

6. The 100 ft. anchor line & anchor belong on the raft.

7. If the raft pontoons are submerged for any period of time they will fill up with water. The efficiency is cut down considerably and the pontoons must be drained, which requires that the raft be overturned and allowed to drain. This operation is needless if care is used in the beginning.

8. When leaving bring the raft up on the flat area above the beach. Never leave it sitting in the intertidal zone for long.

Trucks

1. Observe all speed limits and traffic signs and remember to drive on the left hand side of the road.

2. Check the oil every time you add gas. Use only our oil - Quaker State 10 w-30.

3. Record any damage done to the truck on your trip as well as anything you find that needs to be fixed.

4. Keep track of the gas and oil that you use. Before leaving take an inventory of all oil left. Include truck oil and boat oil.

Diving Gear

1. Diving gear is under supervision of the divemaster but care of all.

2. Gear should be rinsed off with fresh water whenever possible.

3. Dust caps should always be replaced.

4. Vests should be hung up after emptying all water out. Take used CO_2 cartridges out and replace them with good ones.

5. Follow divemasters instructions.

6. Record any repairs or replacements necessary. Inventory before leaving - the group will be responsible for anything they have lost.

I.F.S. TENT RULES

These tents are your home away from home - they require a little extra care to keep them neat and clean.

1. When you put them up, use a ground cloth on the inside to help keep from putting holes in the bottom.
2. They are not clothes racks - never hang anything on a tent.
3. To keep them standing in a high wind or storm you will need to tie lines to nearby trees and/or use wooden bracing poles at the corners.
4. Take your shoes off at the door and leave the dirt and sand outside.
5. Sweep tent out before taking it down.
6. If you keep zippers closed all the time you will cut your number of mosquito bites in half. (If you're inside.)
7. When you leave the island - if there is a group coming the same day - then you may leave the tents up: swept clean, zipped up. If no one else is coming to occupy the tents that day - fold them carefully, put them in proper bags for tents, poles, and stakes, and store them on boards in the schoolhouse. If for any reason they are wet, they should be left spread out in the schoolhouse so they do not mold or mildew and the next group can have dry tents.
8. Record any repairs necessary, making those you can, and clearly mark those which are no longer serviceable.

Appendix F

Sample Road Log in U.S.
(To & From Andros)

By Robert Carver
Lecturer, University of Georgia

ROAD LOG

MACON, GEORGIA TO FLORIDA BORDER

VIA

U.S. INTERSTATE HIGHWAYS I-475 AND I-75

Robert E. Carver

Dept. of Geology, Univ. of Georgia, Athens

This road log describes the route of Interstate Highway 75 across the Coastal Plain of Georgia. The Coastal Plain consists of a wedge of Cretaceous and Tertiary sediments which forms the continental shelf and thins northwest to a feather edge along the Fall Line. The regional strike is N60° E and the dip is approximately 20 feet per mile to the southeast. The surface slope is about 3.5 feet per mile, much less than regional dip, so progressively younger beds are exposed at the surface from the Fall Line to the Coast.

The updip sections of all time-stratigraphic units are fluviatile in character and the Paleogene units grade laterally into limestones. Neogene sediments, principally the Miocene Hawthorne Formation, overlying the Paleogene limestones provide the aquiclude for the Coastal Plain artesian aquifer. Sinks reaching into the aquifer are very common on the Miocene cover and become larger and more abundant to the south and into Florida.

Slopes of the highway cuts are well-graded and grassed over, so the geological scenery is not spectacular. The trip should provide some understanding of the difficulty and challenge of Coastal Plain geology. A three-foot exposure of unweathered sediment in a road cut is enough to send the Coastal Plain geologist into wild-eyed enthusiasm, a ten foot outcrop, into ecstasy.

Except for the first two check points, the road log is keyed to the highway mileposts which record the distance, along I-75, from the Florida Border.

1. I-475, west of Macon, Georgia, at exit to Farmington and Macon via Ga. 74.

Near this point the Upper Cretaceous Tuscaloosa Formation overlaps metamorphics of the Georgia Piedmont. Thin outliners of Tuscaloosa occur on hill tops to the north with metamorphics exposed in the valleys between. To the south the Tuscaloosa becomes thicker and completely covers the metamorphics.

The gradient of the Ocmulgee River flattens at this point (the Fall Line) and the head of navigation on the river, in the pre-railroad era, was here. Cotton was brought from North Georgia by wagon and transferred to river boats for shipment to the Atlantic Coast at Darien, Georgia. The town of Macon grew up at the transfer point, as did Augusta on the Savannah River and Columbus on the Chatahoochee River.

2. Junction I-475 and I-75.

Here and to the south is the Fall-line Hills, or Sand Hills, physiographic province. The hills are developed on sandy sediments of the Tuscaloosa and Barnwell Formations and extend across the state parallel to the Fall-Line. Further to the south, on the Oligocene and Miocene sediments, are the Fort Valley Plateau and Tifton Upland provinces, both rather flat.

Mi. 149 Almost exactly a mile ahead on the left is a borrow pit with good exposure of white, cross-bedded sand of the Tuscaloosa Formation. The white color is due to the kaolin matrix of this very immature (texturally) sand. The formation appears to be fluviatile in origin and consists of coarse, sub-arkosic sand intermixed with kaolin, with complex interlensing of lithologic units.

Most of the world's kaolin production comes from pure kaolin lenses in the Formation between here and Augusta, Georgia. Some of the kaolin is shipped to Europe to be used in the traditionally fine porcellains of England and France, but the vast bulk of the kaolin is used for paper coating. Kaolin-coated paper is required for modern high-speed color-press printing. Without Georgia kaolin Playboy would be just another literary magazine.

Mi. 151 Byron City limit ahead. This is approximately the contact between the Tuscaloosa and Barnwell Formations. The upper part of the Barnwell consists of marine sands which weather rapidly to a deep red color, as in the borrow pit ahead on the left.

Mi. 132 About 5 miles south of exit to Perry and Fort Valley via U.S. 341. Here and at several places in the next 7 miles, slumps in road cuts indicate the presence of the Twiggs Clay Member of the Barnwell Formation. The Twiggs Clay is typically a soft, gray-green, very plastic clay which tends to slump when water saturated. It contains abundant foraminifera in most places.

Mi. 122 From this point to the exit to Unadilla and Pinehurst via U.S. 41, about 1.5 miles ahead, watch shallow road cuts and ditches for the purple-stained clay which is the Oligocene in this area. The local Oligocene rock unit is the Flint River Formation. Typically it consists of gray, plastic, disturbed clays with large blocks of cavernous flint. As the Oligocene is eroded, flint boulders and rubble tend to concentrate on valley slopes and in streams. The Flint River, about 10 miles west, takes its name from concentration of boulders in the stream bed. The Oligocene is about 100 feet thick in this area, so the outcrop band is quite narrow.

Mi. 118 Rest area.

Mi. 114 In the next few miles note the dominant light-orange color of the B soil horizon. This color is typical of the Miocene throughout Georgia. We will be on Miocene sediments for approximately the next 100 miles.

One can normally tell when he crosses the Oligocene-Miocene contact by the change in color of the B horizon and a change in vegetation to predominantly scrub oak. With respect to the basal part of the Miocene, the saying is, "It won't even grow a good pine tree".

The Miocene is represented here by the Hawthorne Formation which, typically, consists of poorly-sorted, texturally-immature, gravelly, clayey sands. The formation appears to be fluviatile in origin and represents a major change in sedimentation patterns early in Miocene time.

Mi. 109 Rest area ahead on left.

Mi. 105 We are passing through a large pecan grove. Pecans are an important Coastal Plain product.

Mi. 89 First outcrops of hard, light gray Ashburn Member in road cuts on right and left ahead.

Mi. 85 Just across bridge about one mile ahead, on the left and in the road cuts beyond, is the type section of the Ashburn Member of the Hawthorne Formation, so-named by E. K. Olsen about two years ago. The outcrop along the stream probably is the most spectacular natural outcrop in the Lower Coastal Plain of Georgia!

The Ashburn member, up to 90 feet thick, can be traced to the northeast as far as the Savannah River, and is overlain by undifferentiated Hawthorne Formation sediments. The Tampa Limestone, which represents the Upper Miocene in the southwest corner of the state, pinches out along strike about 20 miles southeast of here and the Ashburn Member appears to be a lateral equivalent of the lower part of the Tampa Limestone.

The origin of the hard, sandy claystone of the Ashburn Member is largely unknown. The rock consists of large, eroded quartz and feldspar grains in a dense kaolinitic matrix. Heavy and light minerals include those typical of a Piedmont source and some units show cross-bedding, so the rock is sedimentary in origin, but the kaolin appears to have crystallized in place. The original matrix might have been volcanic ash, but the question is far from settled.

Mi. 84 Rest area on left just beyond Ashburn Member type section.

About a half mile beyond this point gray clay which is interbedded with the claystone of the Ashburn Member is exposed in a road cut.

Mi. 80 Ahead on left are baldcypress growing in two small sinkhole swamps. The cypress are deciduous and drop their needles in the winter.

Mi. 76 Rest area on right ahead.

Mi. 73 Young pine plantation on left. As cotton has declined in importance as a Georgia crop, after the 1920's boll weevil invasion and the shift to western-grown long-staple cotton, timber has become Georgia's most important crop. Georgia now produces more paper than any other state.

Mi. 64 Just beyond exit to Tifton and Abac via U.S. 41. Outcrop of Hawthorne Formation, with coarse gravel, in road cut on right. Univ. of Georgia Southeast Coastal Plain Agricultural Experiment Station on right here and extending south along highway. Experimental peach orchard 0.5 miles ahead.

Mi. 48 Rest area on right. Extensive pine plantation ahead. The woods are mixed pine, including longleaf pines with needles 12 to 18 inches long. Mature longleaf pines bear large and attractive cones up to 10 inches in length and six inches in diameter. The undergrowth consists of yaupon (a type of holly), palmetto, scrub oak and large rattlesnakes.

Mi. 38 Weyerhauser Lumber Co. sawmill on left.

Mi. 31 Lowndes County line with tobacco curing barn on left. Tobacco produced in this part of the country is flue-cured, that is dried with artificial heat, which explains the propane tanks seen next to many of the barns.

Tobacco growing requires a great deal of hand labor and acreage allotments are rigidly restricted, so most of the curing barns are quite small.

Mi. 30 Rest area on right. Some of the trees here are longleaf pine and large cones may be on the ground. Many of the trees were tapped for pine gum, from which turpentine is distilled, before the rest area was established. The metal sap guides are still in place, only the collecting buckets, which would hang beneath the guides, are missing.

Mi. 11 Exit to Clyattville and Valdosta via Ga. 31 ahead. Just beyond the exit note a change in color of the B soil horizon from the light orange of the Miocene to light gray. The lighter colored soil is developed on Pleistocene terrace sediments.

Mi. 5 Ask the driver to slow down, there is much to see in the next two miles. Exit to Twin Lakes ahead. Just beyond exit overpass is a borrow pit, on the right, which exposes Pleistocene terrace sands. Immediately south of the borrow pit, on the right side of the road, is a deep, cone-shaped sinkhole with lily pads in the pond at the bottom.

Mi. 4 KOA Kampground on left about 3/4 mile ahead. Just beyond the campground on the left is a Georgia State Welcome Center, with large, spanish moss-draped live oaks in front and a very large sinkhole lake in back.

Mi. 2 Exit to Belliville, Florida and Lake Park, Georgia. I leave you here. Have fun in Florida and when you come back, stop for a free coke and information about Georgia at the Welcome Center. Come back to see us often.

Appendix G

Environmental Studies Course Outline

By Charlsie Keferl
Trip Leader, IFS

Environmental Studies of a Bahamian Island

Proposed Credit: 1/4 High School Credit

Course Objectives:

1. To study the flora and fauna of a subtropical marine environment.
2. To learn some general ecological principles as they apply to Andros Island.
3. To learn the fundamentals of invertebrate classification and morphology.
4. To develope the skills of skin and SCUBA diving as a means of observing the marine environment.

Course Sponsors:

International Field Studies
Any participating High School or College

Participants:

Any school student, grades 9 and up.
Minimum number must be 10
Maximum number must be 39
Instructors, chaperones and drivers will vary from 2 to 6.

Personnel:

Eugene P. Keferl	A Ph. D. candidate in the Department of Zoology at Ohio State University. Has taught 5 years as a teaching associate in various biology and zoology programs at O.S.U. Currently a field trip leader and an educator for International Field Studies.
Dr. Charlsie A. Keferl	Recieved her M.S. in the Department of Zoology at Ohio State University and her Ph. D. from the Department of Anatomy at the Ohio State University. She has taught Senior High School biology in Bakersfield, California and embryology, anatomy and general biology at Capital University. Dr. Keferl is a field trip leader, educator, and cook for International Field Studies.

Personnel:

On each trip there will be one to four Ohio High School teachers who will function as an instructor and/or chaperone. Much of the teaching is done by Eugene Keferl and Charlsie Keferl, but every course will be monitored by a certified Ohio High School teacher.

Course Activities and Time Allotment:

Lectures--There will be one formal lecture per day. This will last approximately one hour after breakfast. Lecture topics are on a separate page.

Diving----There will be at least two hours of diving for each student everyday. Much of the diving will be done on the Andros Island coral reef which is the second longest reef in the world and one of the richest.

The students will learn to dive. Much of what is talked about in the lectures will be observed firsthand. The students will be able to collect specimens to bring back to the camp for study and/or keep.

Laboratory and Short Field Trips

There will be at least two hours of study each day which will involve observing, preserving and dissecting plants and animals collected on various diving trips. This time would also be used to make observations and collections in the various terrestrial plant communities and tidal flats near the camp.

Extended Field Trips

Longer field trips which frequently take one half a day will also be included. Two hours of course time will be allotted for each trip. There will be at least three of these field trips. A brief written report will be required from each student concerning the observations made on the trips.

1. Twin Lakes Farm
   a. Fresh-water habitat will be investigated.
   b. Previous logging sites will be looked at.
   c. A savannah will be observed.
   d. Some tropical fruits and sugarcane will be collected.
2. Red Bays
   a. Visit a native village.
   b. Get a look at the west side of the island.
   c. Investigate a new marine habitat.
3. Nicollstown Beach and Morgan's Bluff
   a. Investigate several intertidal zones.
   b. Make a quantitative transect and quadrat survey of a rocky beach.
   c. Explore a couple of caves.
   d. Visit a coconut grove.

Lectures--------7	hours
Diving---------14	hours
Lab. & Short Field Trips----14	hours
Extended Field Trips-----6	hours
41	hours

Methods of Evaluation:

Two 10 point quizes over lecture material	20 points
Three Extended field trip summary reports	30 points
One Final Examination(Open Book)	50 points
	100 points

Lecture Topics:

All lectures are made to explain and help the student understand the immediate environment. All topics and examples are those that can be seen on Andros Island.

Lecture # 1.
- A. Andros Island
  1. Geology
  2. Soils
  3. Plant Associations
- B. The Andros Islanders
- C. Collecting and preserving techniques
- D. A word about observations
- E. Animals to be careful of while diving

Lecture # 2.
- A. Marine Biology
  1. General considerations
  2. Specific interests at Andros Island
- B. Marine Habitats
  1. How they are formed and maintained
  2. What animals live there and what adaptations they possess.

Lecture # 3.
- A. The Coral Reef
- B. Symbiotic Relationships

Lecture # 4.
- A. The Rocky Beach
- B. The Sandy Beach
- C. Zonation

Lecture # 5.

The classification, morphology, life history, ecology and identification of;
- A. Porifera(Sponges)
- B. Coelenterata(Jellyfish, Sea Anemones and Corals)
- C. Ctenophora(Comb Jellies)

Lecture # 6.

The classification, morphology, life history, ecology and identification of;
- A. Echinodermata(Starfish)
- B. Mollusca(Clams and Snails)

Lecture # 7.

The classification, morphology, life history, ecology and identification of;
- A. Annelida(Worms)
- B. Crustacea(Crabs)
- C. Other miscellaneous organisms

Trip Outline with Scheduled Activities:

Day #1.

Leave Columbus for Orlando, Florida. When the group leaves varies with the group going and the chaperones in charge.

Day #2.

Arrive in Orlando, Florida
Leave via Glenn Airlines for San Andros International Airport on Andros Island, Bahamas.
Travel to the campsite on the property of the Andros Reef Inn owned by Archie Forfar and set up camp.
There will be a short orientation program.

Day #3.

8:30 AM Lecture #1.
- A. Andros Island Natural History
- B. The Andros Islanders
- C. Collecting and preserving techniques
- D. A word about observations
- E. Animals to be careful of while diving
- F. Diving orientation

10:00AM Group #1.
Skin dive on the coral reef---This dive is is primarily to get the students use to the water and the general diving conditions. They will make general observations on types of fish and corals present.
Group #2.
Skin diving in Stafford Creek---This diving is adjacent to the campsite. Again, this is an orientation dive. Diving exercises will be given to those students who need extra help.

2:00PM Group #1.
Extended Field trip to Twin Lakes Farm
1. Skin dive in this semi-freshwater and make observations and collections of the fauna and flora in the lakes.
2. Look at previous logging sites
3. Look at a good example of a savannah
4. Collect some tropical foodstuffs

Group #2.
Skin dive on the coral reef

Day #4.

8:30AM Lecture #2.
- A. Marine Biology
- B. Marine Habitats

10:00AM Group #1.
Skin dive in Stafford Creek
Group #2.
Scuba dive on the coral reef(15-20feet)

2:00PM Group #1.
Scuba dive on the coral reef(15-20 feet)
Group #2.
Extended Field trip to Twin Lakes Farm

Day #5.

8:30AM Lecture #3.

A. Coral Reef

B. Symbiotic Relationships

10:00AM Group #1.

Scuba dive on the coral reef(20-25 feet) On this dive the students will have had a chance to become familiar enough with the equipment to now make more acute observations and collections of the coral reef inhabitants.

Group #2.

Skin dive at Blue Hole Cay---A very good field experience in which the teacher and the student can discover together the many forms of interesting marine life. The area is shallow and has three well defined blue holes or underwater caves(very safe). The life around the openings of these holes is abundant.

2:00PM Group #1.

Extended field trip to Red Bays---This trip gives the students the only chance to see the western side of Andros Island, other than the aerial view. We will visit the only village on this side of the island and hopefully skin dive in the nearby marine habitats. The village of Red Bays is unique on this part of Andros Island because some of the people there still live in thatched houses and cook outside.

Group #2.

Scuba dive on the coral reef(20 to 25 feet)

Day #6.

8:30AM Lecture #4.

A. The rocky beach

B. The sandy beach

C. Zonation

D. Methods of making an ecological study

10:00AM Group #1.

Skin Dive at Blue Hole Cay

Group #2.

Scuba dive on the coral reef(30 feet)

2:00PM Group #1.

Scuba dive on the coral reef(30 feet)

Group #2.

Extended field trip to Red Bays

Day #7.

8:30AM Lecture #5.

The classification, morphology, life history, ecology and identification of some of the local:

A. Porifera(Sponges)

B. Coelenterata(Jellyfish, Sea Anemones, etc.)

C. Ctenophora(Comb Jellies)

Day #7.

10:00AM Group #1.

Scuba dive on the coral reef---By this time most of the students will be confident enough with scuba gear to start making more specific observations. The depth of these subsequent dives will depend upon Archie Forfar and the competence of each group. Assignments will probably be given to collect data on specific organisms, e.g. Watch what a rainbow parrot fish eats, where they live, whether they exhibit territorialism or not, or schooling behavior, actually any life history or ecological information about the species.

Group #2.

Field trip down the beach from the camp
On this field trip emphasis will be upon the burrowing intertidal organisms and those which live on mangrove tree roots. If the tide is in the wrong position, there will be a laboratory at camp. The students will dissect a starfish and examine material through a microscope.

2:00PM Group #1.

Extended field trip to Nicollstown Beach and Morgan's Bluff
Here the students will examine several marine intertidal zones mentioned in Lecture #4 and make a quantitative survey of the organisms on a rocky beach. The students will also visit a coconut grove, visit the village of Nicollstown, investigate a few small caves and visit Morgan's Bluff (a seaward cliff).

Group #2.

Scuba dive on the coral reef
Same as Group #1 in the morning.

Day #8.

8:30AM Lecture #6.

The classification, morphology, life history, ecology and identification of some of the local:

A. Echinodermata(Starfish)
B. Mollusca(Clams and Snails)

10:00AM Group #1.

Field trip down the beach from the camp

Group #2.

Scuba dive outside the coral reef
This dive is to give the students an opportunity to collect and observe marine organisms in a new habitat deeper than the coral reef.

2:00PM Group #1.

Scuba dive outside the coral reef

Group #2.

Extended field trip to Nicollstown Beach and Morgan's Bluff

Day #9.

8:30AM Lecture #7.

The classification, morphology, life history, ecology and identification of some of the local:

A. Annelida(Worms)
B. Crustacea(Crabs)
C. Other miscellaneous organisms

10:00AM Group #1.

Scuba dive to about 50 to 60 feet

This will be the deepest scheduled dive. The students will as before collect and observe marine organisms.

Group #2.

Laboratory at camp

A. Examine collected specimens
B. Prepare individual material which was collected for the trip home
C. If low tide corresponds, the students will make a transect quantitative study of the organisms in front of camp.

2:00PM Group #1.

Laboratory at camp---Same activities as Group #2.

Group #2.

Scuba dive to about 50 to 60 feet.

Day #10.

Prepare to leave Andros Island.
Drive the students and equipment to the San Andros International Airport.
Fly to Orlando, Florida via Glenn Airlines.
Start the drive to Columbus, Ohio.

Day #11.

Arrive in Columbus, Ohio.

Appendix H

Birds of Andros
(Sample Trip Report)

By Tom Thompson, Trip Leader, Audubon Society
&
Eugene Keferl, President, IFS & Education Coordinator

AN ANNOTATED LIST OF THE BIRDS OF ANDROS ISLAND, BAHAMAS

By Tom Thomson

During the winter of 1971-'72, it was my privilege to accompany a Central Ohio group of the International Field Studies program to Andros Island in the Bahamas. The I.F.S. is an organization set up to introduce students and other interested persons with various aspects of natural history study in the field. The period of my observations extended from December 27, 1971 through January 1, 1972. The greatest amount of my time was spent in the field observing birds on each of these days.

Andros is a large flat island 104 miles long and approximately 40 miles wide at its widest point. It is the largest of the Bahama islands.

There are several major types of habitat on Andros. Most important economically are extensive stands of yellow pine which are being logged under a 99-year lease agreement with the Bahamian Government by the Owens Illinois Corporation and, persumably, the cleared land will someday be cultivated.

Almost impenetrable tangles of coppice cover other large areas of the island. This coppice consists of a mixed plant community of poison wood, gumbo limbo, horseflesh trees and, in earlier times, mahogany trees. The coppice usually attains a height no greater than 20 feet, and in many places it grows in abundance right over outcroppings of ossified limestone of which the island is composed.

There are also grassland areas os savanna with scattered trees that grade into open plains or woodlands. In addition, there are regions of human habitation, villages and small towns, airports and scattered settlements.

Andros' beaches are largely undeveloped commercially. They are bordered by numerous groves of coconut palms interlaced with large and small mangrove swamps.

The central part of Andros is characterized by its wide ocean-fed creeks (called bights) which cut extensive swaths across the island. These saline creeks divide into labyrinths of lesser watercourses which nourish great areas of mangrove and related aquatic plant habitats. It was in this region that the roseate flamingo bred in sizeable colonies until about the time of World War II. Individuals of this species are still frequently seen, but there are no recent breeding records.

The western shore of Andros is a long low bank called "the mud" and for the most part it is quite barron and there is a minimum of bird life present.

The east coast is studded with small villages, several resort hotels, and a few good lodges that cater to SCUBA divers. The barrier reef and the Great Wall of Andros lie just off shore alond the Tongue of the Ocean, where there is a drop off of 1,800 feet.

The area of my observations extended from Morgan's Bluff on the extreme northeastern portion of the island west to Red Bank on the northwestern shore, south to the estuary at Somerset, which is five or six miles south of Andros Town. Most field work was done along the east coast from Stafford Creek on the north to the village of Love Hill; around our campsite at Small Hope, and south to Coakley Town, Andros Town, and Somerset.

Half a day was spent wading across several miles of vast tidal flats in the Somerset region. It was here that the majority of shorebirds were seen, and I had hopes of finding some flamingos, but unfortunately none were present at the time of my visit.

During the time I was on Andros, the weather was mostly fair, and with the exception of the morning of January 2 when we were breaking camp, preparatory to leaving, there was a consistently strong southeast wind blowing. The morning of December 31 was cloudier than usual and somewhat cooler. This slight change in the weather resulted in greatly increased bird activity and the observation of unusually large numbers of birds, especially warblers.

The average temperature during my stay was about 72° with daytime maximum temperatures in the middle and high 80's.

I would like to add here that the lush, tropical grounds of the Andros Beach Hotel were particularly attractive to large numbers of passerine birds. Nearby ponds, mangrove swamps, and thickets were also extremely rewarding.

As a result of my stay on Andros, five full days of which were spent in the field, I observed and identified 86 species of birds, and photographed 31 species.

Least Grebe (Podiceps dominicus). - Several individuals observed associating with a flock of coots in the ponds near the Andros Beach Hotel. These little grebes were very shy and diappeared under the water at the slightest indication of my presence.

Green Heron (Butorides v. virescens). - A total of three green herons were seen; two of them in the vicinity of the great tidal flats and mangrove swamps at Somerset, and the other in a mangrove swamp near the Andros Beach Hotel.

Little Blue Heron (Florida caerulea). - Adult and immature birds were observed in various mangrove swamps. Eight birds were seen in one day on the tidal flats at Somerset.

Cattle Egret (Bubulcus i. ibis). - No more than two or three individuals were noted during my entire stay on Andros. Presumably, this species in more numerous than my observations would indicate.

Common Egret (Casmerodius albus). - Single birds and pairs were seen in and around mangrove swamps along the coast on almost every outing, but never more than four or five individuals were recorded on any one day.

Snowy Egret (Leucophoyx t. thula). - Observed in coastal mangrove swamps. A flock of six birds flying over a mangrove swamp near our campsite constituted the largest number seen at one time.

Turkey Vulture (Cathartes aura septentrionalis). - Common; observed each day. A dozen or so of these vultures feeding on a dog's carcass were the most seen at any one time.

Marsh Hawk (Circus cyaneus hudsonius). - One bird was observed hunting over fields near the San Andros airport.

Sparrow Hawk (Falco s. sparverius). - Individual birds observed in open pine woods near Red Bank and San Andros. Never more than two individuals seen in one day.

Limpkin (Aramus guarauna pictus). - An individual of this locally rare species ran across the shore road about 20 feet in front of me near the estuary at Somerset. The limpkin is described by James Bond in Birds of the West Indies as a vagrant in the Bahamas.

Coot (Fulica americana). - Fairly common in some localities, especially around Fresh Creek and in some of the ponds near the Andros Beach Hotel. The largest number of these birds seen in one day was 40 in the vicinity of Andros Town.

Semipalmated Plover (Charadrius semipalmatus). - At least four individuals observed on the tital flats at Winterset.

Piping Plover (Charadrius melodus circumcinctus). - A flock of 20 birds observed at Winterset on January 1, 1972.

Wilson's Plover (Charadrius wilsonia). - One bird was seen over a period of several days on the beach near our campsite.

Black-bellied Plover (Squatarola squatarola). - At least 50 of these birds were scattered over the great tidal flats at Winterset. Small numbers were seen elsewhere on the coast.

Ruddy Turnstone (Arenaria interpres morinella). - Twenty-four turnstones were counted along the ocean beach south of Andros Town on January 1, 1972. Individuals and smaller groups were seen at several other places along the coast.

Spotted Sandpiper (Actitis macularia). - Only on spotty was seen, near our camp.

Willet (Catoptorphorus semipalmatus inornatus). - One of these striking shorebirds was observed on the tidal flats at Somerset.

Greater Yellowlegs (Totanus melanoleucus). - Two or three individuals seen at various places on the coast every day.

Lesser Yellowlegs (Totanus flavipes). - A flock of 40 lesser yellowlegs flew over the lagoon near our campsite during the early evening of December 31. The birds were flying paralel to the coast and in a southerly direction so it is quite possible they were migrating.

Least Sandpiper (Erolia minutilla). - An individual was seen on the tidal flats at Somerset in company with semipalmated sandpipers on January 1, 1972.

Short-billed Dowitcher (Limnodromus griseus hendersoni). - A flock of 18 birds were scattered over an area of the tidal flats at Somerset on January 1, 1972.

Long-billed Dowitcher (Limnodromus scolopaceus). - One bird with an extremely long bill was observed with the short-billed form at Somerset on January 1, 1972.

Semipalmated sandpiper (Ereunetes pusillus). - Eight of these little gray and white "peeps" were counted amongst other shorebirds on the flats at Somerset.

Western Sandpiper (Ereunetes mauri). - Three western sandpipers were closely observed as they fed on the mudflats at Somerset on January 1, 1972.

Sanderling (Crocethia alba). - One or two birds were observed everyday on the beach near our campsite, and at least a dozen birds were seen along the shore near the San Andros Hotel.

Ground Dove (Columbina passerina). - This little dove was common in brushy areas along roadsides and around the edges of the coppice. As many as 24 were seen in one day.

Mangrove Cuckoo (Coccyzus minor). -From one to three individuals seen daily.

Short-earred Owl (Asio f. flammeus). - One of these diurnal owls was observed flying over the meadows surrounding the San Andros airport.

Smooth-billed Ani (Crotophaga ani). -Flocks averaging nine or ten individuals were seen in and around Andros Town and Coakley Town. Attention was usually drawn to these birds by their raucous notes and their comical posturing.

Cuban Emerald (Chlorostilbon ricordii). - Seven individuals were noted between our campsite and Archie's Lodge on December 29. A few were seen each day in other localities.

Bahama Woodstar (Calliphlox evelynae). - A few of these attractive hummingbirds, usually females, were recorded each day.

Belted Kingfisher (Megacer a. alcyon). - One or two birds noted each day.

Yellow-bellied Sapsucker (Sphyrapicus v. varius). - Most often seen in and around pine woods, where as many as four were noted in a day.

Hairy Woodpecker (Dendrocopos v. villosus). - Resident through most of the Bahama Islands. Single individuals were seen on several days.

Tropical Kingbird (Tyrannus melancholicus). -One individual of this attractive kingbird was seen in some coppice along the road between our campsite and Archie's Lodge. In the Birds of the West Indies, Bond does not mention that this bird occurs in the Bahama Islands, but he does state that it is a vagrant to Union Island and to Cuba.

Gray Kingbird (Tyrannus dominicensis). - This is a common wintering species, according to Bond. Three birds were recorded on December 29 and one or two individuals were noted on most other days, usually on the edges of pine woods.

Loggerhead Kingbird (Tyrannus caudifasciatus). - Single birds were observed on three separate days. Dark crown and sides of head and the more olive-colored back are good field marks to separate this bird from the gray kingbird.

Stolid Flycatcher (Myiarchus stolidus). - Usually seen in brushy areas near mangrove swamps; never more than one or two birds seen in a day.

Wood Pewee (Contopus virens). - Common wintering species. Several seen daily.

Greater Antillean Pewee (Contopus caribaeus). - Told from the wood pewee by a buffy wash on the underparts. Has a habit of quivering its tail after perching. This species is a common resident on Andros. At least half a dozen or so birds were seen on most days.

Caribbean Elaenia (Elaenia martinica). - At least one, possibly two, of these little flycatchers observed in a brushy area near the San Andros Hotel.

Bahamian Swallow (Callichelidon cyaneoviridis). - Only one individual was positively identified, but it was proably more common than this one record would indicate. The Bahamian swallow resenbles a tree swallow in coloration, but has the shape of a barn swallow.

Tree Swallow (Iridoprocne bicolor). - Flocks of several dozen birds seen at the San Andros airport, and at the docks near Morgan's Bluff, where fifty or more were hawking insects over the stacks of logged trees awaiting shipment.

House Wren (Troglodytes aedon). - One individual was seen and heard singing on the grounds of the Andros Beach Hotel.

Northern Mockingbird (Mimus p. polyglottos). - Quite common and widespread in distribution, especially in the vicinity of human habitation.

Bahamian Mockingbird (Mimus gundlachii). - One or two were usually seen each day, but I experienced some difficulty in differentiating between the Bahamian and the Northern mockingbirds.

Catbird (Dumetella carolinesis). - Seen most often around Andros Town where 12 birds were tallied on January 1, 1972.

Blue-gray Gnatcatcher (Polioptila c. caerulea). - Very common and recorded in many types of habitat. The maximum number seen in one day was 20 on December 29, 1971.

Starling (Sturnus v. vulgaris). - Flocks of ten and twenty birds were noted on December 31 and January 1, respectively, in and around Andros Town.

Thick-billed Vireo (Vireo crassirostris). - Common and recorded on most days in the field. The largest number seen in one day was 12. Resembles the white-eyed vireo, but entire underparts pale yellow.

White-eyed Vireo (Vireo griseus noveboracensis). - This familiar vireo ranges throughout most of the eastern United States, the Florida Keys, and south to the Bermuda Islands, where it is a resident. One or two individuals were noted daily.

Black-whiskered Vireo (Vireo altiloquus). - This is the West Indian representative of the red-eyed vireo. Individuals were seen on only two occasions: once outside Coakley Town, and once near Andros Town.

Philadelphia Vireo (Vireo philadelphicus). - This rather uncommon North American species is listed by Bond as a vagrant to the West Indies with records only from New Providence, Eleuthera, western Cuba, and Jamaica. On December 31, I observed an individual for several minutes on the grounds of the San Andros Hotel.

Black and White Warbler (Mniotilta varia). - This wintering North American Wood Warbler was noted on four different days; the largest number seen in one day was seven on December 31.

Blue-winged Warbler (Vermivora pinus). - One bird observed and heard singing on the coastal road within a mile of our campsite at Small Hope. This species is described by Bond as a rare winter resident and transient. It winters more regularily in Central America.

Parula Warbler (Parula americana). - This beautiful little warbler was quite common, especially in the vicinity of Coakley Town and Andros Town. At least a dozen individuals were recorded December 31, and again on January 1.

Yellow Warbler (Dendroica petechia aestiva aestiva). - One or two individuals were noted daily. The largest number seen in one day was four.

Magnolia Warbler (Dendroica magnolia). - Three individuals were recorded on two consecutive days: December 31 and January 1.

Cape May Warbler (Dendroica tigrina). - Winters commonly. Recorded each day with as many as 25 to 30 individuals listed on December 31 and again on January 1.

Black-throated Blue Warbler (Dendroica c. caerulescens). - One to three individuals noted on three different days.

Myrtle Warbler (This warbler was a familiar sight every day and was found in virtually every type of habitat. The greatest number listed in one day was 40.

Yellow-throated Warbler (Dendroica dominica). - One or two birds seen most days, frequently in or around coconut palms. One very confiding individual was seen by many persons at the San Andros airport terminal.

Pine Warbler (Dendroica pinus). -Three pine warblers were seen on December 29 in pine woods between our campsite at Small Hope and Archie's Lodge.

Prairie Warbler (Dendroica discolor). - A few individuals seen each day, usually on the edges of dense coppice, or in mixed brush and small bushes where eight birds were seen in one day.

Palm Warbler (Dendroica palmarum). -Very abundant and found in a wide variety of habitats whereever there was a small amount of open ground. Forty to 50 of these little tail-waggers were seen on most days, and 65 were listed on December 29.

Yellow Palm Warbler(Dendroica palmarum hypochrysea). -One individual of this Eastern form of the palm warbler was studied at leisure and in good light on December 28.

Ovenbird (Seiurus aurocapillus). - Single individuals were seen on three occasions, always in fairly dense cover, once on the margin of a mangrove swamp near Andros Town.

Northern Waterthrush (Seiurus noveboracensis). - Three birds were recorded on December 31, and two were seen on January 1, 1972, all in Andros Town.

Louisiana Waterthrush (Seiurus motacilla). - Three individuals of this species were recorded along the road near Love Hill.

Kentucky Warbler (Oporornis formosus). - One individual was seen December 31 near Coakley Town.

Common Yellowthroat (Geothlypis trichas). - Winter resident, commonly found in coppice, brushy situations, and along the edges of mangrove swamps. Over 20 were seen on December 31.

Bahamian Yellowthroat (Geothlypis rostrata). - This large-sized version of the yellowthroat has a decidedly heavier bill. Only one individual was positively identified.

Yellow-breasted Chat (Icteria virens). - A single bird was closely observed January 1, 1972 in the vicinity of Somerset. Bond lists this species as a vagrant in the West Indies.

American Redstart (Setophaga ruticilla). - Observed on four days with the largest number in one day being six birds.

Bananaquit (Coerepa flaveola). - This interesting and colorful bird was seen in thickets, groves of trees, as well as around most of the villages. They were easily "whistled" up close to pose for their pictures. Eight or ten were seen on most days.

Stripe-headed Tanager (Spindalis zena). - Rather common in mixed woods, parks, and brushy areas. These attractive birds were noticed on most days in the field with 12 being the most seen in one day.

Puerto Rican Tanager (Nesoospingus speculiferus). - Although Bond assigns this species exclusively to Puerto Rico, at least four birds were observed in the park-like grounds of the Andros Beach Hotel.

Greater Antillean Grackle (Quiscalus niger). - One bird was seen December 31 near Coakley Town.

Black-cowled Oriole (Icterus dominicensis). - Individual females seen December 31 and January 1 on the grounds of the Andros Beach Hotel.

Red-winged Blackbird (Agelaius phoeniceus). - A single male redwing flew over our campsite at Small Hope.

Greater Antillean Bullfinch (Loxigilla violacea). - Common and rather evenly distributed in the coppice and groves of trees around human habitations. Ten birds were the most seen in one day.

Black-faced Grassquit (Tiaris bicolor). - Very common, usually found in brushy areas. Females and immature birds outnumbered adult males at least four to one. Twenty-five or more birds were noted on most days.

Indigo Bunting (Passerina cyanea). - A dozen or more individuals were noted daily.

Savannah Sparrow (Passerculus sandwichensis). - One individual was identified in an area of open fields and cut pine woods near Red Bank on December 28.

Lincoln's Sparrow (Zonotrichia lincolnii). - A single Lincoln's sparrow was seen in a brushy area near Archie's Lodge on December 29. In the Birds of the West Indies, this species is listed as a vagrant.

The Birds Of The Bahamas

Common Name	Recorded For Andros	Personally Sighted By Eugene Keferl
Least Grebe	T	
Pied-billed Grebe		
Audubon's Shearwater		
Wilson's petrel		
Red-billed Tropicbird		
White-tailed Tropicbird		
White Pelican		
Brown Pelican	x	x
Bluefaced Booby		
Brown Booby		
Double-crested Cormorant	x	
Olivaceous Cormorant	x	
Anhinga	x	
Magnificent Frigatebird	x	
Great White Heron	x	
Great Blue Heron	x	x
Green Heron	x	x
Little Blue Heron	x	
Cattle Egret	x	x
Reddish Egret	x	
Common Egret	x	x
Snowy Egret	T	
Louisiana Heron	x	x
Black-crowned Night Heron	x	x
Yellow-crowned Night Heron	x	
Least Bittern		
American Bittern		
Wood Ibis		
Glossy Ibis		x
White Ibis	x	
Roseate Flamingo	x	
Snow Goose		
Black-bellied Tree Duck		
West Indian Tree Duck	x	
Mallard	x	
Gadwell		
Northern Pintail		
White-cheeked Pintail		
Blue-winged Teal		
American Widgeon		
Northern Shoveler		
Wood Duck		
Redhead		
Ring-necked Duck		
Lesser Scaup		
Ruddy Duck		
Masked Duck		

The Birds Of The Bahamas

Common Name	Recorded For Andros	Personally Sighted By Eugene Keferl
Red-breasted Merganser		
Hooded Merganser		
Sparrow Hawk	T	
Turkey Vulture	x	x
Red-tailed Hawk	x	
Marsh Hawk	T	
Osprey		
Peregrine Falcon		
Pigeon Hawk	x	
Sharp-shinned Hawk		
Common Bobwhite	x	x
Guinea Fowl	x	
North American Turkey	x	
Limkin	T	
Clapper Rail		
Sora Rail		
Black Crake		
Purple Gallinule		
Common Gallinule		
Coot	x	x
Caribbean Coot		
Common Oystercatcher	x	
Semipalmated Plover	x	x
Piping Plover	T	
Wilson's Plover	T	
Snowy Plover		
Thick-billed Plover		
American Golden Plover		
Black-bellied Plover	x	
Killdeer	x	x
Ruddy Turnstone	x	
Stilt	x	
Common Snipe	x	
Upland Sandpiper		
Spotted Sandpiper	x	
Solitary Sandpiper		
Greater Yellowlegs	T	
Lesser Yellowlegs	T	
Willet	x	
Short-billed Dowitcher	x	
Red Knot	T	
Long-billed Dowitcher	T	
White-rumped Sandpiper	T	
Semipalmated Sandpiper	T	
Western Sandpiper	T	
Sanderling	T	
Stilt Sandpiper		

The Birds Of The Bahamas

Common Name	Recorded For Andros	Personally Sighted By Eugene Keferl
Hudsonian Godwit		
Herring Gull		
Laughing Gull	x	x
Ring-billed Gull		
Bonapart's Gull		
Gull-billed Tern		
Forster's Tern		
Common Tern		
Roseate Tern		
Bridled Tern	x	
Sooty Tern	x	
Least Tern	x	
Royal Tern	x	
Sandwich Tern		
Caspian Tern		
Brown Noddy	x	
Black Skimmer		
White-crowned Pigeon	x	x
Mourning Dove	x	x
Zenaida Dove	x	
White-winged Dove		
Ground Dove	x	x
White-bellied Dove		
Key West Quail Dove	x	
Mangrove Cuckoo	x	x
Yellow-billed Cuckoo		
Great Lizard Cuckoo	x	
Smooth-billed Ani	x	x
Barn Owl	x	
Short-earring Owl	T	
Burrowning Owl	x	
Chuck -will's Widow	x	
Common Nighthawk	x	x
Chimney Swifts	x	
Cuban Emerald	x	x
Bahama Woodstar	x	x
Belted Kingfisher	x	x
Yellow-shafted Flicker	x	x
West Indian Red-bellied Woodpecker		
Yellow-bellied Sapsucker	x	x
Bahamian Hairy Woodpecker	x	
Eastern Kingbird		
Grey Kingbird	x	x
Tropical Kingbird	T	
Loggerhead Kingbird	x	
Stolid Flycatcher	x	x
Wood Pewee	T	

The Birds Of The Bahamas

Common Name	Recorded For Andros	Personally Sighted By Eugene Keferl
Great Crested Flycatcher		
Rufous-tailed Flycatcher	x	
Greater Antillean Pewee	x	
Carribbean Elaenia	T	
Bahama Swallow	x	x
Tree Swallow	T	
Purple Martin		
Rough-winged Swallow		
Barn Swallow		
Brown-headed Nuthatch		
House Wren	T	
Northern Mockingbird	x	x
Bahama Mockingbird	x	x
Pearly-eyed Thrasher		
Catbird	x	x
Starling	T	
Robin	x	
Red-legged Thrush	x	x
Grey-cheeked Thrush		
Olive-backed Thrush	x	
Wood Thrush	x	
Veery	x	
Bluebird	x	
Blue-grey Gnatcatcher	x	x
Thick-billed Vireo	x	
White-eyed Vireo		x
Yellow-throated Vireo		
Solitary Vireo		
Philadelphia Vireo	T	
Black-whiskered Vireo	x	
Red-eyed Vireo		
Black-and-White Warbler	x	x
Blackpoll Warbler	x	x
Magnolia Warbler	T	
Prothonotary Warbler		
Tennessee Warbler		
Parula Warbler	x	x
Yellow Warbler	x	x
Cape May Warbler	x	x
Black-throated Warbler (Blue)	x	x
Black-throated Green Warbler		
Myrtle Warbler	T	x
Yellow-throated Warbler	T	x
Pine Warbler	x	
Olive-capped Warbler		
Bay-breasted Warbler		
Prairie Warbler	x	
Swainson's Warbler		
Golden - winged Warbler		

The Birds Of The Bahamas

Common Name	Recorded For Andros	Personally Sighted By Eugene Keferl
Blue-winged Warbler	T	
Bachman's Warbler		
Kirtlands Warbler		
Palm Warbler	x	x
Ovenbird	x	
Northern Waterthrush	x	x
Louisiana Waterthrush	T	
Kentucky Warbler	T	
Connecticut Warbler		
Common Yellowthroat	x	x
Bahama Yellowthroat	x	
Redstart	x	x
Yellow-breasted Chat	T	
Bananaquit	x	x
Stripe-headed Tanager	x	x
Puerto Rican Tanager	T	
Summer Tanager	x	
Orchard Oriole		
Black-cowled Oriole	x	
Red-winged Blackbird	x	
Great Antillean Grackle	T	
Bobolink	T	
Greater Antillean Bullfinch	x	x
House Sparrow		
Yellow-faced Grassquit		
Cuban Grassquit		
Black-faced Grassquit	x	x
Rose-breasted Grosbeak		
Blue Grosbeak		
Indigo Bunting	T	
Painted Bunting		
Dickcissel		
Savannah Sparrow	T	
Lark Sparrow		
White-crowned Sparrow		
Song Sparrow		x
Lincoln's Sparrow	T	

Approximately 227 species of birds recorded from the Bahamas
Approximately 137 species of birds recorded from Andros Island, Bahamas
As of January 1973 Eugene P. Keferl has recorded 52 species of Birds on Andros Island.
There are only three species of endemic birds in the Bahamas:
Bahama Swallow, Bahama Woodstar, Bahama Yellow-throated Warbler
There are approximately only 42 nesting species of birds in the Bahamas.

T = Sighted by Tom Thomson

Appendix I

Taxonomic Guide To Andros

By Eugene Keferl

Taxonomic Guide and Workbook of Marine Organisms Found Near Andros Island, Bahamas

Plant Kingdom

Phylum Chlorophyta (Green Algae)

1. Pigment chlorophyll present.
2. Cellulose cell wall.
3. Unicellular or many-celled filaments or flat, leaflike in structure.

Phylum Rhodophyta (Red Algae)

1. Chlorophyll masked by the red pigment phycoerythrin. This pigment can absorb the longer blue light rays.
2. Can grow at greater depths than other algae.
3. Some accumulate calcium--coralline algae. More important than corals in reef formation.

Phylum Phaeophyta (Brown Algae such as kelp and sargassum)

1. Pigment chlorophyll masked by the golden-brown pigment fucoxanthin.
2. Multicellular plants of various forms.

Phylum Spermatophyta (Seed Plants)

1. Usually have roots, stems, and leaves.
2. Embryo surrounded by cotyledon and usually enclosed in a covering (seed coat).

Notes on Marine Plants:

Animal Kingdom

Phylum Porifera (Sponges)

1. Body with many pores, canals, or chambers through which water flows.
2. Body of two layers of cells with mesenchyme between.
3. Interior surface cells are flagellated choanocytes which set up a current of water through the animal.
4. Tissue level of organization, digestion intracellular.
5. Mesenchymal skeleton of spongin fibers, crystalline spicules, or both.

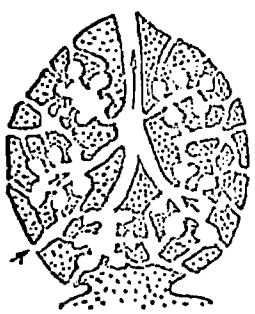


Fig. 1. Typical sponge. Arrows indicate direction of water current.

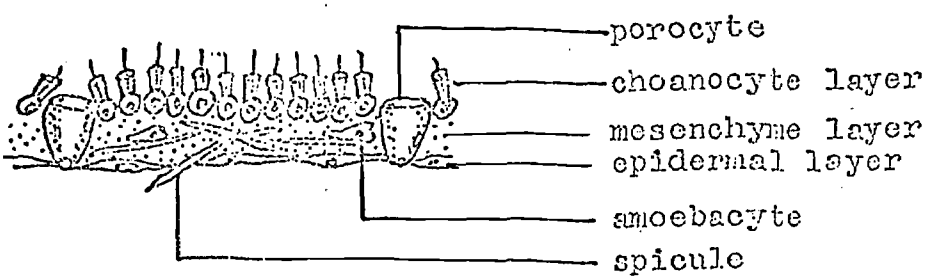


Fig. 2. Diagram of wall of a sponge.

Notes on Sponges:

Phylum Coelenterata (Jellyfish, Hydra, Corals, etc.)

1. Radial Symmetry.
2. Two body layers, outer epidermis and inner gastrodermis, with mesogleal layer between.
3. Some organs--gonads, mouth, gastrovascular cavity, tentacles with nematocysts, etc.
4. A diffuse network of nerve cells.
5. Alternation of generation with asexual polyp stage and sexual medusa stage--only one stage dominates.

Class Hydrozoa

1. Body form a polyp.
2. No partition of gastrovascular cavity.
3. No gullet.
4. Solitary or colonial.

Class Scyphozoa (Jellyfish)

1. Body form a free-swimming medusa.
2. No gullet; gastrovascular cavity is pouched.
3. Tentacles on both the "umbrella" edge and mouth margin.

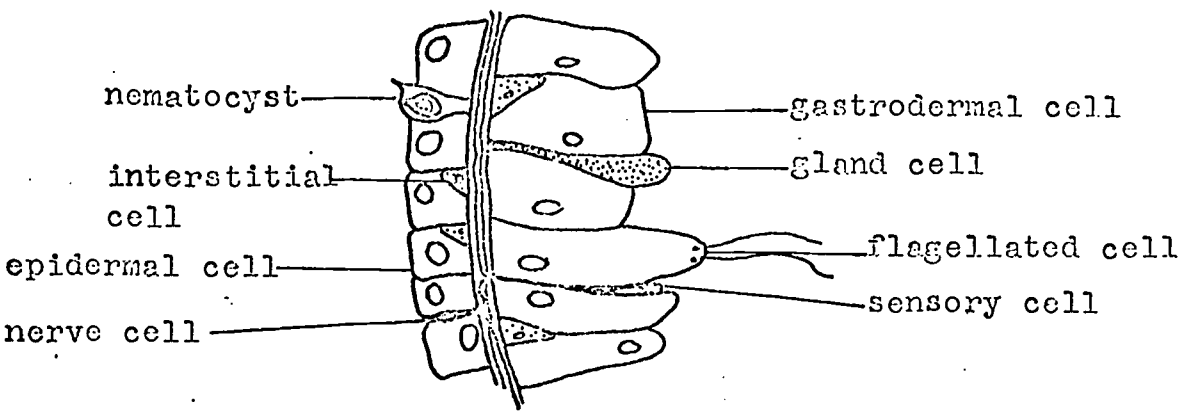


Fig. 3. Diagram of the body wall of a coelenterate.

Notes on hydrozoans and jellyfish:

Class Anthozoa (Corals, Sea Anemones)

1. Body form a polyp (No medusae).
2. Mouth leads into a gullet, gastrovascular cavity divided by vertical septa.
3. Solitary or colonial, attached.
4. Some secrete skeletons internally (Soft and Horny Corals) or externally (Stony Corals).

Subclass Alcyonaria (Soft and Horny Corals)

1. Eight pinnately branched tentacles and
2. Eight single complete septa.
3. An endoskeleton (Formed within the mesoglea).

Order Alcyonacea (Soft Corals)

1. Polyps with lower parts fused.
2. Oral ends (tentacles) protrude.
3. Skeleton of separate limy spicules, no axial rod.

Order Gorgonacea (Horny Corals)

1. Polyps fused, colonies plant-like.
2. Axial skeleton of calcareous spicules or horn-like gorgonin, or both.

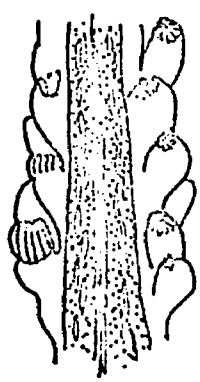


Fig. 4. Diagram of a horny coral. Notice the axial rod. Soft corals do not have this axial structure.

Notes on soft and horny corals:

Subclass Zoantharia (Stony Corals)

1. Tentacles never 8--sometimes branched.
2. Skeleton solid, if present.
3. Skeleton secreted by epidermal cells, external.

Order Actiniaria (Sea Anemones)

1. No skeleton.
2. Polyp large, columnar, with muscular walls and pedal disc.

Order Madreporaria (Stony Corals)

1. Exoskeleton compact, calcareous.

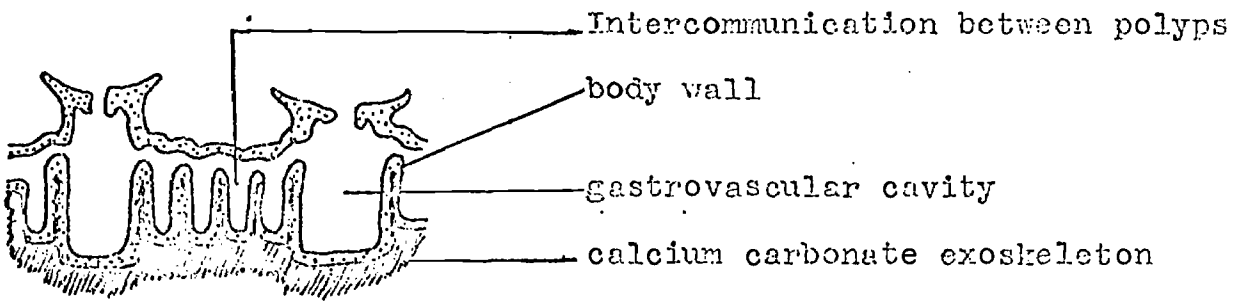


Fig. 5. Diagram of a stony coral. Notice that the hard exoskeleton is outside of the animals.

Notes on stony corals:

Phylum Bryozoa (Moss Animals)

1. Bilateral symmetry, three germ layers.
2. Colonial, each small individual in a separate house (Zooecium).
3. Complete digestive tract, U-shaped.
4. Mouth surrounded by a retractile lophophore bearing tentacles.
5. Zooecium, secreted by epidermis, is usually calcareous or chitinous.

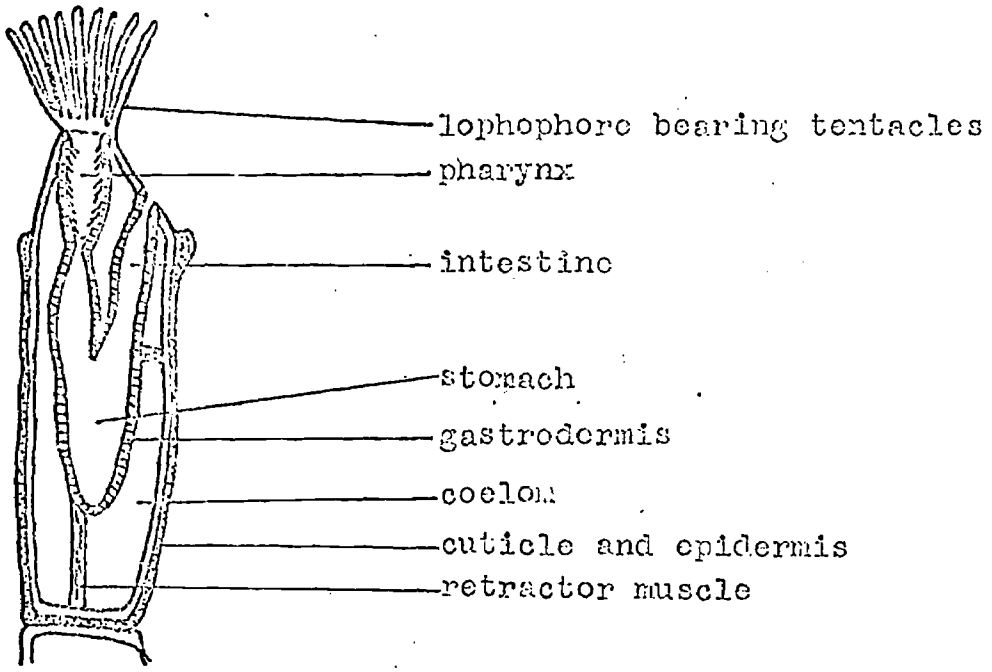


Fig. 6. Diagram of one animal in a colony of bryozoans.

Notes on bryozoans:

Phylum Echinodermata

1. Radial symmetry, usually 5-parted.
2. Three body layers--organs covered with cilia.
3. Body covered by epidermis over a mesodermal skeleton, often with spines (Echinos-spines, dermis-skin).
4. Complete, simple digestive tract.
5. Water vascular system with tube feet for locomotion and respiration (in some); madreporite is entrance and exit for water.
6. Tube feet project from an ambulacral groove.

Class Asteroidea (Starfish)

1. Body flattened, starshaped or pentagonal.
2. Arms not sharply set off from central disc.
3. Spines short.
4. Two or 4 rows of tube feet.

Notes on Class Asteroidea:

Class Holothurioidea (Sea Cucumbers)

1. Body long, sausage-shaped.
2. No arms or spines.
3. Mouth ringed by retractile tentacles.
4. Cloaca usually with respiratory tree.

Class Echinoidea (Sea Urchins, Sand Dollars, Sea Biscuits)

1. Skeleton rigid and globular or disc-like, with movable spines.
2. Slender tube feet with suckers.

Class Ophiuroidea (Brittle Stars)

1. Body a central disc with 5 slender jointed arms.
2. Tube feet in 2 rows.
3. Incomplete digestive system--stomach sac-like.

Notes on sea cucumbers, sea urchins, sand dollars, sea biscuits, and brittlestars;

Phylum Annelida (Segmented Worms)

1. Body long, usually visably segmented with paired setae (bristles).
2. Complete digestive tract.
3. Blood system closed.
4. Midventral nerve cord with a ganglion per segment.
5. Nephridia as excretory system.

Class Polychaeta ("Many Bristles")

1. Many segments with parapodia (fleshy feet) with setae.

Order Errantia (Bristleworms, Clamworms)

1. Segments alike except in head and anal regions.

Order Sedentaria (Tubeworms)

1. Body segments of two unlike regions.
2. Live in burrows or tubes (calcareous or non-calcareous).

Notes on annelid worms:

Phylum Arthropoda (Joint-footed Animals)

1. Body with head, thorax, and abdomen.
2. Like or unlike somites (segments) variously fused.
3. Each somite bears a pair of jointed appendages.
4. Exoskeleton of chitin which is molted periodically.
5. Open blood system.
6. Ventral nerve cord with paired ganglia in each somite.

Class Crustacea

1. Head of 5 fused somites.
2. Two pair antennae, 1 pair jows, 2 pair maxilla.
3. Body usually with dorsal carapace.
4. Appendages often biramous.
5. Respiration by gills in most.

Subclass Cirripedia (Barnacles)

1. Adults sessile.
2. Attached in head region by secretion from cement gland.
3. Carapace becomes mantle around body--usually with limy plates.
4. Thoracic appendages slender and bristly, used for food-gathering. Abdomen vestigeal.

Subclass Malacostraca

1. Body typically of 19 somites (5 head, 8 thoracic, 6 abdominal).
2. Head fused with several thoracic somites (cephalothorax).

Order Isopoda (Pill bugs, for example)

1. Body flattened dorsoventrally.
2. No carapace.
3. Abdomen short, somites partly or all fused.

Notes on Barnacles and Isopods:

Order Amphipoda (Sand hoppers, beach fleas, etc.)

1. Body flattened laterally.
2. No carapace.
3. Abdomen flexed ventrally.

Order Stomatopoda (Mantis shrimp)

1. Chelipeds look like first legs of preying mantis.

Order Decopoda (Lobsters, Crabs, etc.)

1. Mostly marine.
2. Five pairs of walking legs.

Notes on amphipods, mantis shrimp, and decopods:

Phylum Mollusca

1. Bilateral symmetry.
2. Soft body surrounded by a mantle which usually secretes a limy shell of 1, 2, or 8 parts.
3. Usually an anterior head and ventral muscular foot.
4. Mouth with a horny radula (except bivalves).

Class Amphineura (Chitons)

1. Body elliptical.
2. Shell middorsal of 8 plates.
3. Foot large and flat.
4. Gills in a row in groove around foot.

Class Gastropoda (Limpets, Slugs, Snails, Conchs)

1. Single shell, usually spiral. (Uncoiled, reduced, or absent in some)
2. Head distinct, with rasping radula, commonly with tentacles and eyes.
3. Foot large and flat.

Notes on amphineurans and gastropods:

Class Pelecypoda (Clams, Scallops, etc.)

1. Shell of 2 lateral valves, usually with dorsal hinge and ligament, and closed by 1 or 2 adductor muscles.
2. Mantle of flattened right and left lobes, with posterior siphons in marine forms.
3. Foot wedge-shaped in most, projecting between mantles and shells.
4. No head, jaws, or radula.

Class Cephalopoda (Squid, Octopus, Nautilus)

1. Shell external in nautiloids, internal in squids, lacking in octopi.
2. Head large, eyes conspicuous, mouth with horny jaws and radula.
3. Foot modified into 8 or 10 arms.

Notes on pelecypods and cephalopods:

Phylum Chordata

1. Dorsal tubular nerve cord, paired gill slits, and a notochord at some time in their life cycle.
2. Segmentation usually evident.
3. Tail behind anus.

Subphylum Tunicata (Urochordata) (Sea Squirts)

1. Larva free-swimming, tadpole-like, with nerve cord and notochord in tail.
2. Adult tubular, globose, or irregular in form, covered with tunic which is often transparent.
3. Gill slits in pharyngeal region.
4. Animal solitary or colonial.

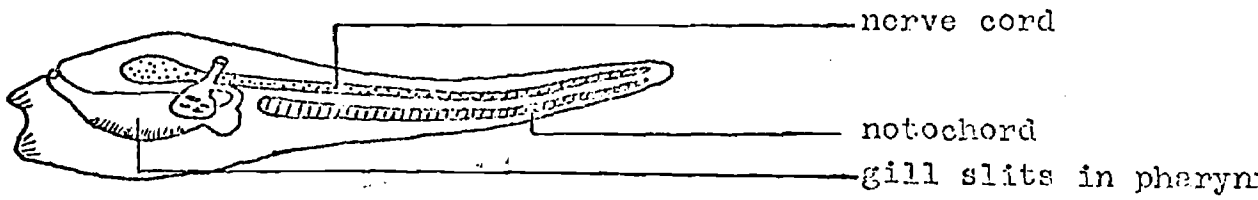


Fig. 7. Diagram of the free-swimming larval form of a tunicate.

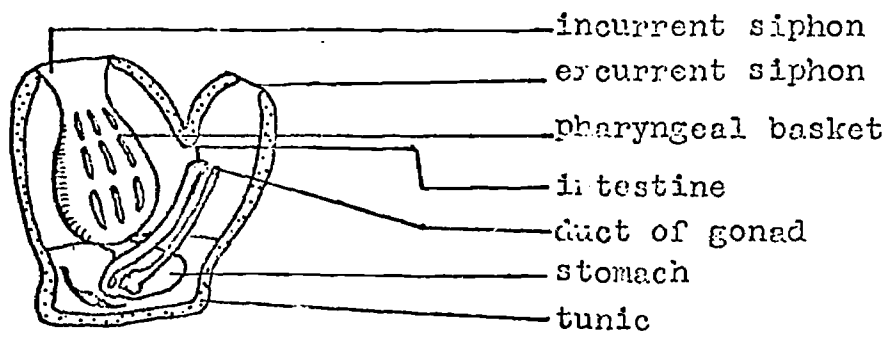


Fig. 8. Diagram of one sessile adult tunicate.

Notes on tunicates:

A List of Marine Plants and Animals

Found Near Andros Island, December, 1970

Compiled by Eugene P. Keferl

Phylum Chlorophyta (Green algae)

Ulva	Sea lettuce
Enteromorpha	grass
Acetabularia	Mushroom shaped
Penicillus	Merman's shaving brush
Halimeda	heart or kidney-shaped segments
Codium	club-shaped branches (sponge seaweed)
Caulerpa	resembles mosses, ferns or cacti
	each plant is a single cell

Phylum Rhodophyta (Red algae)

Corallina	
Goniolithon	dinsely branched - pink

Phylum Phaeophyta (Brown algae)

Sargassum

Phylum Tracheophyta (Marine seed plants)

Zostera	eelgrass
Thalassia	turtle grass

Phylum Porifera
Class Demospongiae

Loggerhead Sponge
Vase Sponge (Hircinia)
Finger Sponge (Chalina)
Tube Sponge
Black Sponge

Phylum Coelenterata
Class Hydrozoa

Order Hydroida (Hydroids)
Many unknown species

Order Hydrocorallina
Stinging (Fire) Coral (Millepora)

Phylum Coelenterata
Class Anthozoa
Subclass Alcyonaria
Order Alcyonacea (Soft Corals)

Order Gorgonacea (Horny Corals)

Sea Fan (*Gorgonia flabellum*)
Sea Whip
Sea Feather (*Pseudopterogorgia*)

Subclass Zoantharia
Order Actiniaria (Sea Anemones)
Several Unknown Species

Order Madreporaria (Stony Corals)

Staghorn coral	*Acropora cervicornis*
Elkhorn coral	*Acropora palmata*
Large finger coral	*Porites porites*
Small finger coral	*Porites furcata*
Brain Coral	*Meandra*
Lumpy or Mountain coral	*Monastrea annularis*
Low brain coral	*Diploria clivosa*
Star coral	*Eusmilia fastigiata*
Rose coral	*Manicina areolata*
?	*Favia fragum*
Small round coral	*Siderastrea radians*
Lettuce coral	*Agaricia agaricites*
Pillar coral	*Dendrogyra cylindrus*

Phylum Echinodermata
Class Asteriodea (Starfish)
Oreaster reticulatus
Echinaster sentus
Unknown small sand starfish

Class Holothurioidea (Sea cucumbers)
Holothuria floridana West Indian Sea Cucumber

Class Echinoidea (Sea Urchins)

Diadema antillarum	long-spined black sea urchin
Tripneustes esculenta	short-spined white (pink)
Eucidaris tribuloides	blunt-spined sea urchin
Echinometra subangularis	Rock-boring sea urchin
Clypeaster subdepressus	Sea biscuit
Mellita testudinata	Sand Dollar

Class Ophiuroidea (Brittle Stars)
Unknown species

Phylum Annelida
Class Polychaeta
Order Errantia

Bristle worm	Odontosyllis
Clam worm	Nereis

Order Sedentaria (Fanworms and feather duster worms)

Family Sabellidae	non-calcareous tubes	Sabellaria
Family Serpulidae	Calcareous tubes	Spirula

Phylum Arthropoda
Class Crustacea

Subclass Cirripedia	Barnacles	Several unknown species

Subclass Malacostraca

Order Isopoda	Many unknown species
Order Amphipoda	Beach fleas and many others
Order Stomatopoda	Mantis Shrimp

Order Decapoda

Spiny rock lobster	Panulirus
Blue crab	Callinectes
Purple clawed hermit crab	Coenobita clypeatus
Other hermit crabs	
Rock crabs	
Mud crabs	

Phylum Mollusca
Class Gastropoda

Barbados Keyhole Limpet	Fissurella barbadensis
Spotted Limpet	Acmaea pustulata
West Indian Top Shell	Cittarium pica
American Star Shell	Astraea Americana
Four-toothed Nerite	Nerita versicolor
Tessellate Nerite	Nerita tessellata
Virgin Nerite	Neritina virginea
Angulate Periwinkle	Littorina angulifera
False Prickly-Winkle	Echinimus nodulosus
Beaded Periwinkle	Tectarius muricatus
West Indian Worm-Shell	Vermicularia spirata
Slipper shell	Crepidula
Stocky Cerith	Cerithium litteratum
Queen Conch	Strombus gigas
Flamingo Tongue	Cyphoma gibbosum
Common West Indian Simnia	Neosimnia acicularis
Southern Miniature Natica	Natica pusilla
Triton's Trumpet	Charonia variegata
Deltoid Rock Shell	Thais deltoidea
True Tulip	Fasciolaria tulipa
West Indian Bubble Shell	Bulla occidentalis
Unknown Olive Shell	

Phylum Mollusca

Class Amphineura

Fuzzy Chiton	Acanthopleura granulata

Class Pelecypoda

Flat Tree Oyster	Isognomon alatus
Atlantic Wing Oyster	Pteria colymbus
Atlantic Pearl Oyster	Pinctada radiata
Amber Pen Shell	Pinna carnea
Tiger Lucine	Codakia orbicularis
Leafy Jewel Box	Chama macerophylla
Gaudy Asaphis	Asaphis deflorata

Class Cephalopoda

Common Spirula	Spirula spirula

Appendix J

Andros Workbook

By Eugene Keferl

Phylum Porifera(To bear pores)--Sponges

A. Morphological Characteristics
1. Radial symmetry or none.
2. All shapes and sizes($\frac{1}{2}$ in. to 6 ft.) and colors.
3. Body with many pores, canals or chambers through which water flows.
4. Body with two layers of cells and a mesenchyme between.
5. Mesenchymal skeleton of spongin fibers, crystalline spicules or both.
6. Interior surface cells are flagellated, these cells called choanocytes, set up a current of water through the animal.
7. Tissue level of organization.

B. Habitat and Life History Characteristics
1. Most are marine, a few live in fresh-water.
2. None are parasitic.
3. Always sessile.
4. Solitary or colonial.
5. Feeds on plankton and suspended organic matter.
6. The larger sponges take 5 to 6 years to reach maturity.
7. Reproduce asexually by budding and gemmules.
8. Reproduce sexually by egg and sperm.

C. Classification basis
1. Skeletal arrangement.
2. Shape of the spicules or skeletal unit.
3. Structure of the canal system.

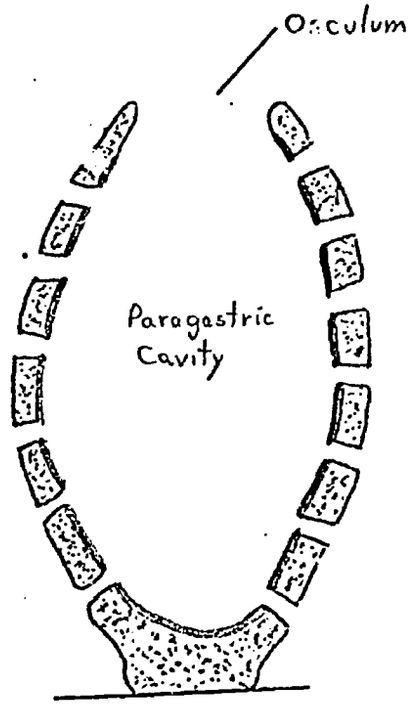
D. Classification(5000 species)
1. Class Calcarea(Calcareous sponges)
a. Usually small and drab.
b. Has calcium carbonate spicules.
c. Can be an ascon, sycon or leucon grade sponge.

2. Class Hexactinellida(Glass sponges)
a. Pale color.
b. Symmetrical in shape.
c. 6 pointed siliceous spicules.
d. Deep water

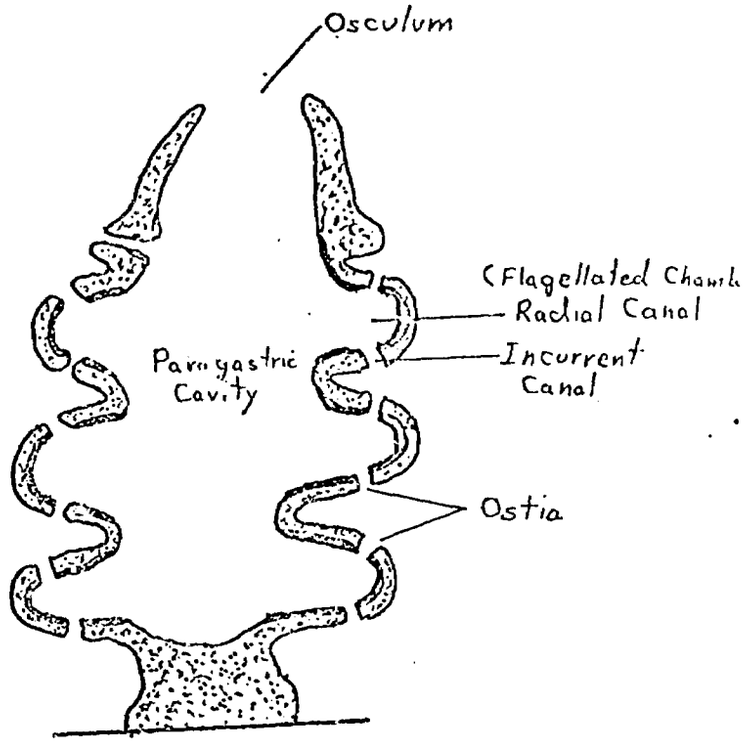
3. Class Demospongiae
a. Coloration is frequently brilliant.
b. Irregular in shape.
c. Leucon grade only.
d. Siliceous spicules or spongin fibers or both.

Notes:

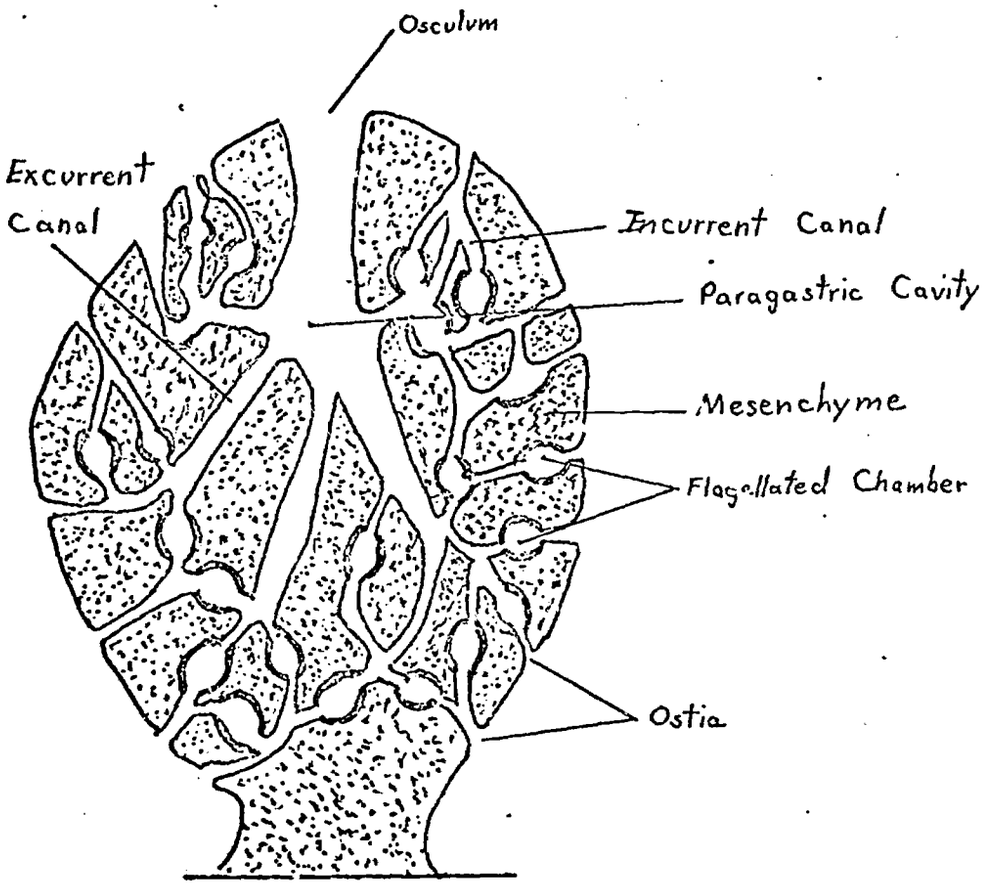
Types of Sponges



A. Ascon Grade



B. Sycon Grade

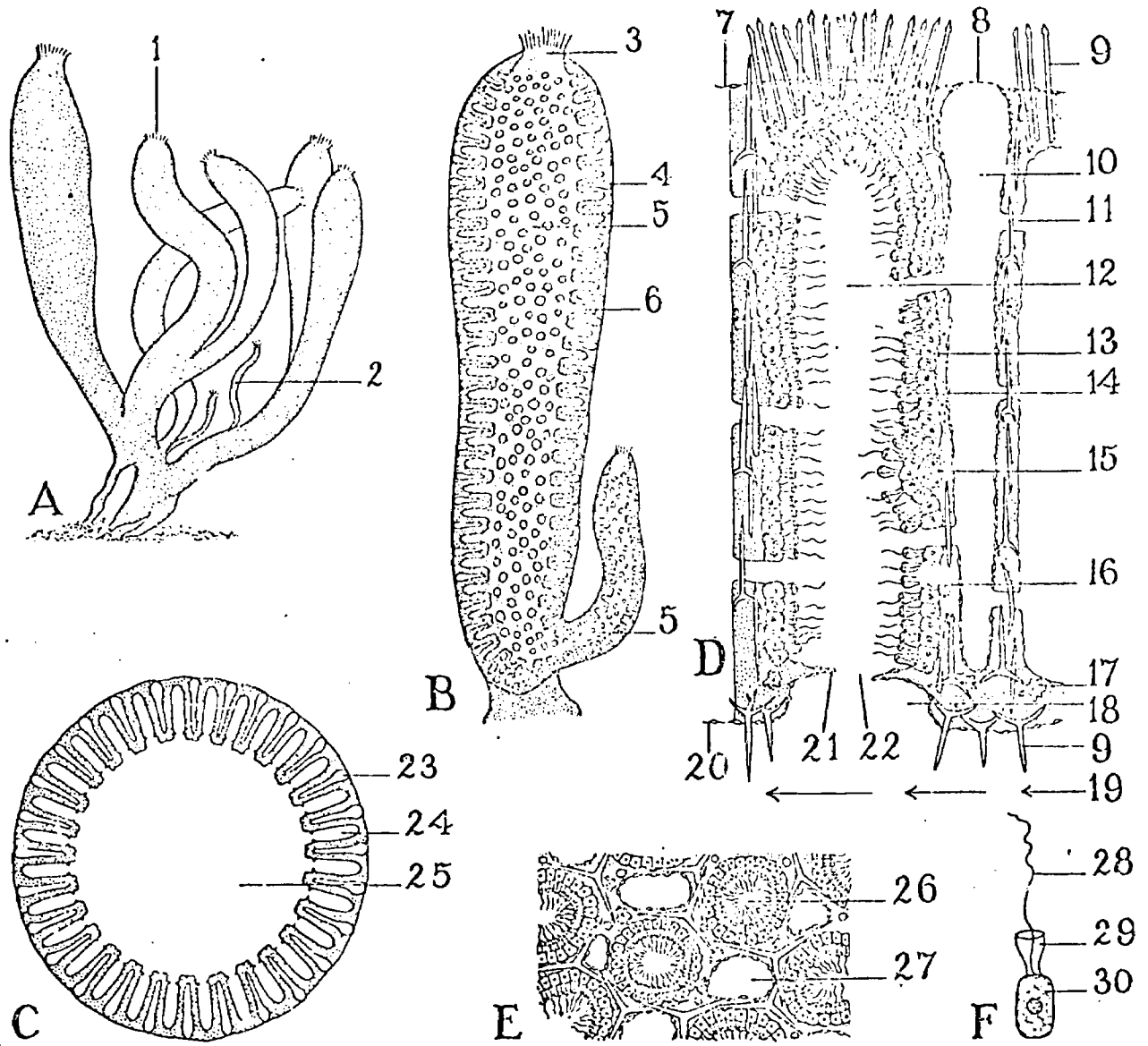


C. Leucon Grade

Some Diagrams modified from Borradaile, Eastham, Potts and Saunders' (1961). pg. 119

TURTOX KEY CARD
for

Grantia



A. Habit sketch
B. Longitudinal section
C. Cross section
D. Detail of canals
E. Tangential section
F. Choanocyte
1. Osculum
2. Bud
3. Osculum
4. Incurrent canal
5. Paragastric cavity (cloaca)
6. Radial canal
7. Dermal epithelium (ectoderm)
8. Pore membrane
9. Spicule
10. Incurrent canal
11. Prosopyle
12. Radial canal
13. Entoderm
14. Collar
15. Embryo
16. Egg cell
17. Ameboid wandering cell
18. Excurrent canal
19. Paragastric cavity
20. Paragastric epithelium (entoderm)
21. Diaphragm
22. Apopyle
23. Incurrent canal
24. Radial canal
25. Paragastric cavity
26. Radial canal
27. Incurrent canal
28. Flagellum
29. Collar
30. Cell body

Phylum Coelenterata(Hollow gut)

A. Phylum Characteristics
   1. Radial symmetry.
   2. Body generally with two layers of cells, an outer epidermis and an inner gastrodermis, but has a mesogeal layer between.
   3. Skeleton limy, horny or none.
   4. Possesses specialized cells called nematocysts.
   5. Some organs; gonads, mouth, sensory and tentacles.
   6. Possesses a gastrovascular cavity.
   7. Possesses a diffuse network of unpolarized nerve cells an some sensory organs.
   8. Reproduction is commonly by alternation of generation; with medusa and polyp stages. One stage usually dominates.

B. Class Hydrozoa(Hydroids---2,700 species)
   1. Some Class Characteristics
      a. Can display either the polyp or medusa stage or both.
      b. Mesoglea is never cellular.
      c. Hydromedusa has a velum.
      d. Gastrodermis does not have nematocysts.
      e. Some have a calcareous exoskeleton.
   2. Some Habitat and Life History Characteristics
      a. Most are relatively small and inconspicuous; frequently appear to be "seaweeds" or algae.
      b. Colonial or solitary.
      c. Feed on small planktonic animals.

C. Class Scyphozoa(Jellyfish---200 species)
   1. Some Class Characteristics
      a. Medusa stage is the dominant life form.
      b. Thick mesoglea which contains wandering amoeboid cells.
      c. The bell never has a velum.
      d. Four to many tentacles.
      e. Manubrium is drawn out into four oral arms.
      f. The bell varies from a flat saucer to a deep helmet.
   2. Some Habitat and Life History Characteristics
      a. All are marine.
      b. Most are free swimming, only one group is sessile.
      c. Size varies from 1 inch to 7 feet.
      d. They feed on all types of animals, a few are ciliary feeders.
      e. Some possess symbiotic algae.

Notes:

D. Class Anthozoa(Sea anemones and corals---6,000 species)
1. Some Class Characteristics
a. Polyp stage only, the medusoid stage is completely absent.
b. Mesoglea is cellular.
c. Animal possesses a tubular pharynx.
d. The gastrovascular cavity is divided by vertical septa.
e. The septa have nematocysts.
f. They are both colonial and solitary.

2. Subclass Alcyonaria(Soft and Horny Corals)
a. Eight pinnately branched tentacles.
b. Eight single complete septa.
c. Has an endoskeleton formed within the mesoglea.
d. Colonial

e. Order Alcyonacea(Soft Corals)
aa) Polyps with the lower parts fused.
bb) Only the oral ends(tentacles) are exposed.
cc) Skeleton is made up of separate limy spicules, no axial rod.

f. Order Gorgonacea(Horny Corals)
aa) Polyps are fused.
bb) Colonies are plant-like.
cc) Axial skeleton of calcareous spicules or horn-like gorgonin, or both.

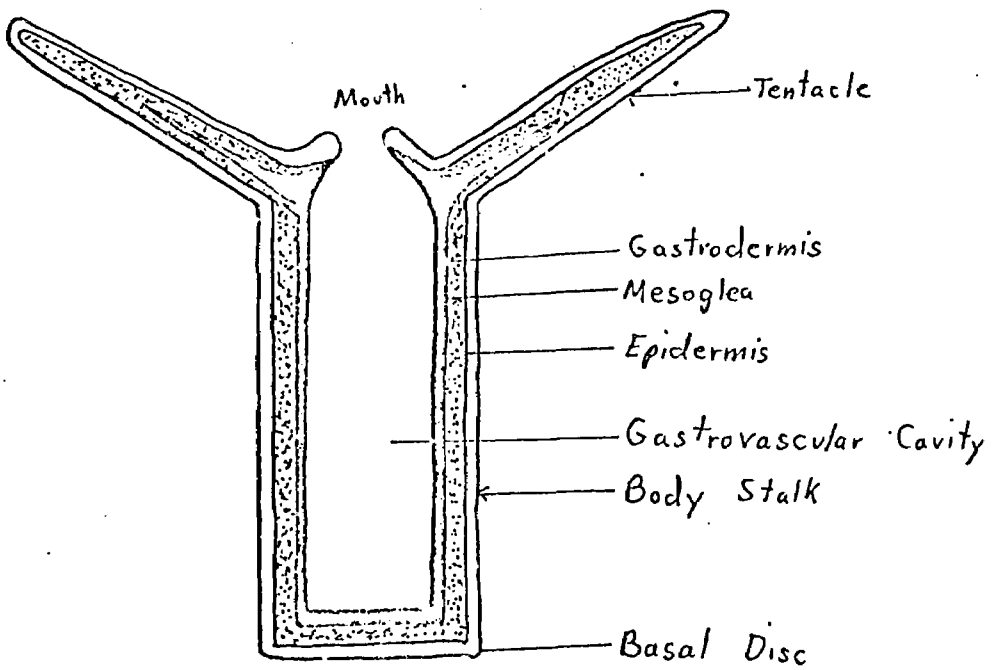
3. Subclass Zoantharia(Stony Corals and Sea Anemones)
a. Tentacles are never 8, sometimes they are branched.
b. The skeleton is solid or absent.
c. The skeleton is secreted by epidermal cells externally.

d. Order Actiniaria(Sea Anemones)
aa) No skeleton.
bb) Polyps are large, columnar, with muscular walls and a pedal disc.
cc) Solitary.

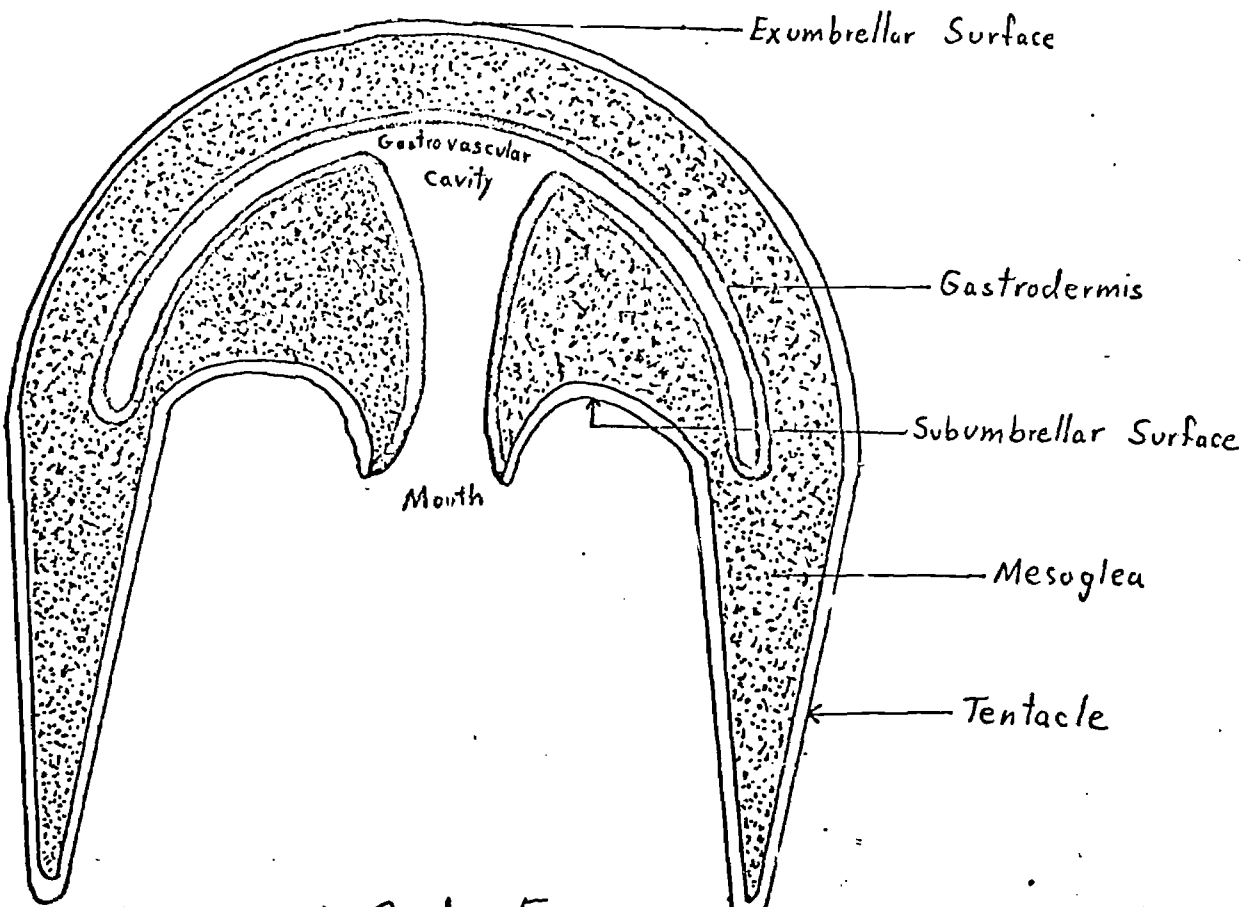
e. Order Madreporaria(Stony Corals)
aa) Exoskeleton is compact and calcareous.
bb) Colonial or solitary.

Notes:

Coelenterate Body Forms



Polypoid Body Form



Medusoid Body Form

Modified from Barnes (1963) pg. 61

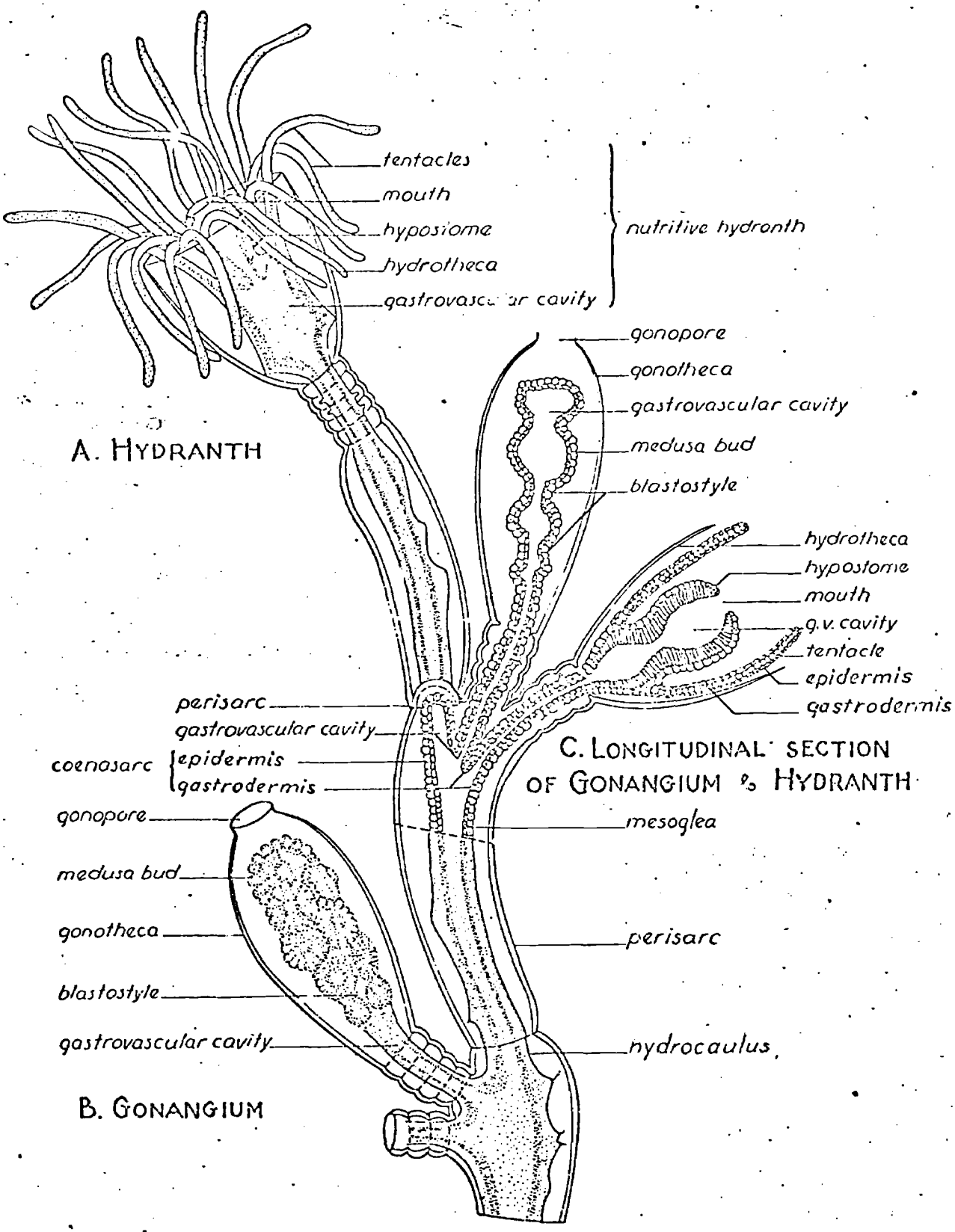
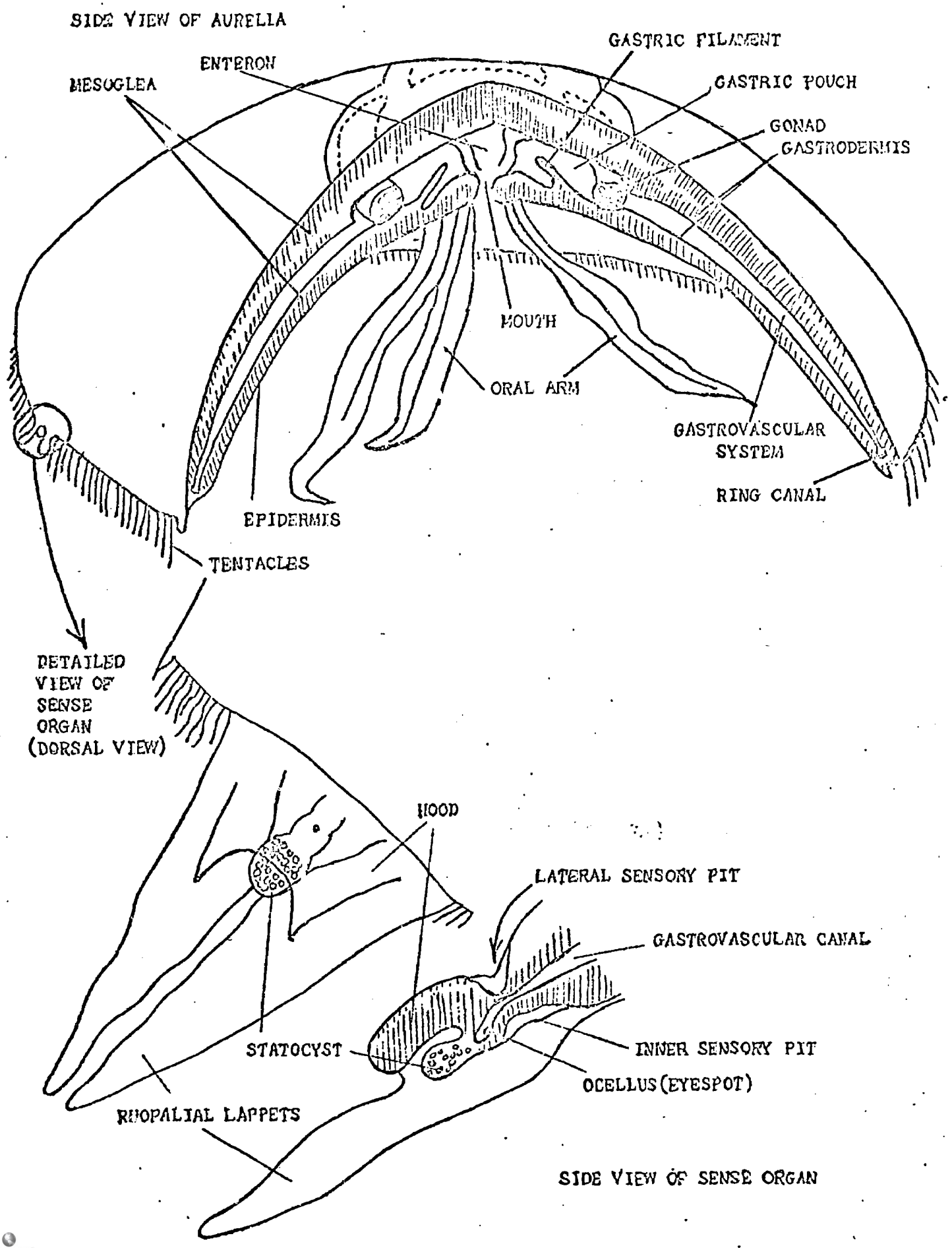
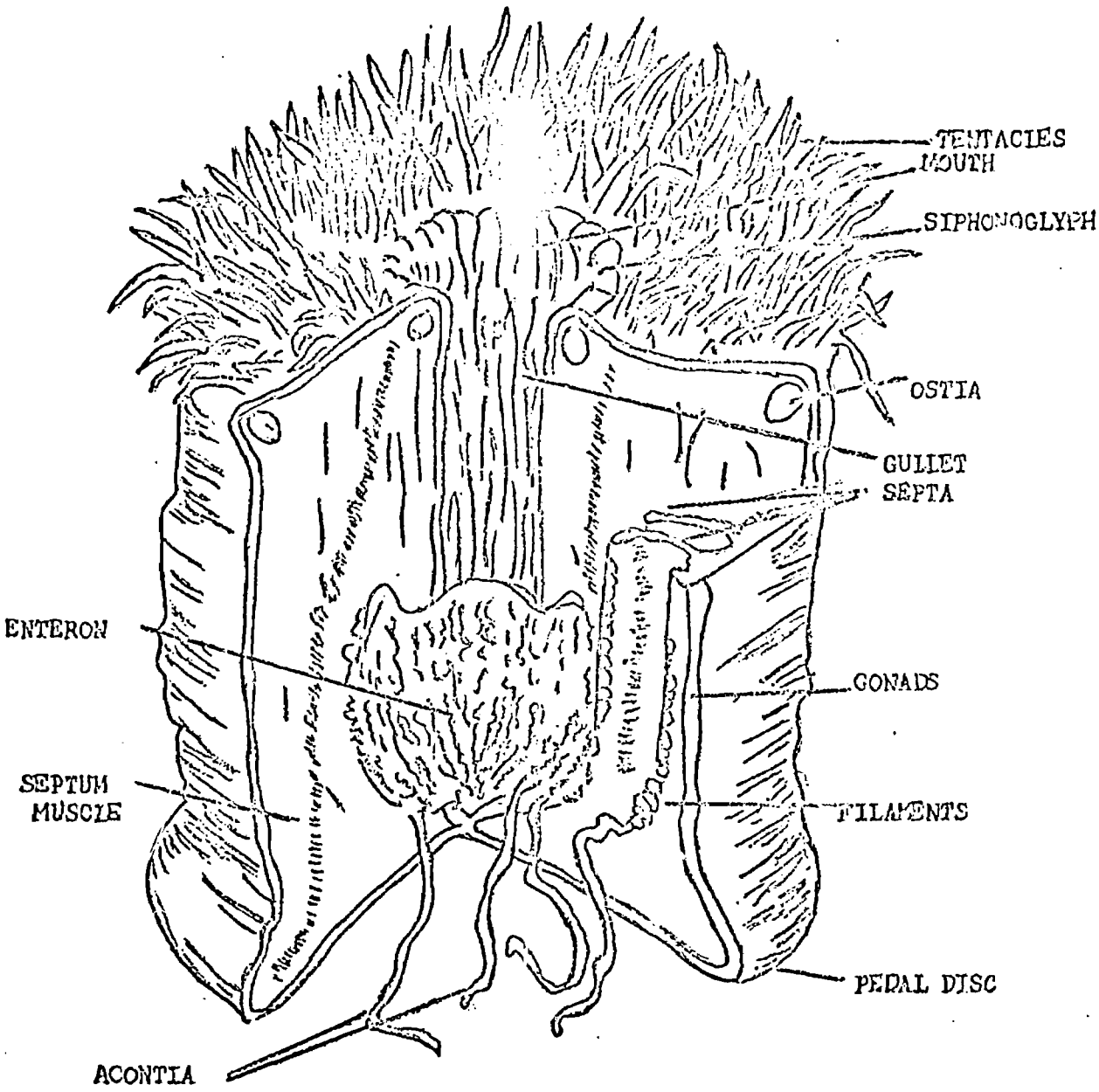


Fig. 69. OBELIA

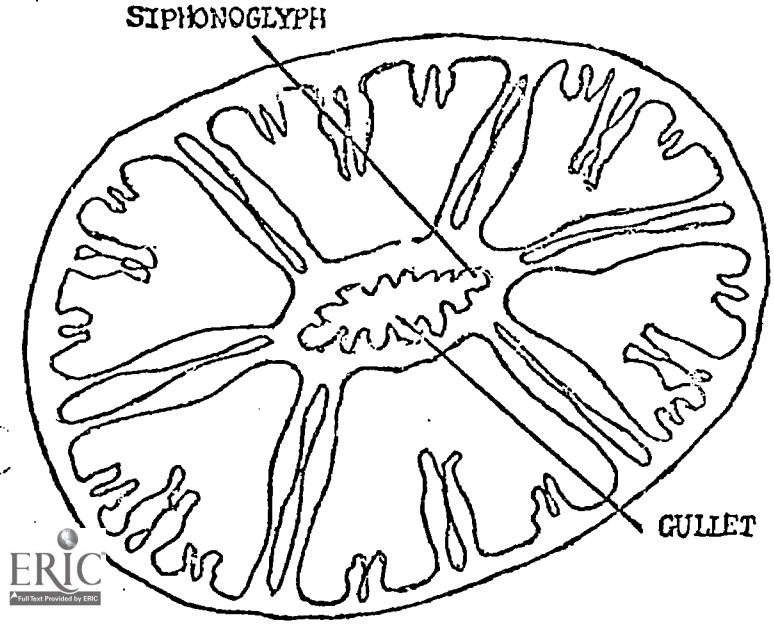
Jellyfish


SIDE VIEW OF AURELIA
GASTRIC FILAMENT
ENTERON
MESOGLEA
GASTRIC POUCH
GONAD
GASTRODERMIS
MOUTH
ORAL ARM
GASTROVASCULAR SYSTEM
RING CANAL
EPIDERMIS
TENTACLES
DETAILED VIEW OF SENSE ORGAN (DORSAL VIEW)
HOOD
LATERAL SENSORY PIT
GASTROVASCULAR CANAL
STATOCYST
INNER SENSORY PIT
OCELLUS (EYESPOT)
RHOPALIAL LAPPETS
SIDE VIEW OF SENSE ORGAN

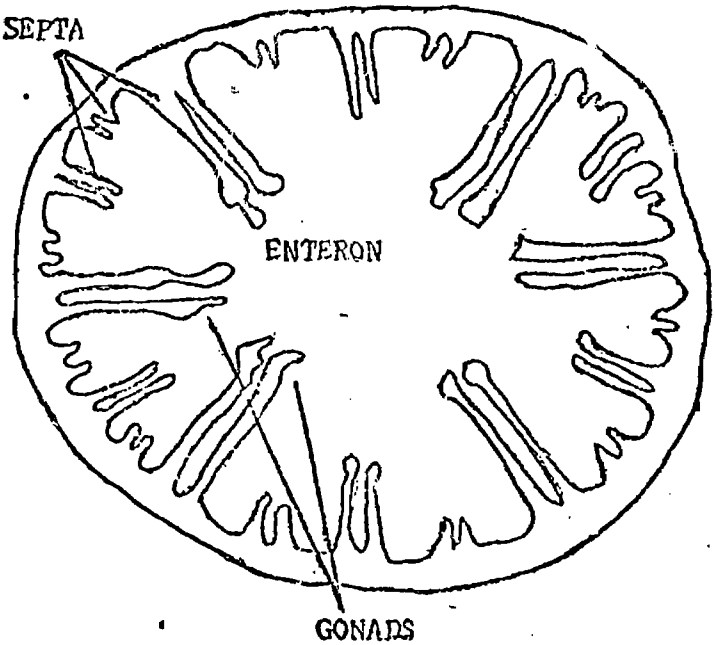
Sea Anemone



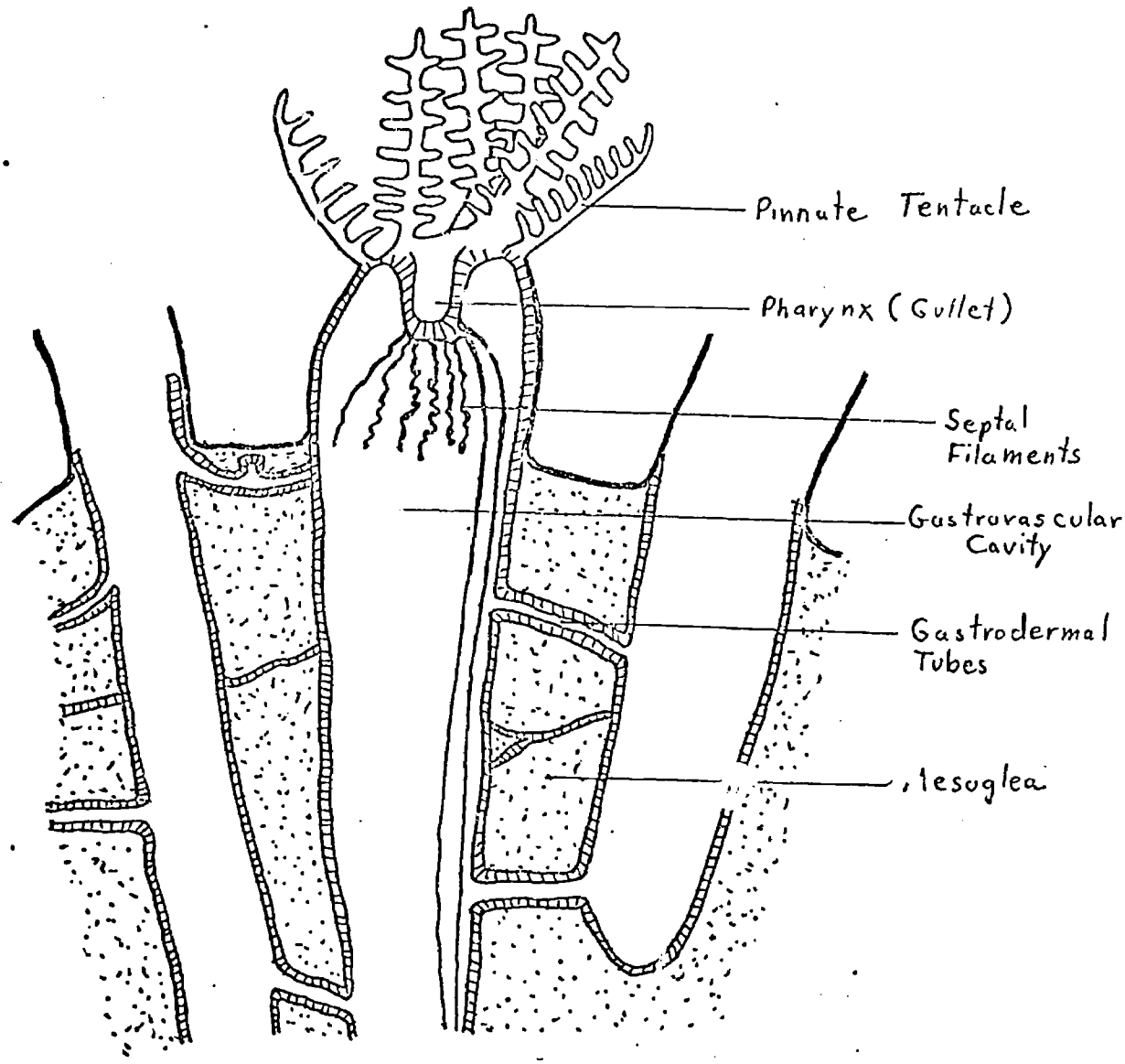
CROSS SECTION THROUGH GULLET



CROSS SECTION BELOW GULLET

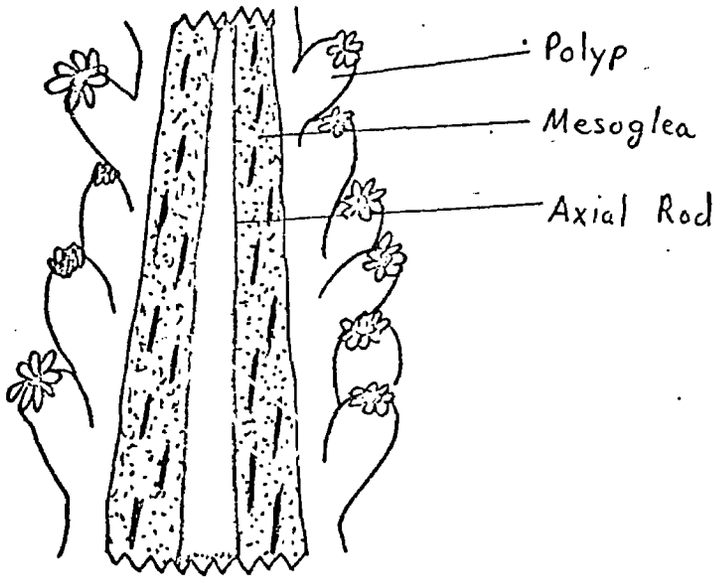


Section through a Colony of Soft Coral

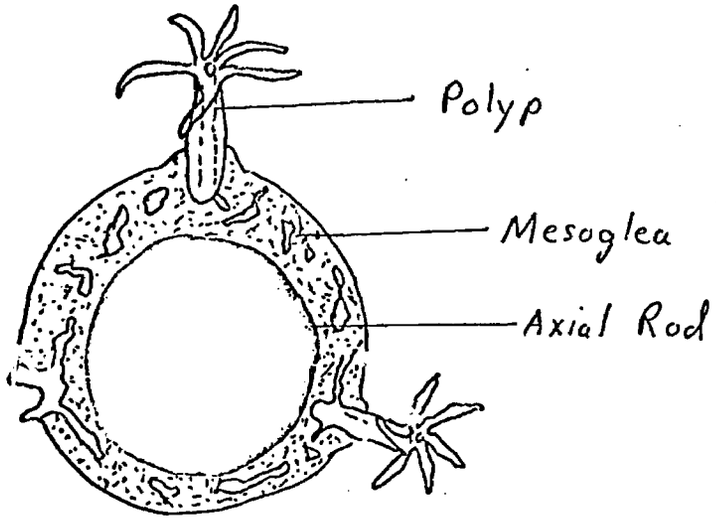


Taken From
Borradaile, Eastham,
Potts and Saunders

Sections of a Horny Coral



A. Longitudinal Section

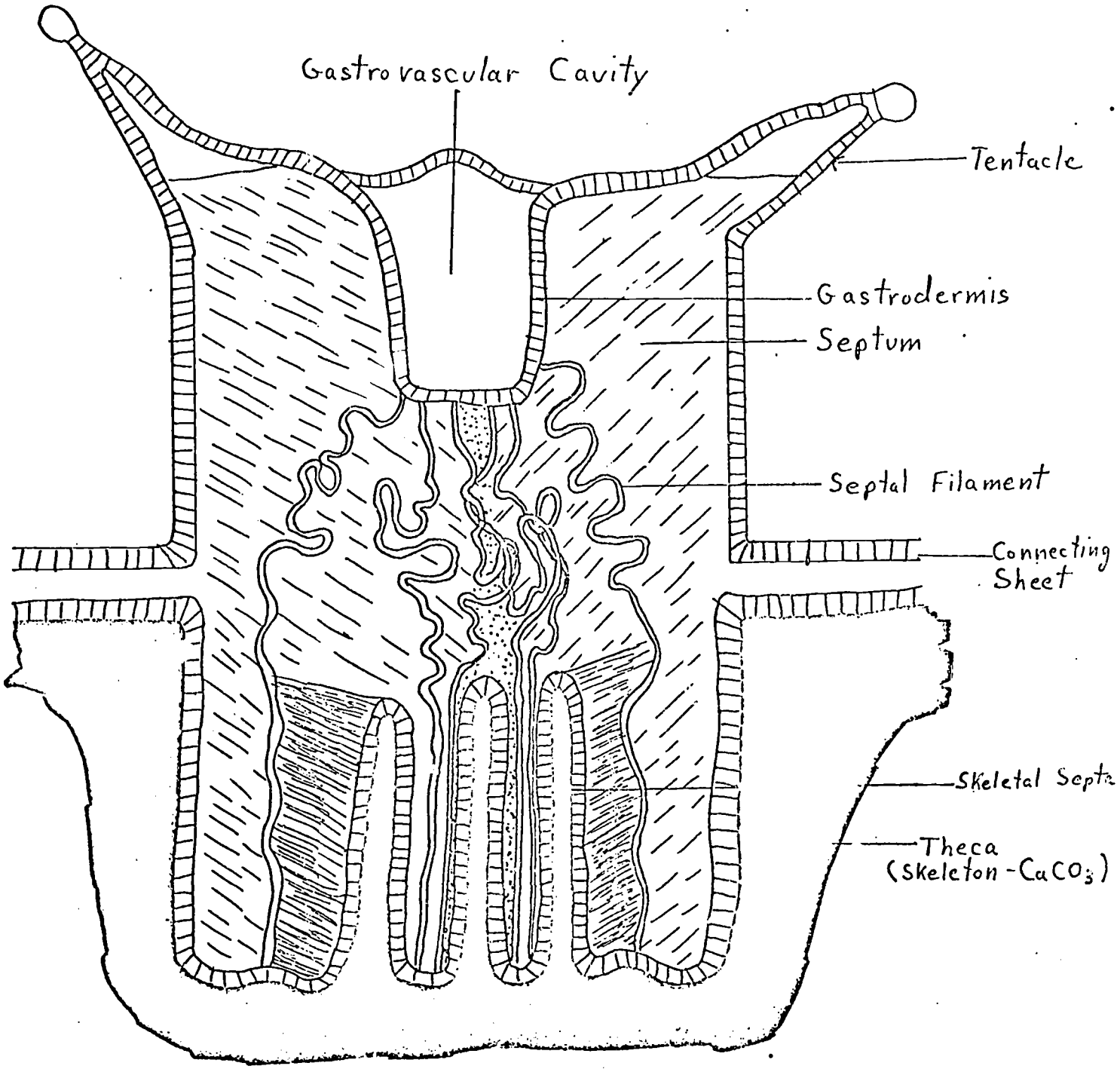


B. Transverse Section

B. Taken From
Borradaile, Eastham, Potts and Saunders (1961) pp. 17

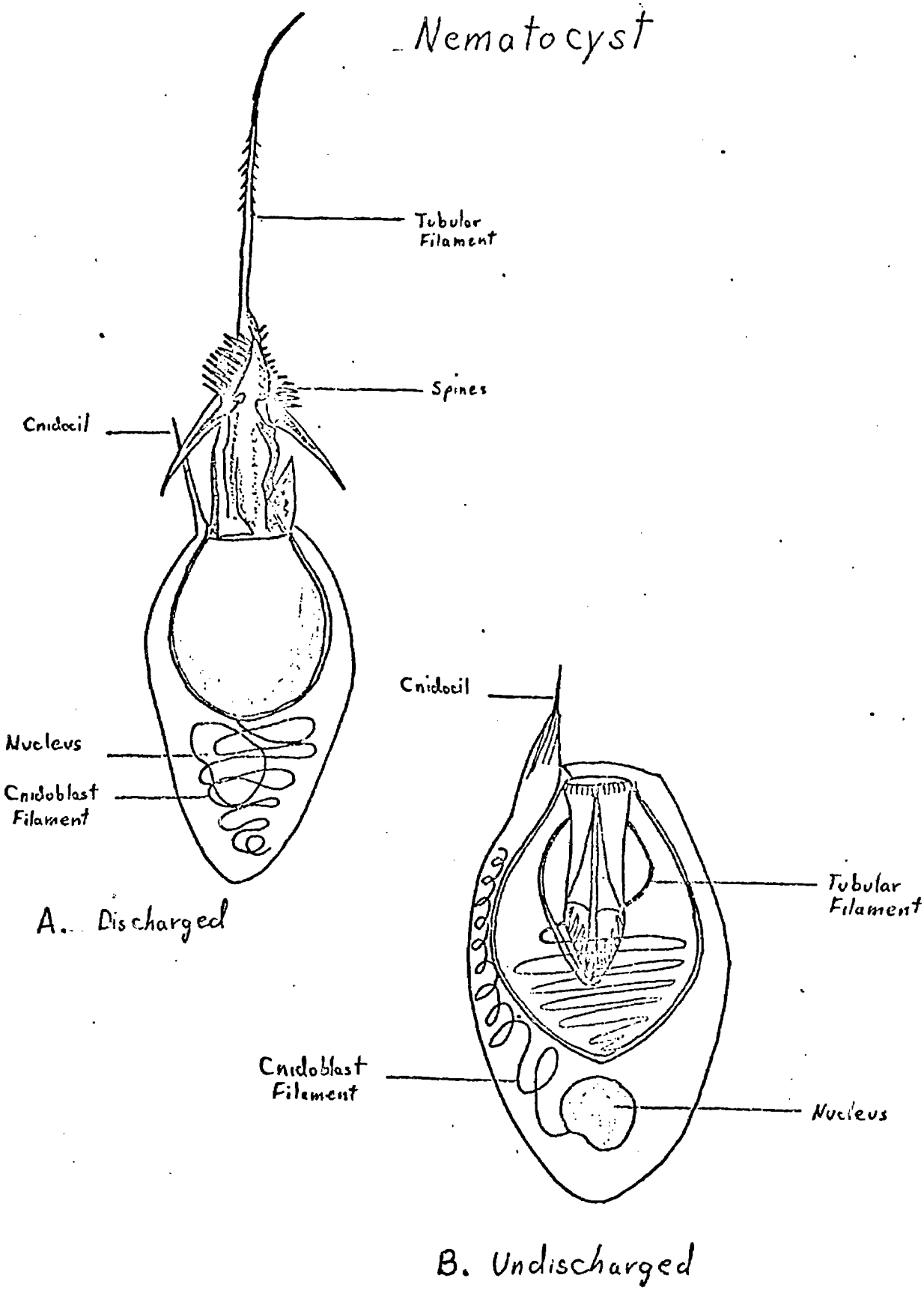
Coral Polyp in its Theca

Longitudinal Section



Taken From Barnes (1963) pg. 8.

Nematocyst


Tubular Filament
Spines
Cnidocil
Nucleus
Cnidoblast Filament
A. Discharged
Cnidocil
Tubular Filament
Cnidoblast Filament
Nucleus
B. Undischarged

Phylum Ctenophora(comb bearing)--Comb Jellies---80 species

A. Morphological Characteristics

1. Biradial Symmetry.

2. Three germ layers with much mesoglea.

3. Two tentacles.

4. Eight ciliated bands of fused cilia(Comb rows)

5. No nematocysts(one rare exception)

6. The gut has one opening(Gastrovascular Cavity)

7. Possesses colloblasts or adhesive cells.

B. Habitat and Life History Characteristics

1. All marine(Usually in coastal waters)

2. Carnivorous, feed on small planktonic animals.

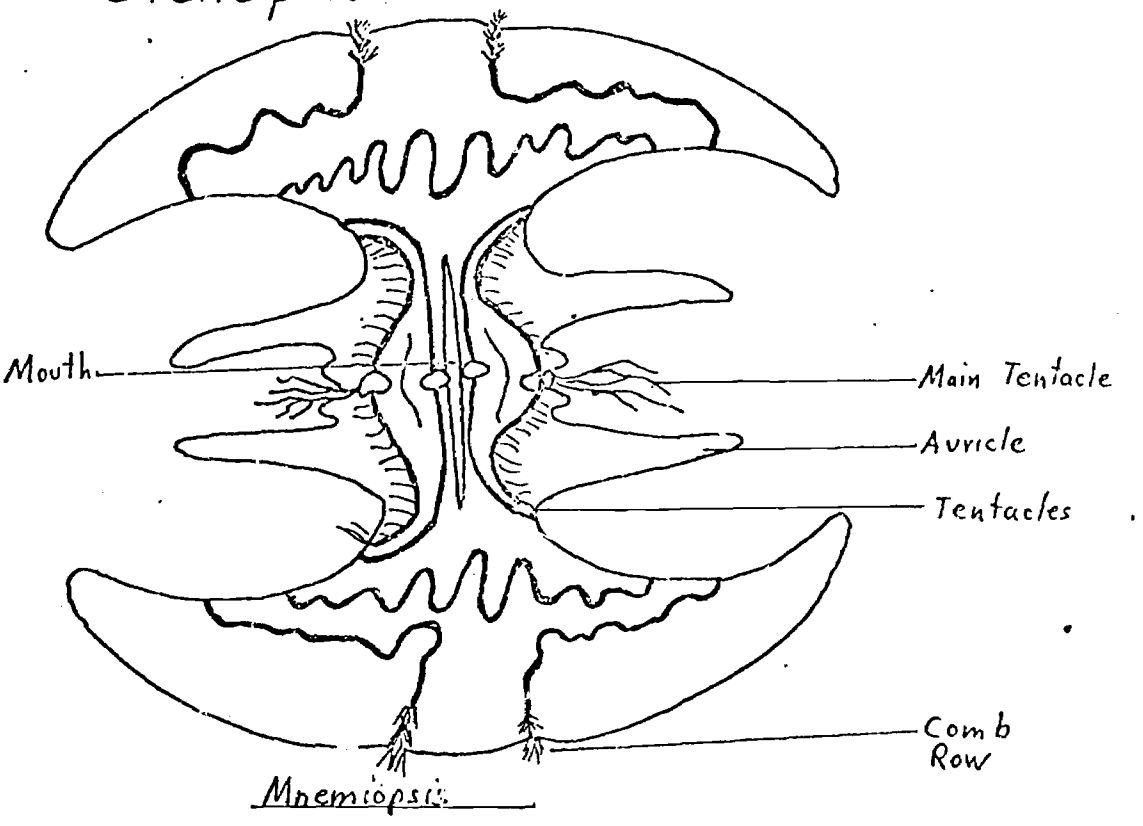
3. Most are luminescent.

4. Feeble swimmers.

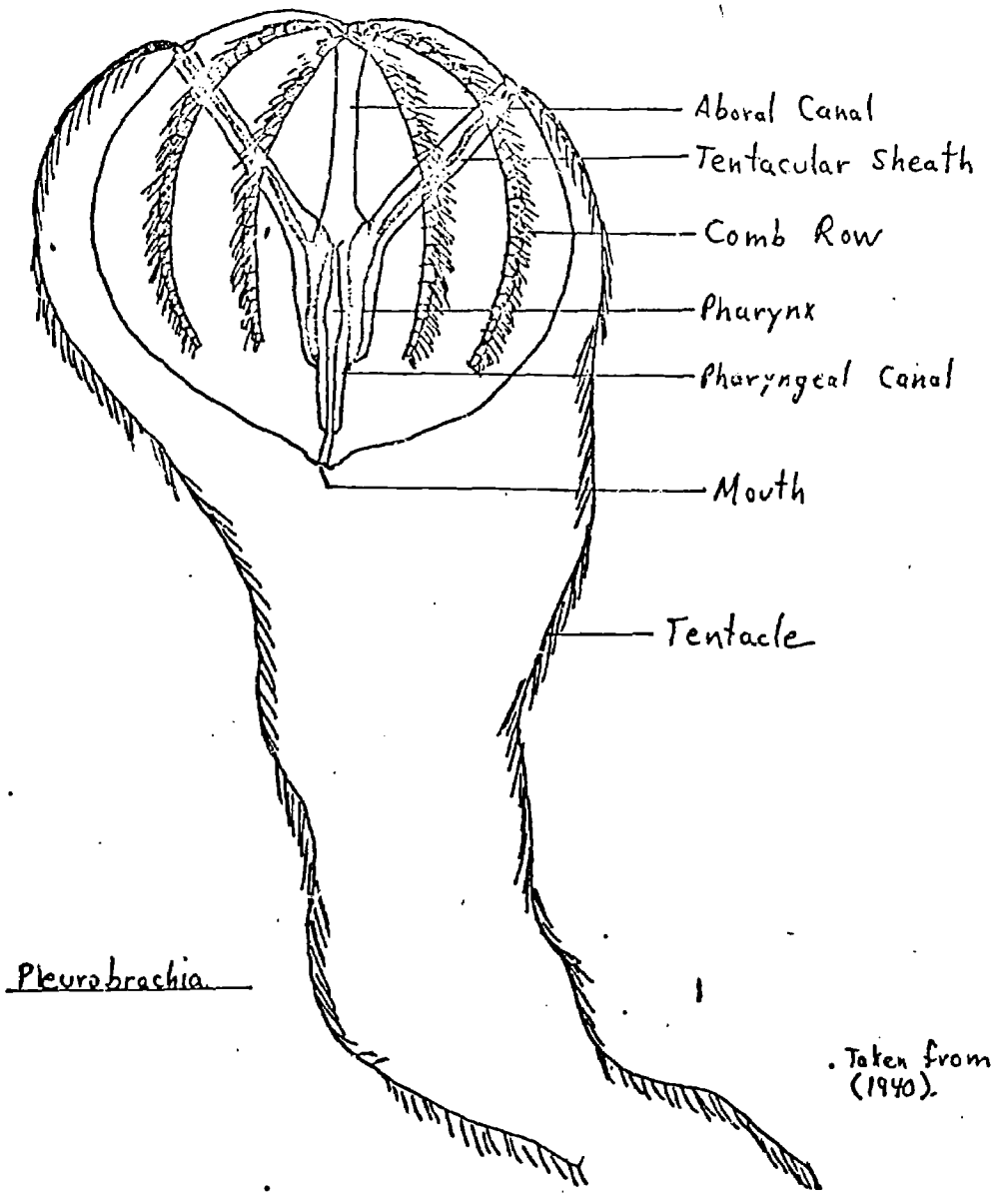
5. Moneocious

Notes:

Ctenophora



Mnemiopsis



Pleurobrachia

Taken from Hyman (1940).

Phylum Annelida(Ringed worms)---Segmented Worms

A. Phylum Characteristics
   1. Bilateral symmetry.
   2. Body elongated.
   3. Body divided into segments.
      a. The body is composed of body divisions which are arranged in a linear antero-posterior axis.
      b. Condition is called metamerism.
      c. Condition exists internally as well as externally.
   4. Digestive system is complete.
   5. Circulatory system is closed.
   6. Complex nervous system with a ventral nerve cord and some cephalization.

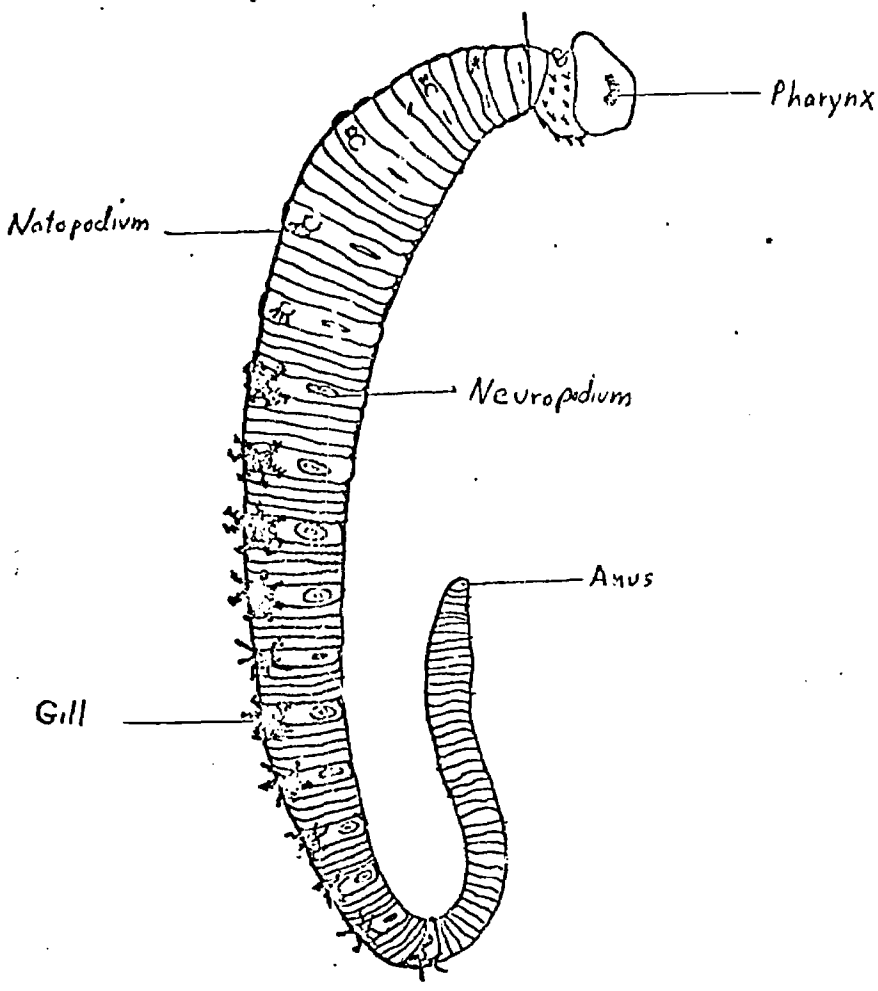
B. Class Polychaeta(Many bristles)---4,000 species
   1. Class Characteristics
      a. Well defined head region(cephalization)
      b. Possess lateral appendages called parapodia on most segments.
      c. Sexes are separate without permanent gonads.
   2. Miscellaneous Information
      a. Most primitive class.
      b. Most are marine.
      c. Vary from 2 mm to 3 meters in length.
      d. Many are brightly colored ;some iridescent.
      e. Most polychaetes are secretive.
      f. Can become adapted to low salinities.
   3. Classification
      a. Subclass Errantia
         aa. Many similar segments.
         bb. Possess head appendages.
         cc. Swimming, crawling, burrowing and tube building forms.
         dd. Active worms.
      b. Subclass Sedentaria
         aa. Body is regionally differentiated.
         bb. Parapodia reduced.
         cc. Head region is highly modified for feeding.
         dd. Usually tube dwellers, tube is fixed to something.
   4. Epitoky
      a. A reproductive phenomenon characteristic of some errant polychaetes in which a nonsexual form(atoke) becomes a sexual form(Epitoke).
         aa. Head region changes.
         bb. Parapodia changes.
         cc. Gonads develop.
      b. Swarming
         aa. Swim to the surface.
         bb. Shed eggs and sperm.
         cc. Very distinct periodicity which often coincides with lunar periods.
      c. West Indian example---Atlantic Palolo(Eunice schemacephala) July; first or last quarter of a lunar cycle; 3 to 4AM in the morning.

C. Oligochaeta(Few bristles)---2,700 species
   1. Poorly developed head.
   2. Few setae.
   3. No lateral appendages.
   4. Very few marine species.

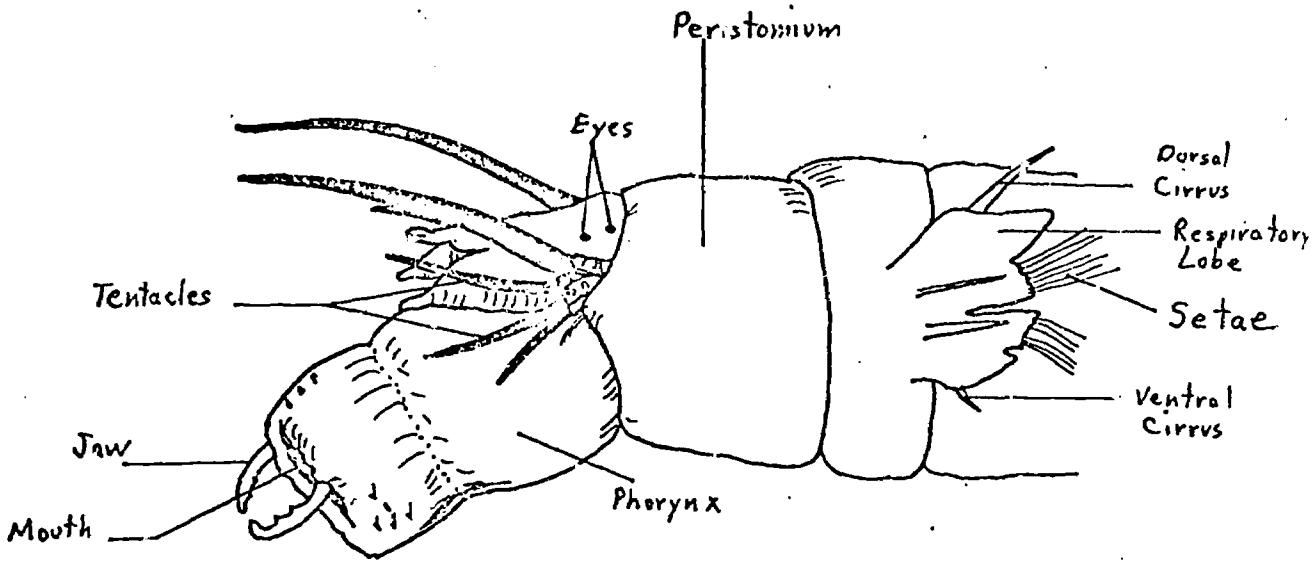
D. Class Hirudinea---Leeches
   1. No setae.
   2. Possesses suckers.
   3. Segments hard to see.
   4. No tentacles or parapodia.
   5. Few marine species.

Notes:

Polychaeta

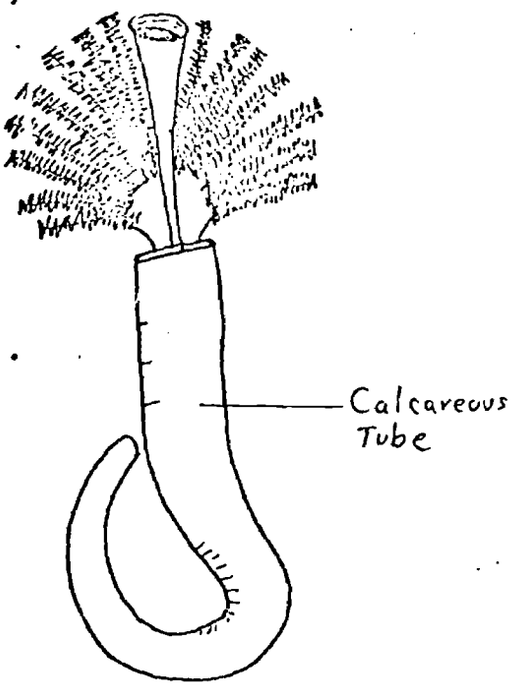


A. Lugworm

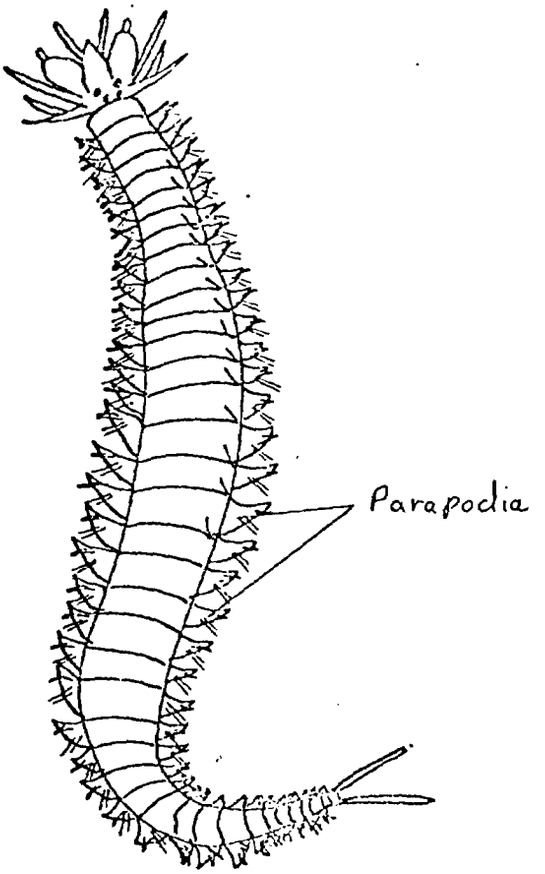


B. Clamworm head
Pharynx extended.

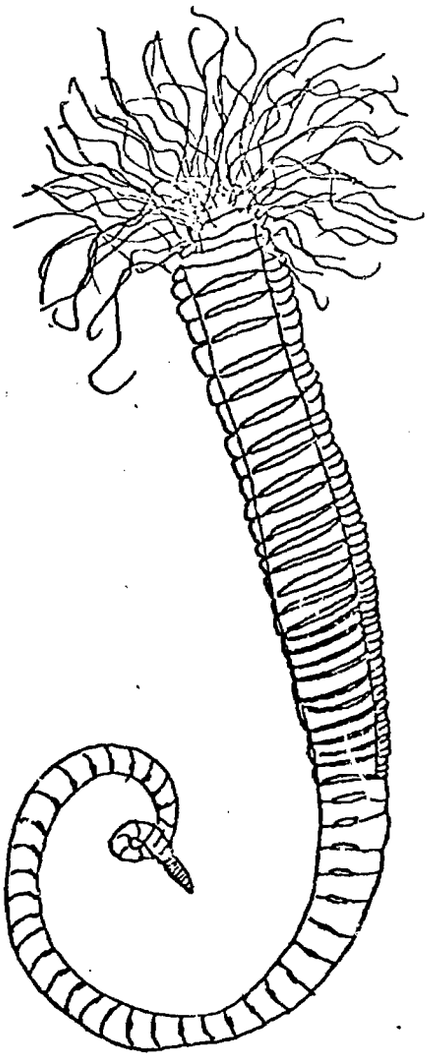
Polychaeta



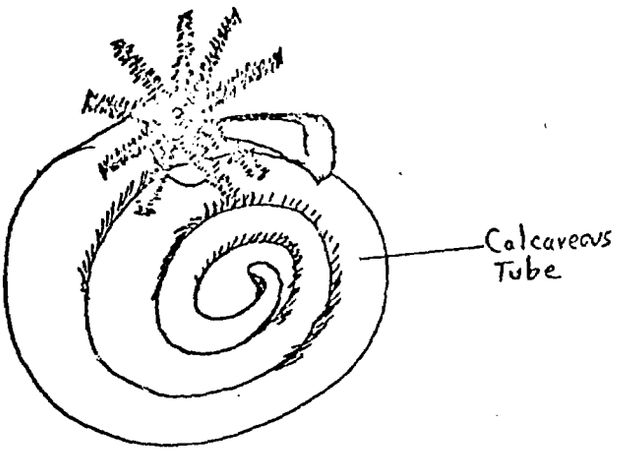
A. Feather Duster Worm



B. Nereis type
Clamworm



C. Mop-Headed Worm



Coiled Worm (Spirorbis)

Miscellaneous Worm-Like Phyla

Phylum Nemertinea(Sea Nymph)---Ribbon Worms: 550 species
- A. Phylum Characteristics
  1. Unsegmented.
  2. Ribbon shaped.
  3. Complete digestive system.
  4. Posseses a proboscis.
  5. Many have eyes.
- B. Miscellaneous Information
  1. One species is said to be 80 feet long.
  2. Feed on other animals living and dead.
  3. Most are marine.

Phylum Aschelmenthes
- A. Class Nematoda---Roundworms: at least 20,000 species.
  1. Unsegmented.
  2. Cylindrical and slender; ends usually pointed.
  3. No large appendages.
  4. Longitudinal muscles only.
  5. Complete digestive system.
  6. Found in all habitats, many are serious parasitic pests to plants and animals.

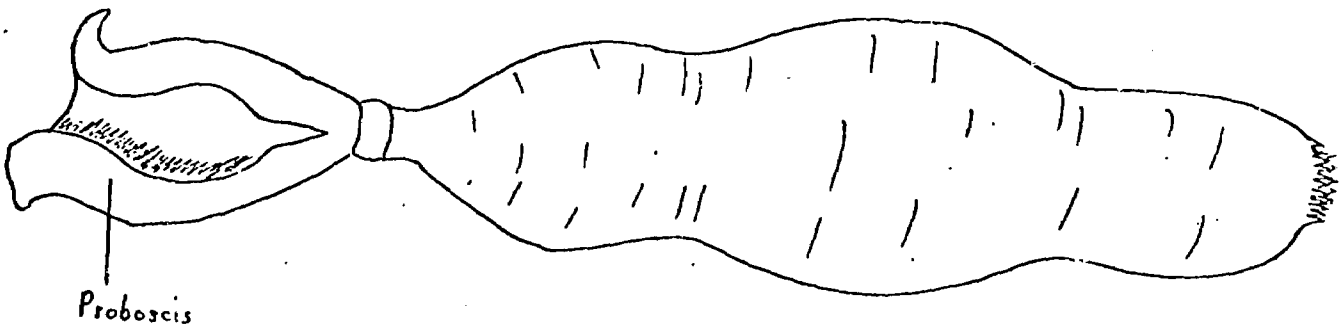
Phylum Sipunculoidea(Little pipe)---Peanut worms: 250 species.
- A. Phylum Characteristics
  1. Unsegmented.
  2. Cylindrical, blunt posteriorly.
  3. Retractile front end which bears the mouth.
  4. Mouth surrounded by tentacles.
- B. Miscellaneous Information
  1. 1/10 inch to 24 inches long.
  2. All marine.
  3. Burrow in mud and sand.
  4. Yellowish or grayish in color.

Phylum Echiuroidea(Adder worm)---Spoon worm: 60 species
- A. Phylum Characteristics
  1. Unsegmented.
  2. Sausage-shaped.
  3. Anterior proboscis spatulate or thread-like, cannot be completely withdrawn.
- B. Miscellaneous Information
  1. One inch to 18 inches long.
  2. All marine.
  3. Burrows in the mud or sand, or in rock or coral crevices.
  4. Color usually drab.

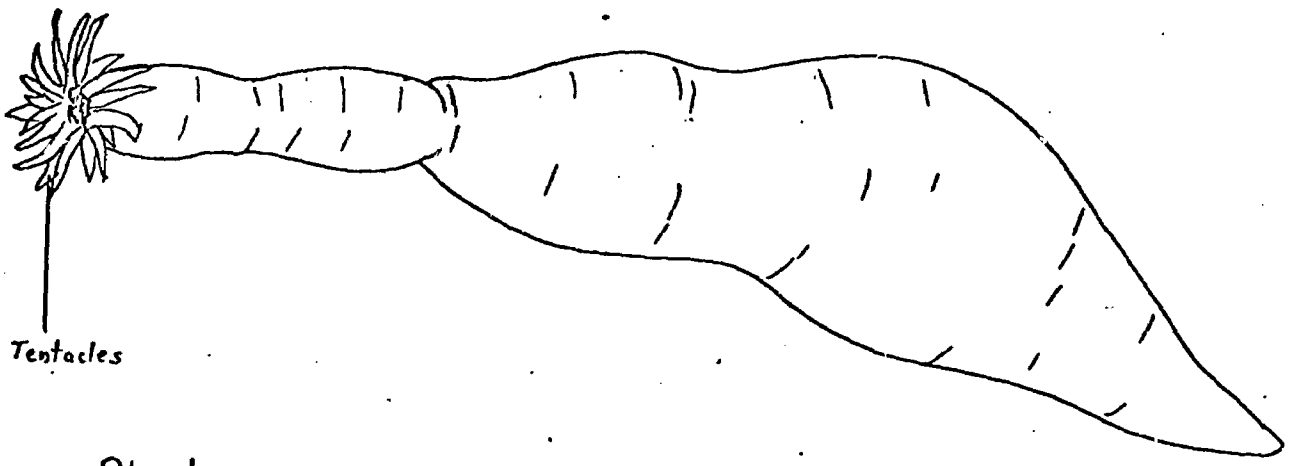
Phylum Hemichordata(Half string)---Acorn Worms: 100 species
- A. Phylum Characteristics
  1. 3 body divisions(Proboscis, collar and trunk).
  2. Gill slits.
  3. Complete digestive system.

B. Miscellaneous Information
   1. 4 to 24 inches long.
   2. All marine.
   3. Burrow in mud and sand or live under stones and shells.
   4. Have coiled castings at exits of U-shaped burrows.

Notes:

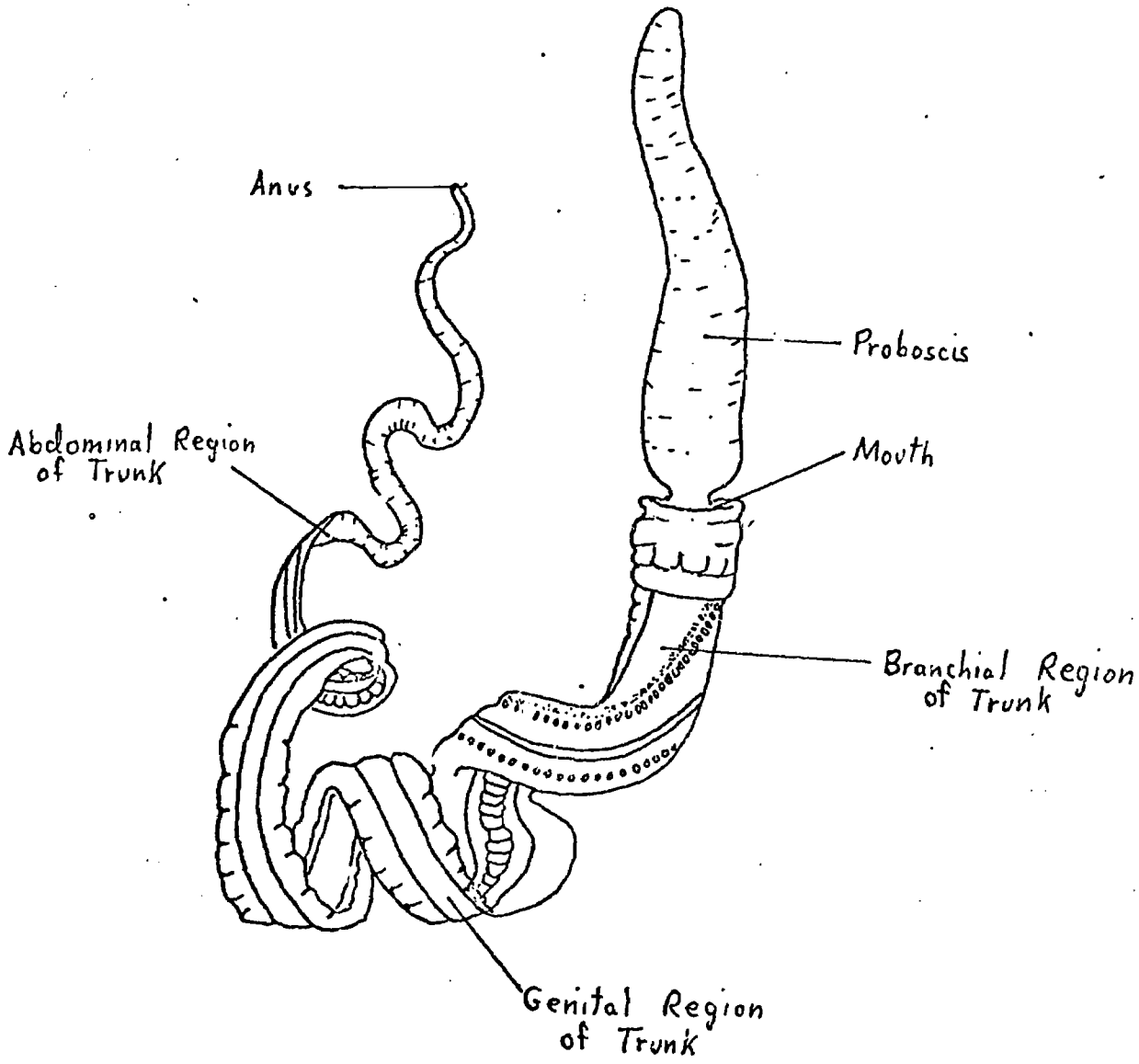


Phylum Echiuroidea Spoon Worm



Phylum Sipunculoidea Peanut Worm

Phylum Hemichordata



Phylum Echinodermata(Spiny skin)---5,300 species

A. Phylum Characteristics
1. Radial symmetry, usually 5-parted.
2. Three body layers(A true coelom)
3. Body covered by an epidermis over a mesodermal skeleton often with spines.
4. Complete digestive system in most classes.
5. Many possess a water-vascular system.
6. Many have tube feet.
7. Dioecious usually; reproduction is usually sexual. Some species can reproduce by self-division and many regenerate lost parts readily.
8. All are marine.
9. Generally carnivorous.

B. Class Asteriodea---Starfish: 1500 species
1. Body flattened, star-shaped or pentagonal.
2. Arms not sharply set off from the central disc.
3. Spines usually short.
4. Two to four rows of tube feet.
5. Has an open ambulacral groove.
6. Has a madriporite.
7. Has pedicellaria.
8. Usually has a complete digestive system.

C. Class Ophiuroidea---Brittle Stars and Basket Stars; 1900 species
1. Body flattened.
2. 5 arms are sharply set off from the central disc.
3. Spines usually short.
4. No suckers on the tube feet.
5. Closed ambulacral groove.
6. Has a madreporite.
7. No pedicellaria.
8. Has an incomplete digestive system; no anus.

D. Class Echinoidea---Sea Urchins, Sand Dollars, Sea Biscuits 860 species
1. Body globular or disc like.
2. Skeleton rigid.
3. Slender tube feet with suckers.
4. Spines short to very long and movable.
5. Possesses pedicellaria.
6. Mouth has sharp teeth; Aristotle's lantern.

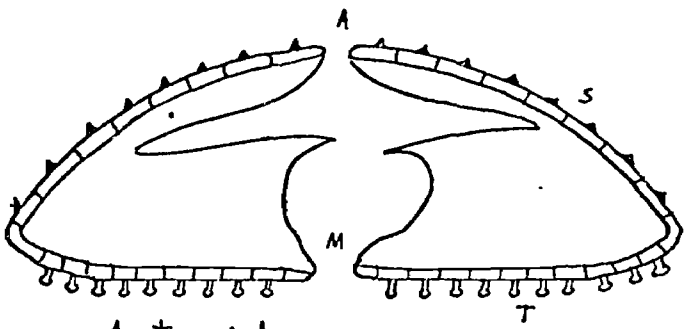
E. Class Holothurioidea---Sea Cucumers: 1100 species
1. Body long, sausage-shaped.
2. Skeleton is usually composed of microscopic plates.
3. No arms.
4. No rigid spines.
5. No pedicellaria.
6. Mouth ringed by retractile tentacles.
7. Cloaca usually with a respiratory tree.
8. Possesses tube feet with suckers.
9. Food is organic material from bottom debris or plankton.

F. Class Crinoidea---Feather Stars and Sea Lilies: 620 species
   1. Body is a small cup-shaped calyx.
   2. 5 arms can be branched.
   3. Arms have lateral appendages called pinnules.
   4. Some are stalked and sessile(sea lilies).
   5. No madreporite.
   6. Open ambulacral groove lined with cilia and tube feet.
   7. Food is microscopic plankton, small crustaceans and detritus caught by the tentacles.

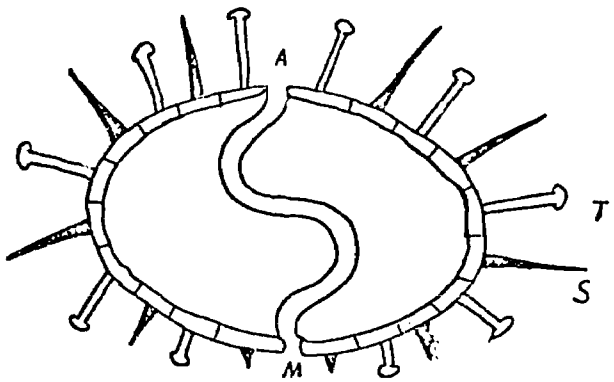
Notes:

Five Living Classes of Echinodermata

Diagrammatic Sections Showing Body Forms

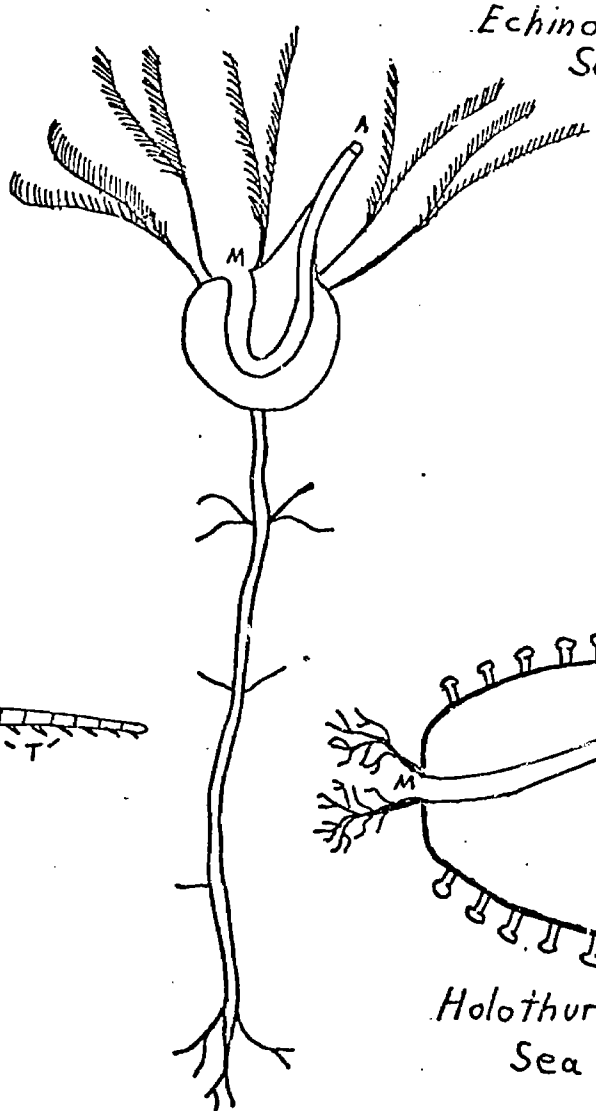


Asteroidea
Starfish



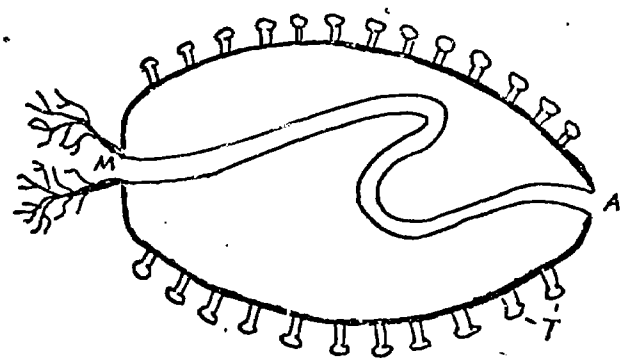
Echinoidea
Sea Urchin

A = Anus
M = Mouth
T = Tube Feet
S = Spines



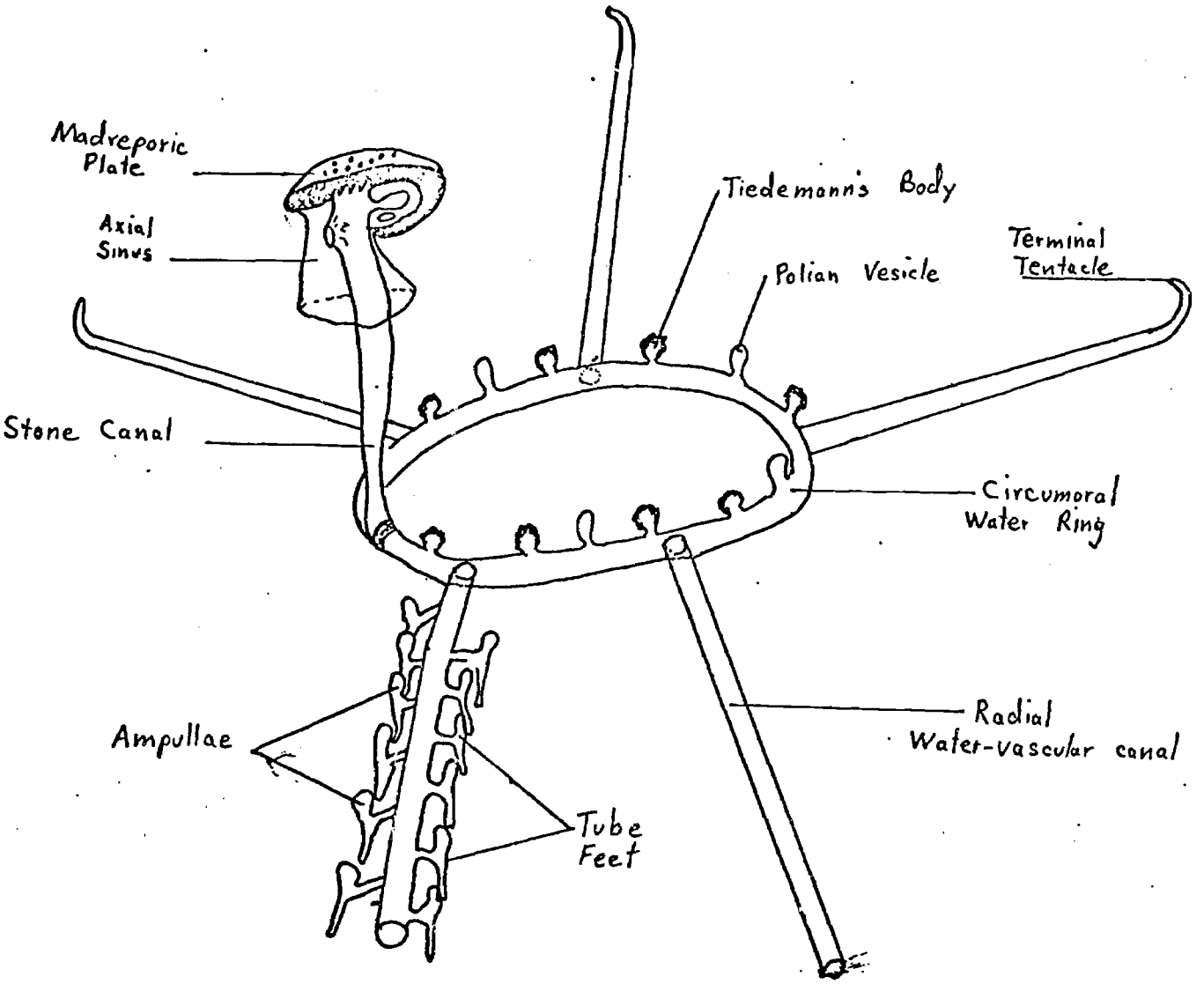
Crinoidea
Sea Lily

Ophiuroidea
Brittle Star



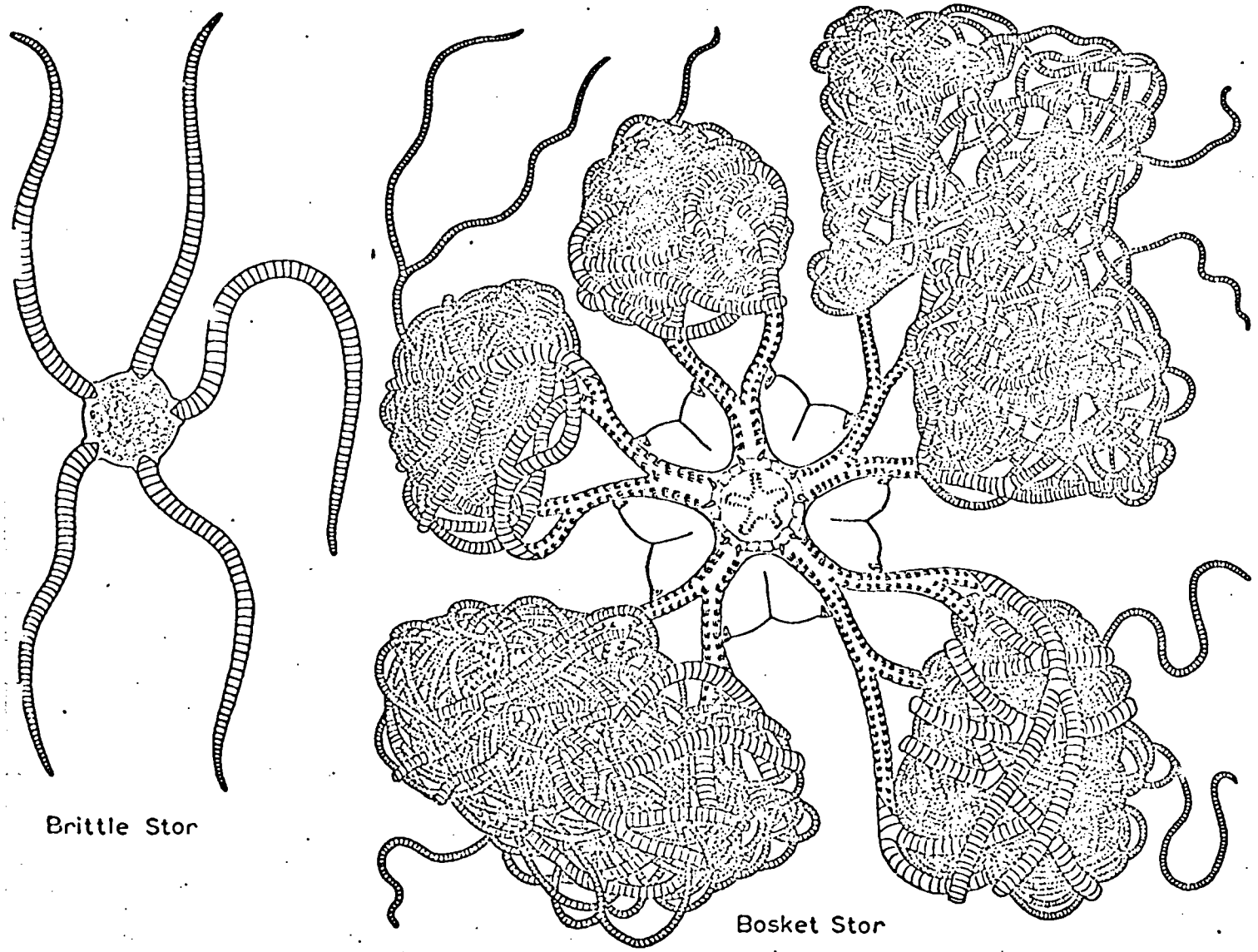
Holothurioidea
Sea Cucumber

Diagrammatic Representation Of The Asteroid Water-Vascular System
Drawn as though the walls of the vessels are transparent.
Tube feet are drawn on one arm only.



Modified from a diagram in "Physiology of Echinodermata". Ed. Richard Boolootian 1966 pg. 221

BRITTLE STARS-BASKET STARS

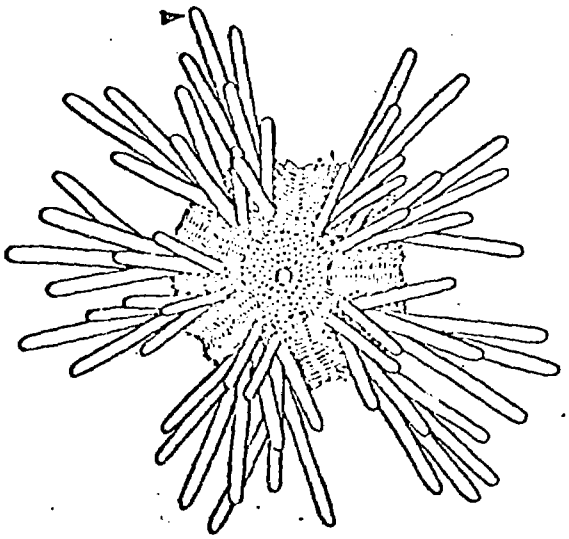


Brittle Stor

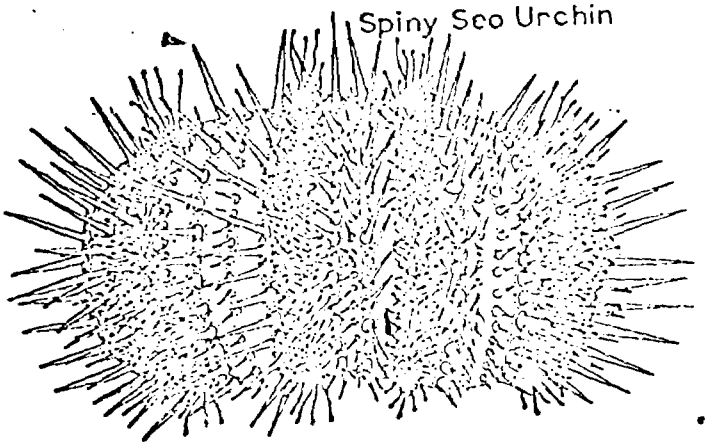
Bosket Stor

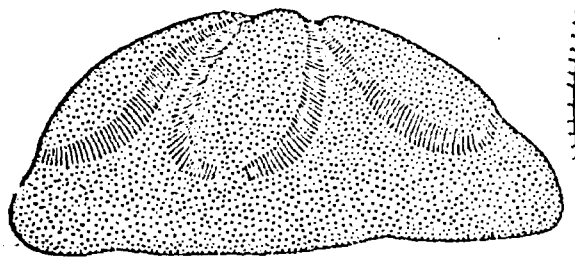
SEA URCHINS-SEA BISCUITS-SAND DOLLARS

Clubbed Sea Urchin

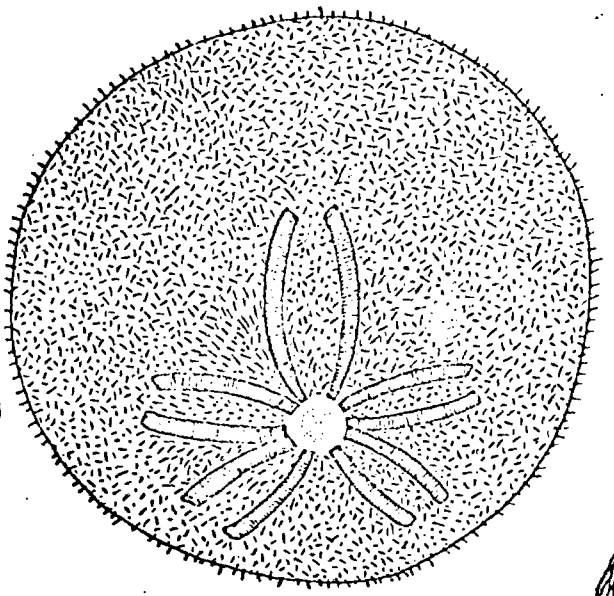


Spiny Sea Urchin

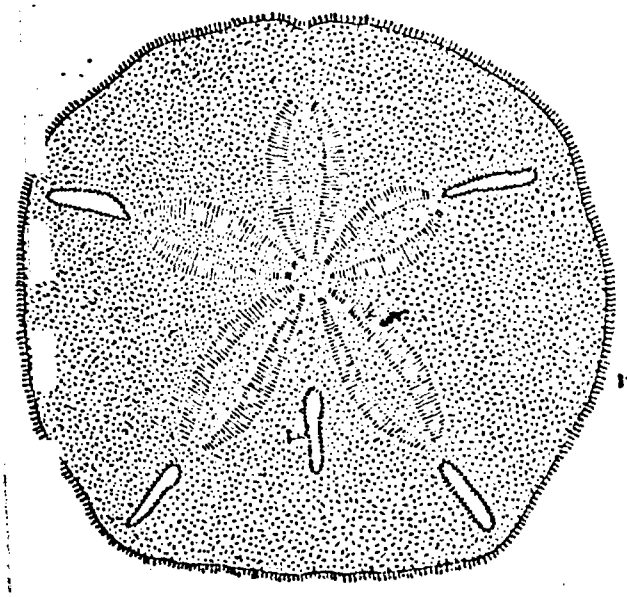




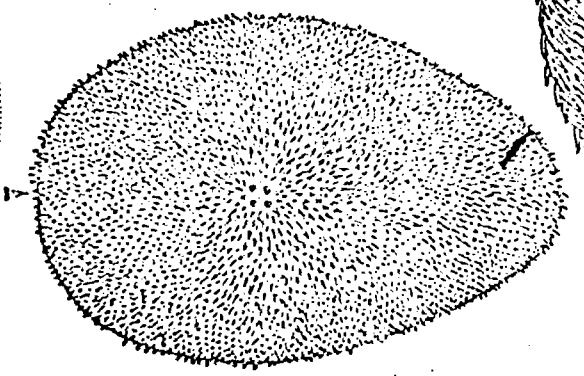
Sea Biscuit



Sand Dollar



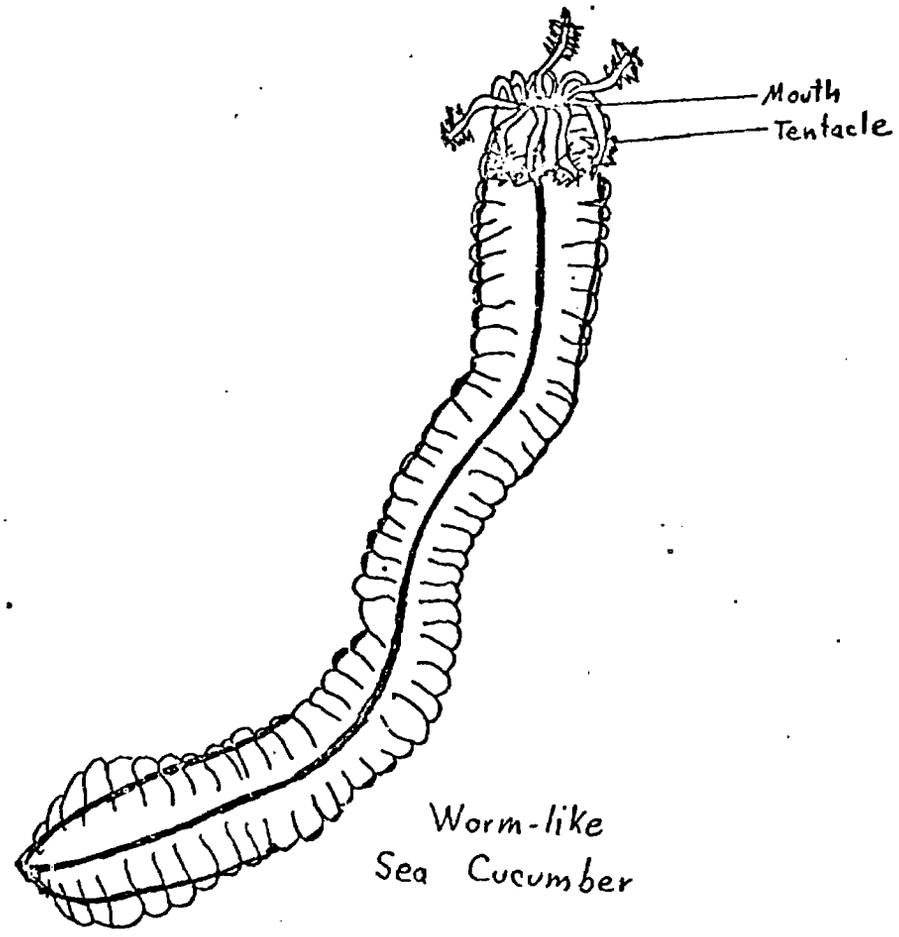
Keyhole Urchin



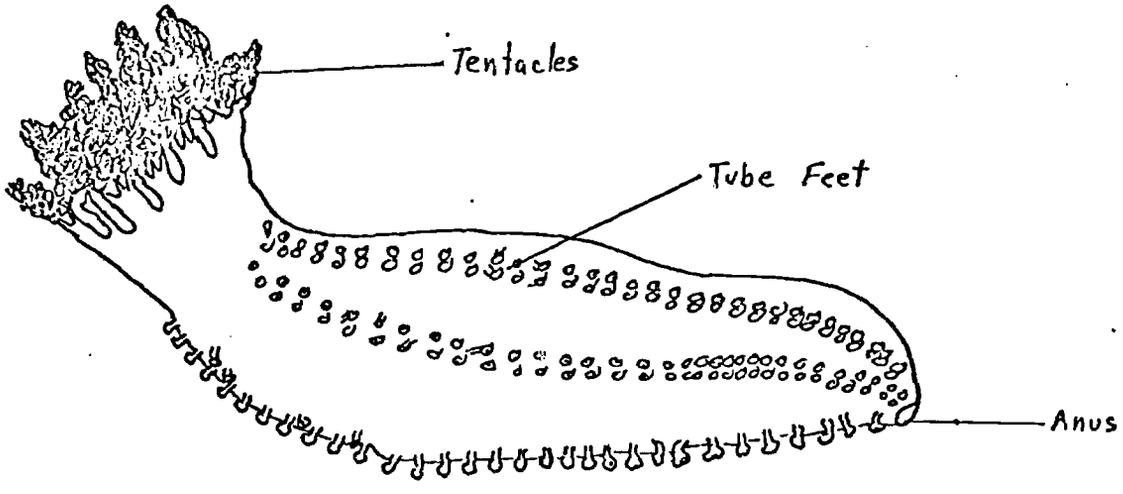
Pear Urchin

Heart Urchin

Sea Cucumbers

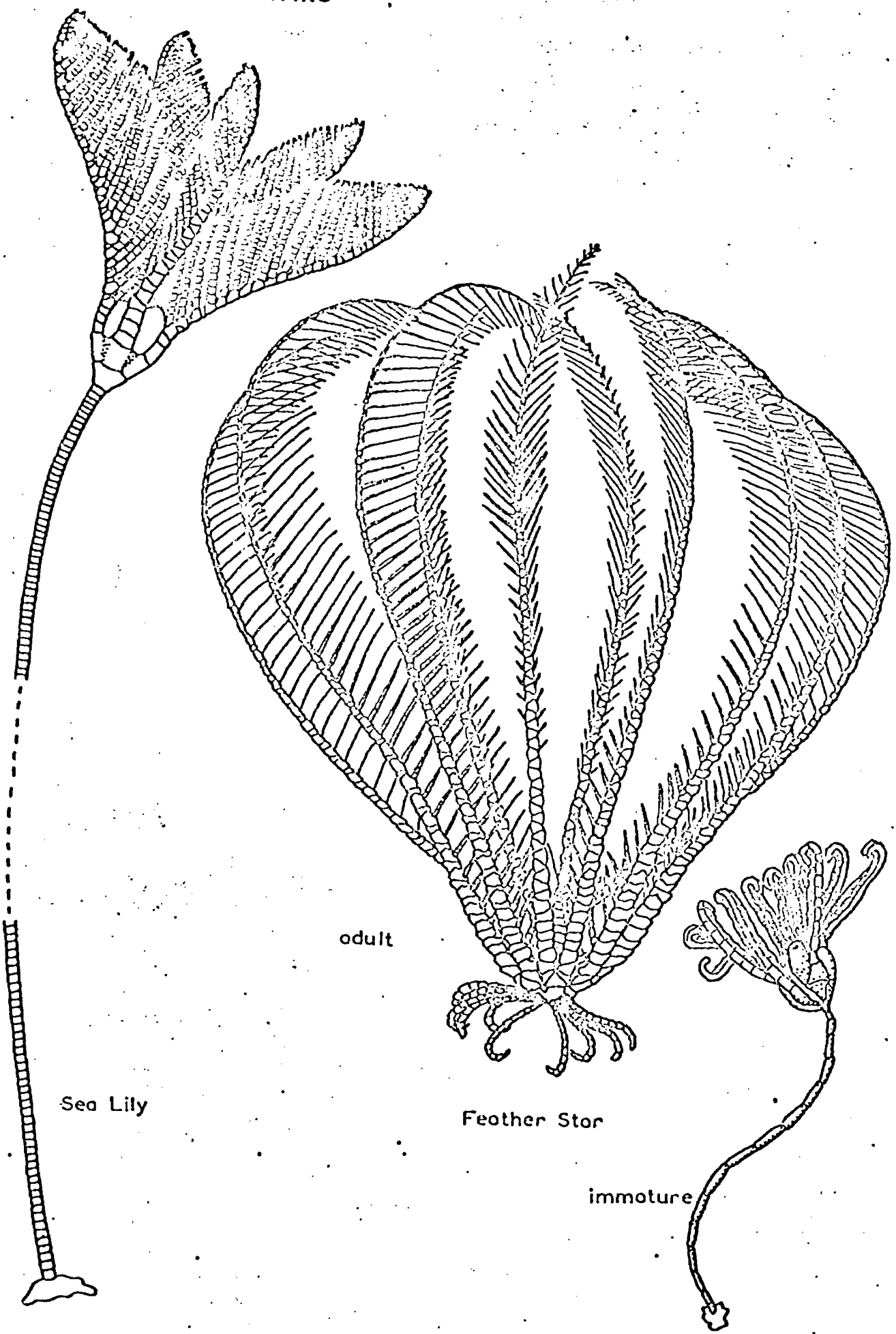


Worm-like
Sea Cucumber



Tree-tentacled Sea Cucumber

Taken from
Richard Pimental
1967. pg 135


adult
Sea Lily
Feather Star
immature

Phylum Mollusca

A. Phylum Characteristics
   1. Bilateral symmetry.
   2. Soft body surrounded by a mantly which usually secretes a limy shell of 1, 2 or 8 parts.
   3. Head region developed in some classes.
   4. Mouth has a radula bearing minute chitinous teeth (Except Pelecypoda)
   5. Many have a ventral muscular foot.

B. Class Amphineura---Chitons: 600 species
   1. Class Characteristics
      a. Possesses 8 dorsal plates(shells) or none.
      b. Body elliptical.
      c. Foot large and flat.
      d. Head small; no eyes; no tentacles.
      e. 6 to 80 gills in the pallial groove.
   2. Miscellaneous Information
      a. One to 12 inches long.
      b. All marine.
      c. Usually found on racky shores.
      d. Most feed on algae.
      e. All are dioecious.

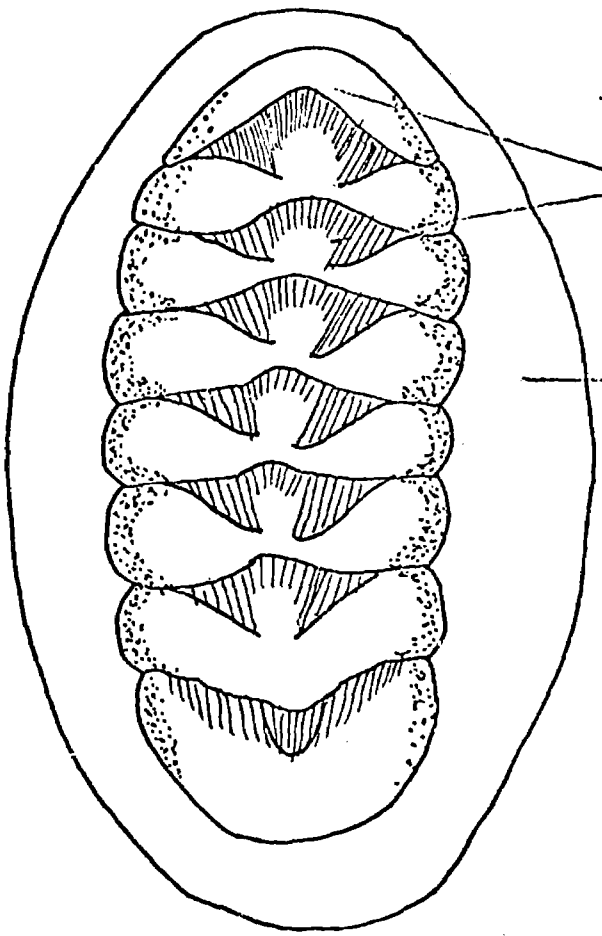
C. Class Gastropoda(Belly-foot)---Snails: 100,000 species
   1. Class Characteristics
      a. Most possess a single coiled shell(May be uncoiled, reduced, absent, internal or external).
      b. Head distinct usually with eyes and tentacles.
      c. Foot large and flat.
      d. Possesses gills and/or a pulmonate cavity.
   2. Miscellaneous Information
      a. 1/25 inch to 24 inches long.
      b. Marine, fresh-water or terrestrial.
      c. Free living, sessile, some are parasitic.
      d. Omnivorous, carnivorous, herbivorous, scavengers, or ciliary feeders.
      e. Monoecious or dioecious.
      f. Further classification of the Gastropoda is based solely on internal anatomy which is not practical to use in the field.

D. Class Pelecypoda(Hatchet-foot)---Bivalves: 30,000 species
   1. Class Characteristics
      a. Shell is in two parts.
      b. Laterally compressed.
      c. No head.
      d. Foot is wedge-shaped.
   2. Miscellaneous Information
      a. 1/10 inch to 48 inches(500 lbs.)
      b. Marine and fresh-water.
      c. Most are ciliary feeders; a few feed on bottom debris.

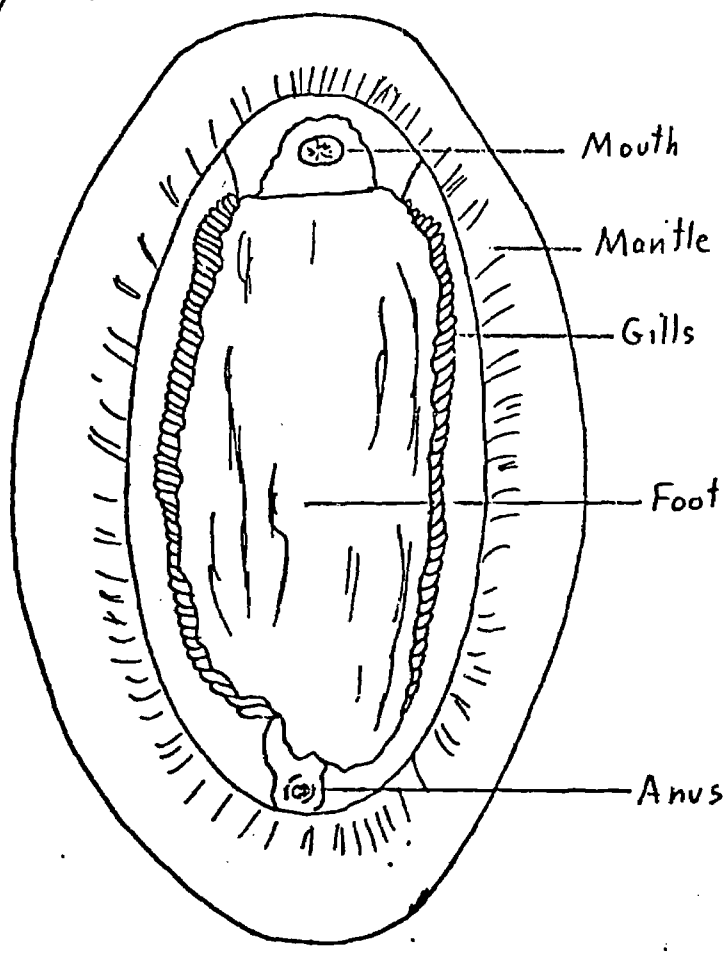
E. Class Cephalopoda(Head-foot)---Octopus, Squid: 1,000 species
   1. Class Characteristics
      a. One shell or none; the shell can be internal or external, flat or coiled.
      b. Head is well developed with conspicuous eyes.
      c. Tentacles and arms with suckers surround the mouth.
      d. Mouth possesses a horny beak and a radula.
      e. Mantle surrounds the body organs.
   2. Miscellaneous Information
      a. $\frac{1}{2}$ inch to 100+ feet long.
      b. All marine.
      c. Most are free-swimming.
      d. All are predaceous carnivores.
      e. May be the most intelligent of the invertebrates.

Notes:

Class Amphineura (Chiton)

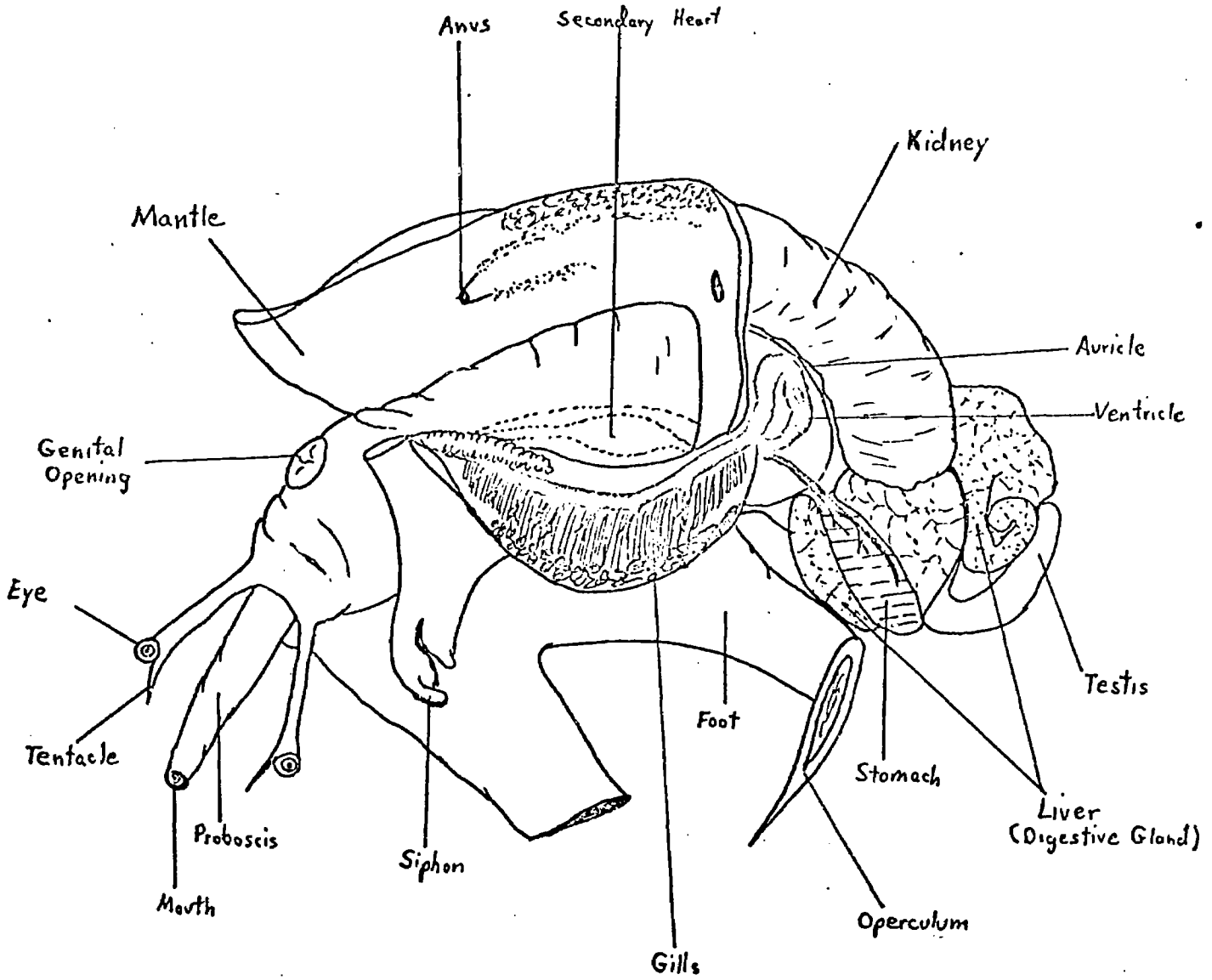


A. Dorsal View



B. Ventral View

Anatomy of a Queen Conch



Modified from Busycon diagram

Phylum Arthropoda(Joint-footed)---1,000,000 species

A. Phylum Characteristics
   1. Body frequently divided into segments; head, thorax and abdomen; may be fused in some groups.
   2. Hardened exoskeleton containing chitin; must molt periodically.
   3. Jointed appendages.
   4. Open circulatory system.

B. Class Merostomata---Horseshoe Crab: 5 species
   1. Class Characteristics
      a. Six pair of appendages on the cephalothorax.
      b. Horseshoe shaped carapace.
      c. Bayonet-like telson.
      d. Five pair of exposed book gills.
   2. Miscellaneous Information
      a. Carapace reaches a length of 2 feet.
      b. All marine.
      c. Most are found in shallow areas.
      d. Scavengers, feed on small invertebrates, some feed on algae.
      e. One West Indian species(Xiphosura polyphemus)

C. Class Pycnogonida---Sea spiders: 500 species
   1. Class Characteristics
      a. 4-6 pair of legs(8 segments/ leg).
      b. Body is usually composed of distinct segments(4-5).
      c. Four dorsal eyes.
      d. Possesses chelicera and a proboscis.
   2. Miscellaneous Information
      a. 3 mm. to 500 mm.
      b. Exclusively marine bottom dwellers.
      c. Feed on hydroids, soft corals, anemones bryozoans and sponges.
      d. Abundance is directly proportional to the food supply.
      e. They move very slowly and are very hard to see.

D. Class Crustacea---30,000 species
   1. Class Characteristics
      a. Head is 5 fused segments.
      b. Two pair of antennae, one pair of jaws, two pair of maxilla.
      c. Body is usually covered with a dorsal carapace.
      d. Appendages are often biramous.
      e. Respiration by gills in most groups.

   2. Subclass Cirripedia---Barnacles: 800 species
      a. Adults sessile
      b. Attached in the head region by a secretion from a cement gland
      c. Carapace becomes a mantle around the body; this usually forms limy plates.

d. Thoracic appendages are slender and bristly; used for food gathering.
e. Abdomen vestigal.
f. Exclusively marine.
g. May be free-living or parasitic.
h. Many commensal on jellyfish, sharks, bony fish, whales, manatees, sea snakes, turtles and crabs. Many species are host specific.

3. Subclass Malacostraca
a. Body typically of 19 somites(5 head, 8 Thoracic and 6 abdominal).
b. Head fused with several thoracic somites; cephalothorax.

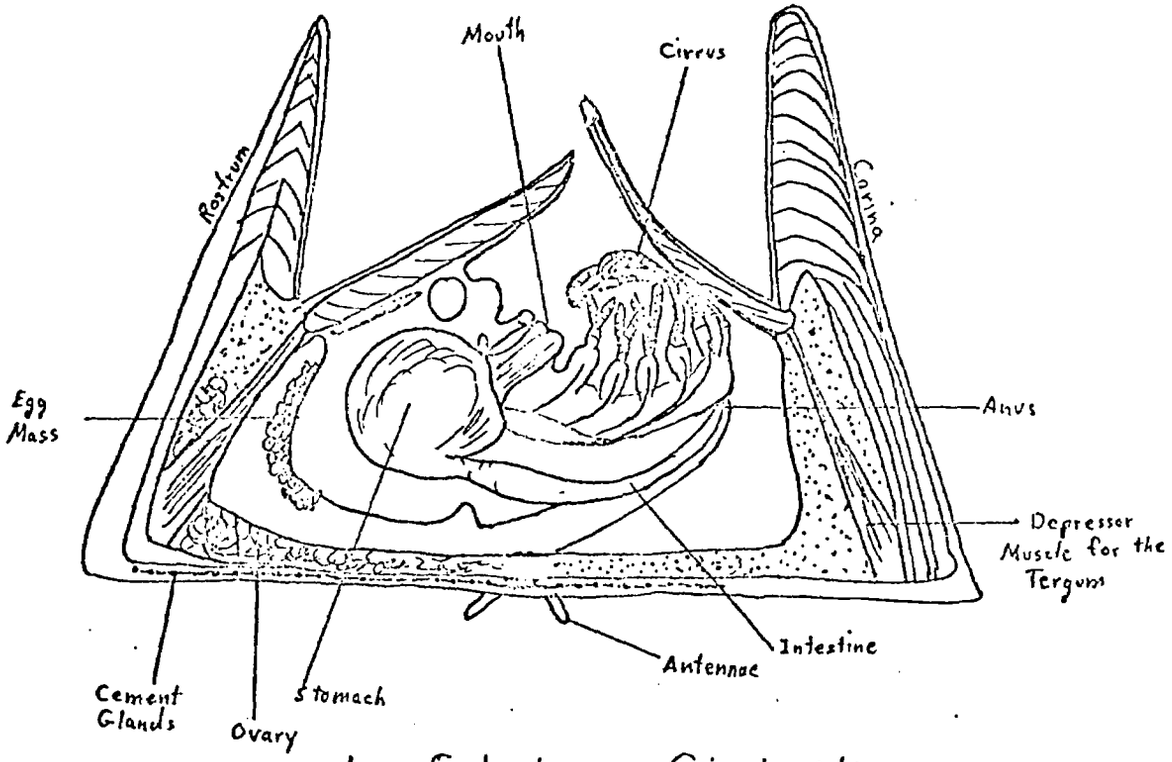
c. Order Isopoda---4,000 species
aa. Body flattened dorsoventrally.
bb. No carapace.
cc. Abdomen short.
dd. 1/5 inch to 14 inches.
ee. Marine, fresh-water or terrestrial.
ff. Free-living or parasitic.

d. Order Amphipoda---Scuds, beach hoppers
aa. Body flattened laterally.
bb. No carapace.
cc. Abdomen flexed ventrally.
dd. 1/10 inch to 4½ inches long.
ee. Marine, fresh-water or semi-terrestrial.
ff. Free-living or parasitic.

e. Order Stomatopoda---Mantis shrimp
aa. Body flattened dorsoventrally.
bb. Shield-like carapace.
cc. Eyes are large and stalked.
dd. Chelipeds look like the first legs of a preying mantis.
ee. 1½ inches to 12 inches long.
ff. All are marine, most are burrowers.
gg. Most are brilliantly colored.

f. Order Decapoda---Shrimp, crabs and lobsters: 8,500 species
aa. First three pairs of thoracic appendages are modified as maxillipeds.
bb. Five pairs of legs.
cc. First pair of legs are often chelate.
dd. Head and thorax are fused.
ee. 1/10 inch to 24 inches(body length) some have a cheliped span of 12 feet.
ff. Marine, fresh-water and terrestrial.
gg. Most are predacious and/or scavengers; a few are filter feeders.

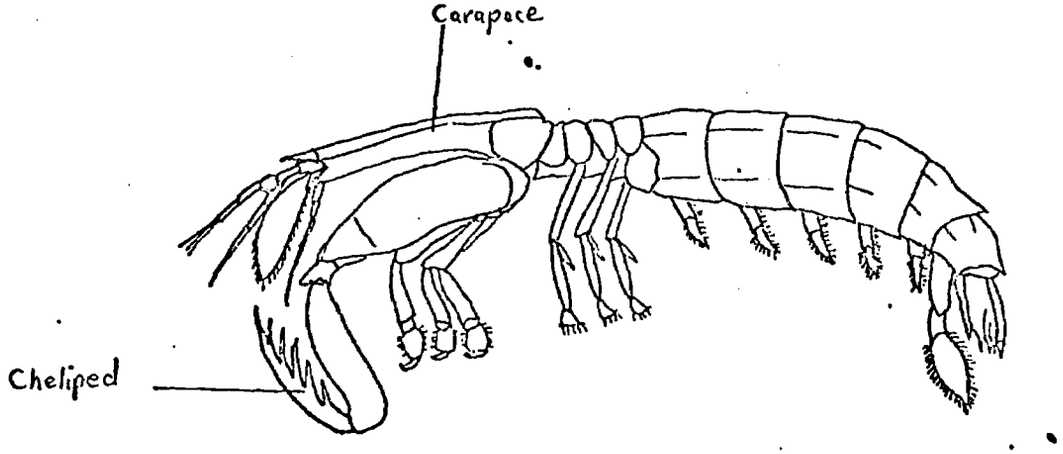
Class Crustacea



A. Subclass Cirripedia

Acorn Barnacle

Redrawn From Barnes, 1963 Pg 415 E.P.K.



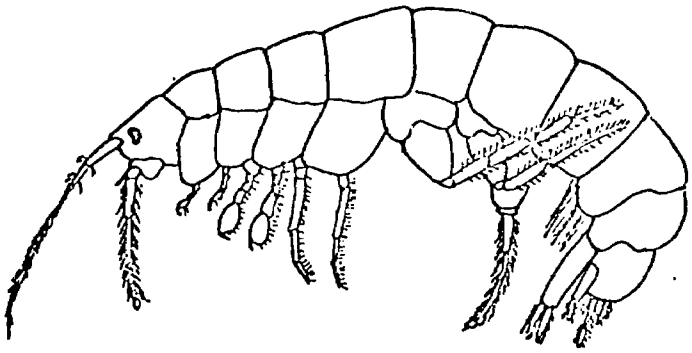
B. Subclass Malacostraca

Order Stomatopoda

Mantis Shrimp

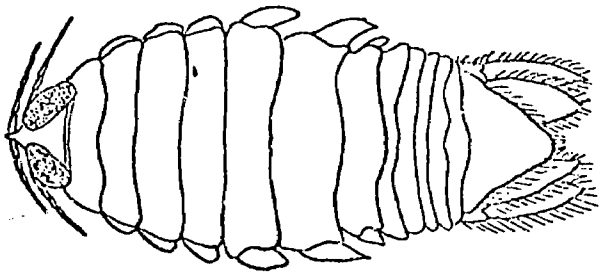
From Pimental (1967) pg 69 E.P.K.

Subclass Malacostraca



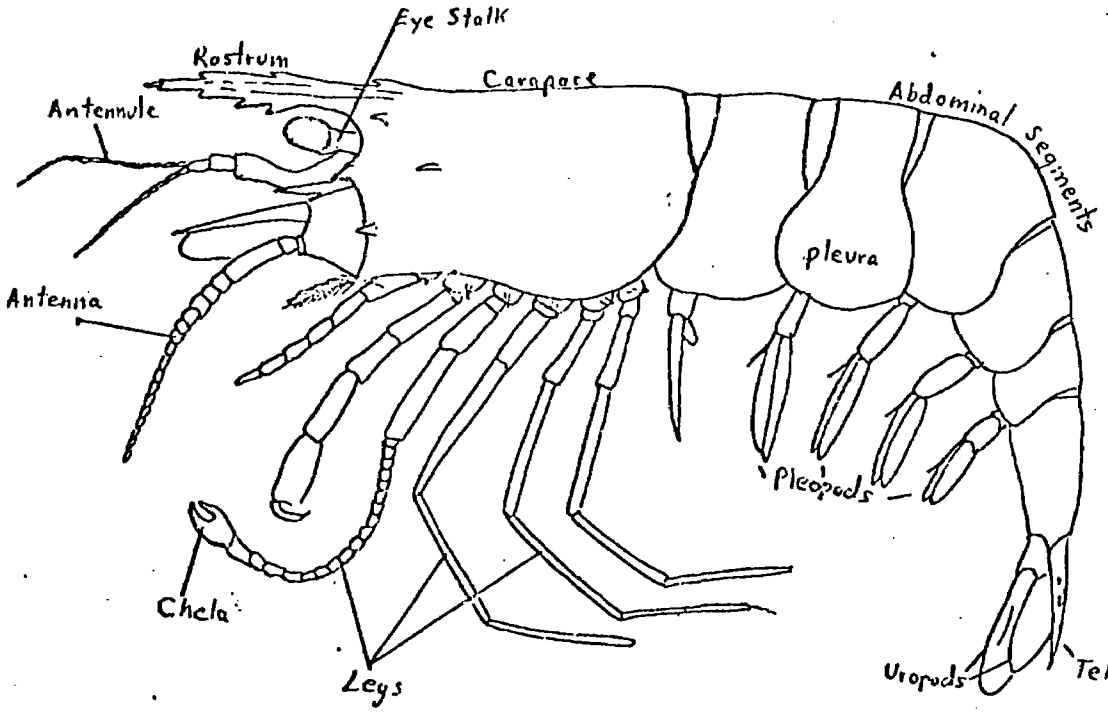
Order Amphipoda

Redrawn from Pimentel (1967) Pg 89. E.P.K.



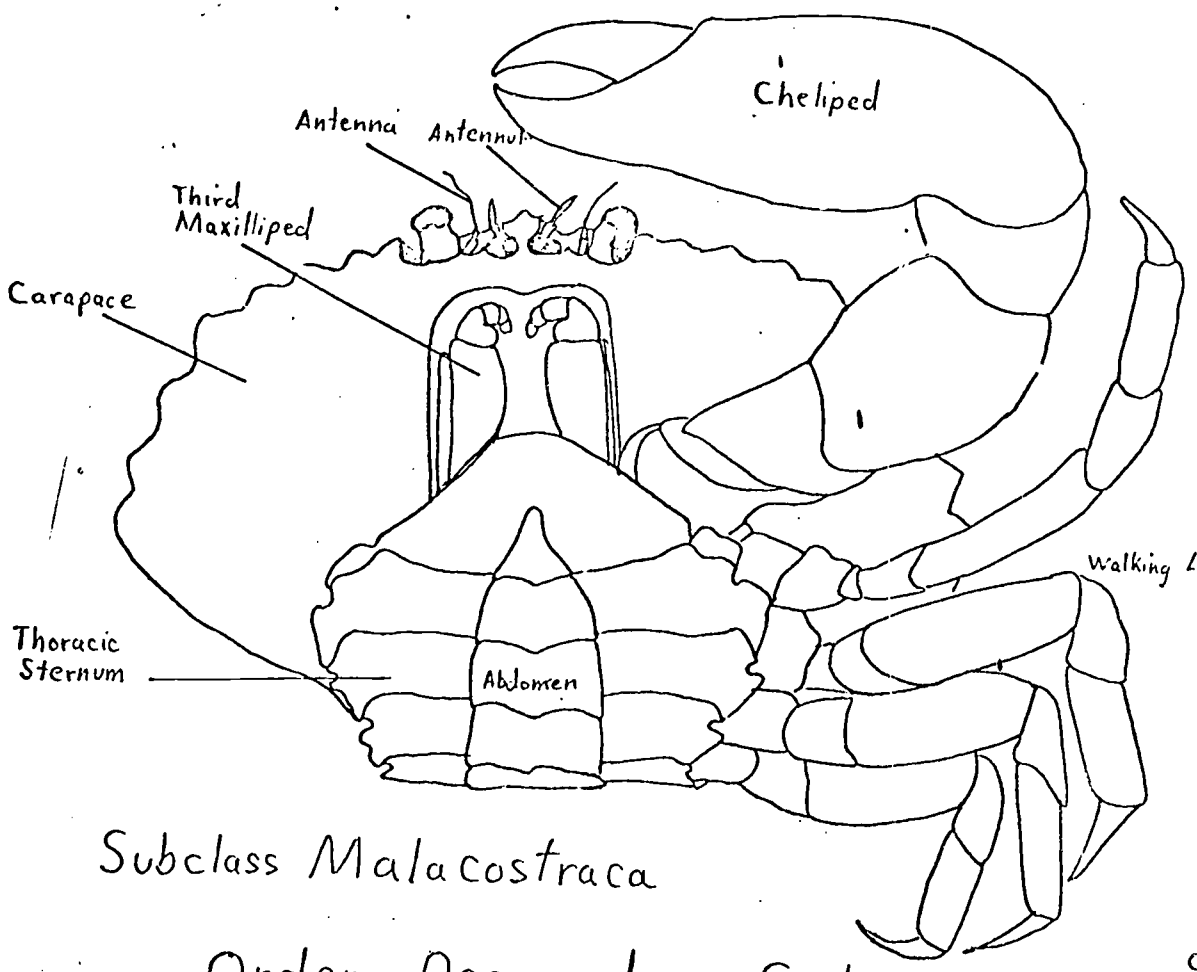
Order Isopoda

Copied from Schultz (1969) Pg 190. E.P. Keferl



Order Decapoda - Shrimp

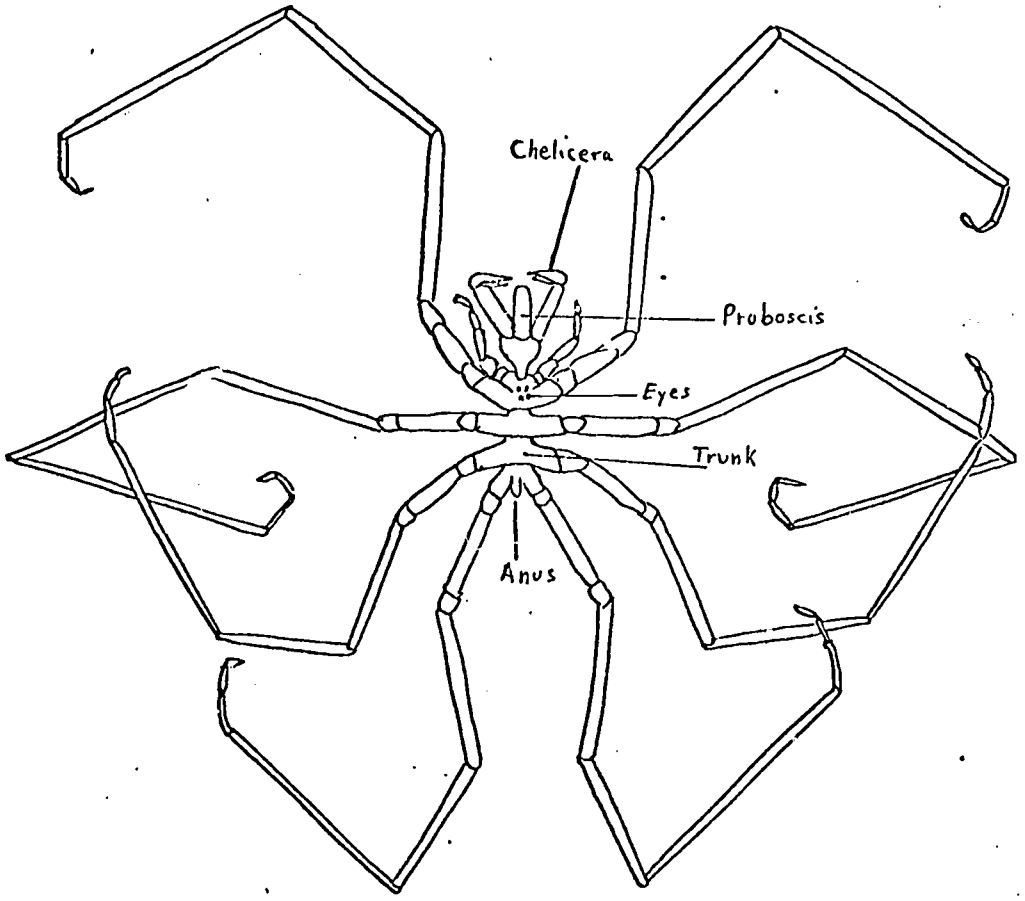
Copied from Williams (19[illegible]) Pg 9 E.P.K.



Subclass Malacostraca

Order Decapoda - Crab.

Copied From Williams (1965) Pg. 11 E.P. Kelert



Class Pycnogonida Sea Spider

Phylum Chordata

1. Dorsal tubular verve cord, paired gill slits, and a notochord at some time in their life cycle.
2. Segmentation usually evident.
3. Tail behind anus.

Subphylum Tunicata (Urochordata) (Sea Squirts)

1. Larva free-swimming, tadpole-like, with nerve cord and notochord in tail.
2. Adult tubular, globose, or irregular in form, covered with tunic which is often transparent.
3. Gill slits in pharyngeal region.
4. Animal solitary or colonial.

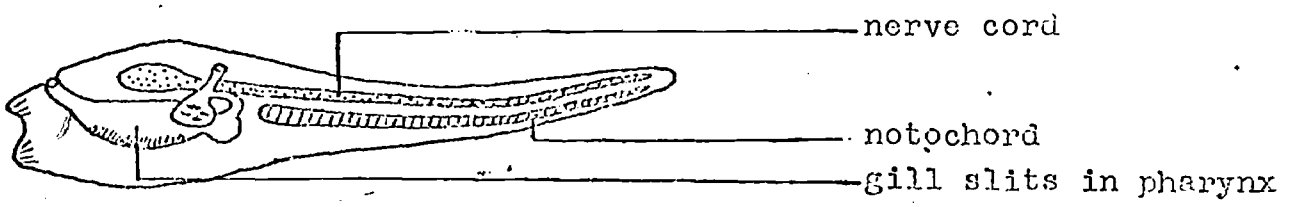


Fig. 7. Diagram of the free-swimming larval form of a tunicate.

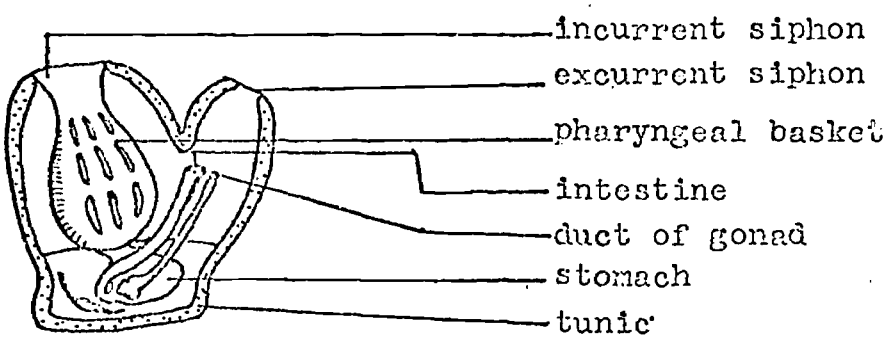


Fig. 8. Diagram of one sessile adult tunicate.

Notes on tunicates:

Phylum Bryozoa (Moss Animals)

1. Bilateral symmetry, three germ layers.
2. Colonial, each small individual in a separate house (Zooecium).
3. Complete digestive tract, U-shaped.
4. Mouth surrounded by a retractile lophophore bearing tentacles.
5. Zooecium, secreted by epidermis, is usually calcareous or chitinous.

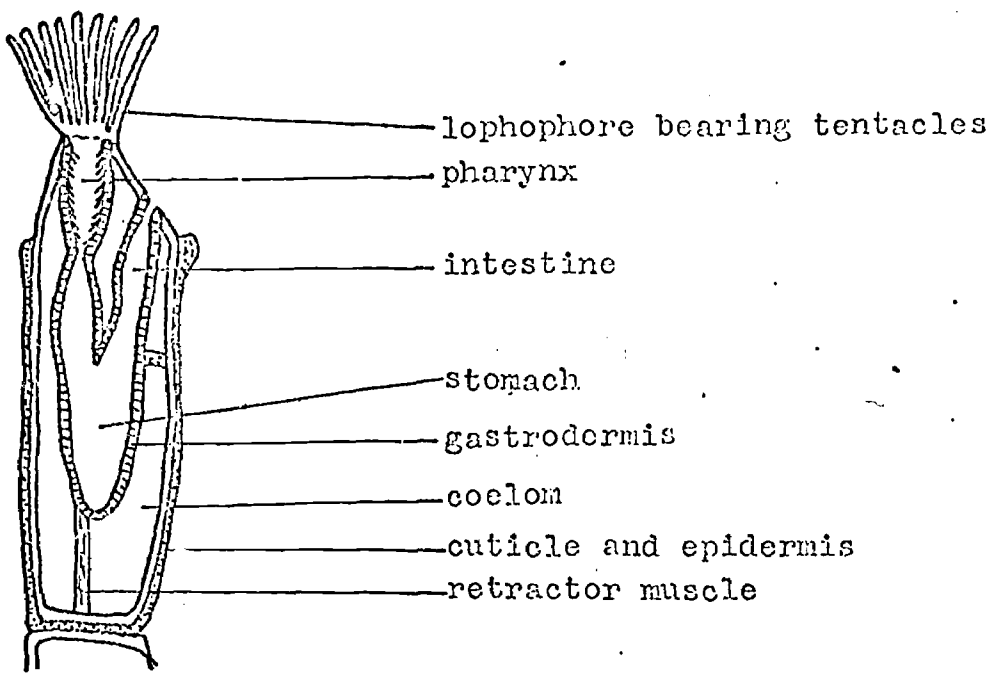


Fig. 6. Diagram of one animal in a colony of bryozoans.

Notes on bryozoans:

A LIST OF THE MARINE ORGANISMS FOUND AROUND ANDROS ISLAND

Compiled from collections made in December, 1970, January, 1971, March, 1971, May, 1971, and September, 1971.

These plants and animals were either collected or observed by Eugene P. Keferl.

Phylum Chlorophyta(Green Algae)
- Ulva lactuca(Sea lettuce)
- Enteromorpha(Grass Algae)
- Dasycladus
- Acetabularia crenulata
- Penicillus dumentosus(Merman's Shaving Brush)
- Halimeda
- Caulerpa mexicana
- Udotea

Phylum Rhodophyta(Red Algae)
- Corallina
- Goniolithon
- Poralithon

Phylum Phaeophyta(Brown Algae)
- Sargassum bacciferum
- Padina

Phylum Tracheophyta(Marine Seed Plants)
- Zostera(Eelgrass)
- Thalassia(Turtle Grass)

Phylum Porifera(Sponges)
- Class Demospongiae
  - Speciospongia vespara(Loggerhead Sponge)
  - Euspongia(Bath Sponge)
  - Hircinia(Vase Sponge)
  - Chalina(Finger Sponge)
    - (Pleated Tube Sponge)
    - (Lavender Tube Sponge)
  - A very large number of unidentified sponges.

Phylum Ctenophora
- Class Tentacula
  - Mnemiopsis(Sea Walnut)
  - At least another unidentified species.

Phylum Coelenterata
- Class Hydrozoa
  - Order Hydroida
    - Several unidentified species.
  - Order Hydrocorallina
    - Millepora alcicornis(Fire Coral)
  - Order Siphonophora
    - Physalia physalis(Portuguese Man-of-War)

Class Scyphozoa
Cassiopea xamachana(Mangrove Jellyfish)
Aurelia aurita (Moon Jelly)
At least one other unidentified species.
Class Anthozoa
Subclass Alcyonaria(Soft Corals)
Order Alcyonacea
Alcyonium(Dead Man's Fingers)
Other unidentified species.
Order Gorgonacea(Horny Corals)
Gorgonia flabellum(Sea fan)
Leptogorgia(Sea Whip)
Pseudopterogorgia(Sea Feather)
Many other unidentified species.
Subclass Zoantharia
Order Actiniaria(Sea Anemones)
At least three unidentified species observed.
Order Madreporaria(Stony Corals)
Acropora cervicornis(Staghorn Coral)
Acropora palmata(Elkhorn Coral)
Porites porites(Large Finger Coral)
Porites furcata(Small Finger Coral)
Meandra labyrinthiformis(Brain Coral)
Meandra clivosa(Low Brain Coral)
Meandra areolata(Mushroom Coral)
Monastrea annularis(Mountain Coral)
Eusmilia fastigiata(Star Coral)
Siderastrea radians(Brown Coral)
Agaricia agaricites(Lettuce Coral)
Agaricia sp.(Bracket Coral)
Dendrogyra cylindrus(Pillar Coral)
Isophyllia sp.(Rose Coral)
Favia fragum
Colpophyllia natans(Moon Coral)
Many other unidentified species observed.

Phylum Echinodermata
Class Asteroidea
Order Phanerozonia
Astropecten sp.(Sand Starfish)
Oreaster reticulatus(West Indian Starfish)
Order Spinulosa
Echinaster sentus(Spiny Starfish)
Class Holothurioidea
Actinopyga agassizi(West Indian Sea Cucumber)
Euapta lappa
Class Echinoidea
Diadema antillarum(Long-spined Black Sea Urchin)
Tripneustes esculenta(Sea Egg)
Lytechinus variegatus(Short-spined White Sea Urchin)
Eucidaris tribuloides(Slate Pencil Urchin)
Echinometra subangularis(Rock-boring Sea Urchin)
Echinanthus rosaceus(Sea Biscuit)
Clypeaster subdepressus(Cake Urchin)
Mellita testudinata(Sand Dollar)

Class Ophiuroidea
Ophiothrix sp.(Little Spiny Brittlestar)
Ophiocoma echinata(West Indian Brittlestar)
Ophioderma brevispinum(Green Serpent Star)
Gorgonocephalus sp.(Basket Star)
Several unidentified species.
Class Crinoidea
Antedon sp.(Feather Star)
At least two unidentified species.

Phylum Annelida
Class Polychaeta
Order Erantia
Odontosyllis sp.(Bristleworm or Fire Worm)
Nereis sp.
Several other unidentified species.
Order Sedentaria
Family Sabellidae(Non-calcareous tubes)
Sabellaria(Fan Worm)
Family Serpulidae(Calcareous tubes)
Serpula(Featherduster Worm)
Family Terebellidae(Mop-headed Worms)
One unidentified species known.

Phylum Arthropoda
Class Crustacea
Subclass Cirripedia
Order Thoracia
Family Lepadidae
Lepas anatifera(Goose-neck Barnacle)
Family Balanidae
Balanus sp.(Acorn Barnacle)
Chthamalus fragilis(Acorn Barnacle)
Subclass Malacostraca
Order Isopoda
Several unidentified species.
Order Amphipoda
Several unidentified species.
Order Stomatopoda
Several unidentified species.
Order Decapoda
Suborder Macrura
Family Alpheidae(Crangonidae)
At least two unidentified species of snapping shrimp are found in the Loggerhead sponge, in Pen Shells and under rocks.
Family Palaemonidae
Several unidentified species
A Burrowing species
(Barbarshop Shrimp--a cleaner shrimp)
Suborder Reptantia
Family Scyllaridae
Scyllarus sp.(Spanish Lobster)
Family Palinuridae
Panulirus argus(West Indian Spiny Lobster)

Suborder Anomura
Family Paguridae
Coenobita clypeatus(Purple-clawed Hermit Crab)
Petrochirus diogenes
Clibanarius vittatus(Striped Hermit Crab)
Pagurus sp.
Suborder Brachyura
Family Dromiidae
Dromidia antillensis(West Indian Sponge Crab)
Family Calappidae
Calappa flammea(Flamed Box Crab)
Family Portunidae
Callinectes sp.(Blue Crab)
Portunus sp.
Family Xanthidae
Panopeus herbstii(Common Mud Crab)
Family Ocypodidae
Ocypode albicans(Ghost Crab)
Uca sp. (Fiddler Crab)
Family Grapsidae
Pachygrapsus transversus(Mottled Shore Crab)
Sesarma cinereum(Square-backed Crab)
Family Majidae
At least one unidentified Spider crab
Family Gecarcinidae
Gecarcinus ruricola(West Indian Land Crab)
Cardisoma guanhumi(Edible Land Crab)
Family Majidae
Stenorynchus seticornis(Arrow Crab)

Phylum Mollusca
Class Gastropoda
Subclass Prosobranchia
Order Archaeogastropoda
Family Fissurellidae
Fissurella barbadensis(Barbados Keyhole Limpet)
Dicdora listeri(Lister's Keyhole Limpet)
Diodora cayenensis(Cayenne Keyhole Limpet)
Lucapina sowerbii(Sowerby's Fleshy Limpet)
Lucapina suffusa(Cancellate Fleshy Limpet)
Family Acmaeidae
Acmaea pustulata(Spotted Limpet)
Family Trochidae
Cittarium pica(West Indian Top Shell)
Calliostoma jujubinum(Jujube Top Shell)
Tegula fasciata(Smooth Atlantic Tegula)
Tegula lividomaculata(West Indian Tegula)
Family Turbinidae
Astraea americana(American Star Shell)
Astraea phoebia(Long-spined Star Shell)
Astraea caelata(Carved Star Shell)
Family Neritidae
Nerita versicolor(Four-toothed Nerite)
Nerita tessellata(Tessellate Nerite)
Nerita peloronta(Bleeding Tooth Nerite)
Neritina virginea(Virgin Nerite)
Puperita pupa(Zebra Nerite)

Order Caenogastropoda
- Family Littorinidae
  - Littorina angulifera(Atlantic Periwinkle)
  - Littorina ziczac(Zigzag Periwinkle)
  - Littorina mespillum(Dwarf Brown Periwinkle)
  - Littorina floccosa(Floccose Periwinkle)
  - Nodilittoria tuberculata(Common Prickly-winkle)
  - Tectarius muricatus(Beaded Periwinkle)
  - Echininus nodulosus(False Prickly-winkle)
- Family Vermetidae
  - Vermicularia spirata(West Indian Worm Shell)
- Family Planaxidae
  - Planaxis lineatus(Dwarf Atlantic Planaxis)
- Family Potamididae
  - Batillaria minima(False Cerith)
  - Cerithium lutosum(C. variabile)
  - Cerithium eburneum(Ivory Cerith)
  - Cerithium litteratum(Stocky Cerith)
- Family Calyptraeidae
  - Crepidula maculosa(Spotted Slipper Shell)
- Family Strombidae
  - Strombus gigas(Queen Conch)
  - Strombus raninus(Hawk-wing Conch)
  - Strombus costatus(Milk Conch)
  - Strombus samba
  - Xenophora conchliophora(Atlantic Carrier Shell)
- Family Ovulidae
  - Cyphoma gibbosum(Flamingo Tongue)
  - Neosimnia acicularis(Common West Indian Simnia)
- Family Naticidae
  - Natica canrena(Colorful Atlantic Natica)
  - Natica livida(Livid Natica)
  - Polinices lacteus(Milk Moon Snail)
- Family Cassidae
  - Cassis tuberosa(King Helmet)
  - Cassis madagascariensis(Queen or Emperor Helmet)
  - Cassis flammea(Flame Helmet)
- Family Cymatiidae
  - Charonia variegata(Triton's Trumpet)
  - Cymatium tuberosum(White-mouthed Triton)
  - Cymatium caribbaeum(Dog-headed Triton)
  - Cymatium nicobaricum(Gold-mouthed Triton)
- Family Tonnidae
  - Tonna maculosa(Atlantic Partridge Tun)
- Family Muricidae
  - Murex dilectus(Lace Murex)
  - Murex pomum(Apple Murex)
  - Morula nodulosa(Blackberry Drupe)
  - Purpura patula(Wide-mouthed Dye Shell)
  - Thais deltoidea(Deltoid Rock Shell)
  - Thais haemostoma floridana(Florida Rock Shell)
- Family Columbellidae
  - Columbella mercatoria(Common Dove Shell)
- Family Fasciolariidae
  - Fasciolaria tulipa(True Tulip)
  - Leucozonia nassa(Chestnut Latirus)

Family Olividae
Oliva reticularis(Netted Olive)
Family Vasidae
Xantus angularis(Lamp Shell)
Family Marginellidae
Prunum apicinum(Common Atlantic Marginella)
Family Conidae
Conus mus(Mouse Cone)
Subclass Opisthobranchia
Order Tectibranchia
Family Bullidae
Bulla occidentalis(West Indian Bubble)
Family Aplysidae
Aplysia dactylomela(Spotted Sea Hare)
Class Amphineura
Acanthopleura granulata(Fuzzy Chiton)
Class Pelecypoda
Order Filibranchia
Family Arcidae
Arca zebra(Turkey Wing)
Arca imbricata(Mossy Ark)
Anadara notabilis(Eared Ark)
Barbatia cancellaria(Red-brown Ark)
Family Mytilidae
Modiolus americanus(Tulip Mussel)
Family Isognomonidae
Isognomon alatus(Flat Tree Oyster)
Family Pteriidae
Pteria colymbus(Atlantic Wing Oyster)
Pinctada radiata(Atlantic Pearl Oyster)
Family Pinnidae
Pinna carnea(Amber Pen Shell)
Family Pectinidae
Aequipecten muscosus(Rough Scallop)
Family Plicatulidae
Plicatula gibbosa(Kitten's Paw)
Family Spondylidae
Spondylus americanus(Atlantic Thorny Oyster)
Order Eulamellidbranchia
Family Lucinidae
Codakia orbicularis(Tiger Lucine)
Lucina pennsylvanica(Pennsylvanian Lucine)
Family Chamidae
Chama macerophylla(Leafy Jewel Box)
Family Cardiidae
Laevicardium laevigatum(Common Egg Cockle)
Trachycardium egmontianum(Prickly Cockle)
Papyridea soleniformis(Spiny Paper Cockle)
Family Veneridae
Chione cancellata(Cross-barred Venus)
Family Tellinidae
Tellina fausta(Faust Tellin)
Tellina radiata(Sunrise Tellin)
Tellina listeri(Speckled Tellin)
Family Sanguinolariidae
Asaphis deflorata(Gaudy Asaphis).
Class Cephalopoda
Spirula spirula(Common Spirula)
Octopus vulgaris(Common Octopus)
Sepiotcuthis sp.(Cuttle fish)

Eastern coast of Andros Island, Bahamas.

Compiled by Eugene P, Kefer1

I. Intertidal Zone

A. Oolitic Limestone Rock

Barnacles
Terrestrial Isopods
Mud Crabs(Xanthidae)
Shore Crabs(Grapsidae)
Hermit Crabs
Beaded Periwinkle
Zigzag Periwinkle
Common Prickly-winkle
False Prickly-winkle
Barbados Keyhole Limpet
Lister's Keyhole Limpet
Cayenne Keyhole Limpet
Sowerby's Fleshy Limpet
Dwarf Atlantic Planaxis
Spotted Limpet
Four-toothed Nerite
Tessellate Nerite
Zebra Nerite
Bleeding Tooth Nerite
West Indian Top Shell
Florida Rock Shell
Wide Mouthed Dye Shell
Blackberry Drupe
Lace Murex
Flat Tree Oyster
Tulip Mussel
Fuzzy Chiton
Common Octopus

B. Mangrove Community

1. On Mangrove roots and branches
   Angulate Periwinkle
   Barnacles
   Hydroids
2. Under Mangrove on the mud or rock
   Mud Crabs(Xanthidae)
   Shore Crabs(Grapsidae)
   Hermit Crabs
   False Cerith
   Minature Cerith

C. Tidal Flats(Marl, Mud or Fine Sand) Exposed during very low tides

Hermit Crabs
Sand Starfish
Virgin Nerite
False Cerith
Minature Cerith
Common Atlantic Marginella
Milk Moon Snail
Colorful Atlantic Natica
West Indian Bubble
Tiger Lucine
Gaudy Asaphis
Mantis Shrimp
Many species of Polychaetes

D. Exposed Sandy Beach

Ghost Crab
Hermit Crab
Amphipods
Collembola

II. Infratidal Zone

A. Coral and Rock Rubble

Sea Anemones
Brown Coral
Hermit Crab
Sponge Crab
Spider Crab
Spiny Lobster
Clam Worm(Nereis)
Bristle Worm
Mantis Shrimp
Snapping Shrimp
Deltoid Rock Shell
West Indian Top Shell
American Star Shell
Triton's Trumpet
Lister's Keyhole Limpet
Cayenne Keyhole Limpet
Lace Murex
Octopus
Long-spined Black Sea Urchin
Rock-boring Sea Urchin

B. Subtidal Flats(Marl, Mud or Sand)

1. Usually in Eel or Turtle Grass Beds

Queen Conch
True Tulips
Lamp Shell
Spotted Sea Hare
Hydroids
Spiny Lobster

2. Not Particularly Associated with Grass Beds

Blue Crab
Hermit Crab
Flame Box Crab
Loggerhead Sponge
Black Sponges
Mangrove Jellyfish
Short-spined White Sea Urchin
Long-spined Black Sea Urchin
Pencil Urchin
West Indian Sea Cucumber
Sand Starfish
West Indian Starfish
Spiny Starfish
Green Serpent Star
Brittlestars
Several small corals
Brown Coral
Finger Corals.
Rose Coral
Sea Fan
Sea Whip
Sea Feather
Soft Corals
Amber Sea Pen
Cross-barred Venus
Triton's Trumpet
West Indian Bubble
Colorful Atlantic Natica
Milk Moon Snail
Ivory Cerith

C. Coral Reef

Many species of corals with the dominants being Elkhorn, Staghorn, Mountain and Brain Corals.
Tube Sponges
Vase Sponges
Sea Fans
Sea Whips
Sea Feathers
Many Species of Soft Corals
Spotted Limpet
Barbados Keyhole Limpet
West Indian Worm Shell
Long-spined Black Sea Urchin
Sabellidae Worms
Serpulidae Worms

Specialized Habitats(See the sheet on Symbiotic Relationships)

. On Gorgonian Corals(Sea Fans, Sea Whips, Sea Feathers)
Leafy Jewel Box
Atlantic Wing Oyster
Atlantic Pearl Oyster
Kitten's Paw
Flamingo Tongue
West Indian Simnia

. On Other Shells(Dead or Alive)
Spotted Slipper Shell
Atlantic Pearl Oyster

Marine Trophic Levels of Various Common Invertebrates found around Andros Island, Bahamas.

Compiled by Eugene P. Keferl

Herbivores

Fissurellidae(Keyhole Limpets)--usually browsing at night on algae covered rocks or on sponges.
Acmaeidae(True Limpets)--same as above
Trochidae(Top Shells)
Turbinidae(Turban Shells)--exclusively on marine algae
Neritidae(Nerites)--Feed on algae
Littorinidae(Periwinkles)--Microscopic algae and diatoms
Calyptraeidae(Slipper Shells)--Modified filter feeder, sometimes called a ciliary feeder, traps algae.
Strombidae(Conchs)--some are suppose to feed on red algae
Aplysidae(Sea Hares)--algae and large seaweeds
Amphineura(Chitons)--Algae, diatoms

Primary Consumers

Fissurellidae(Keyhole Limpets)--some feed on sponges
Cypraeidae(Cowries)--Presumably feed on colonial invertebrates such as tunicates and hydroids.
Naticidae(Moon Snails)--Generally feed on bivalves and sometimes other gastropods; drills holes.
Tonnidae(Tun Shells)--Other invertebrates
Muricidae(Murex Shells)--Bivalves, freshly killed sea animals, barnacles, many intertidal gastropods.
Fasciolariidae(Tulip Shells)--very active predators
Olividae(Olives)--carnivorous sand burrowers
Conidae(Cones)--marine worms, gastropods and living fish.
Bullidae(Bubble Shells)--carnivores
Amphineura(Chitons)--Some feed on bryozoans
Scaphopoda(Tusk Shells)--Feed on Foraminifera
Many Decapods

Secondary Consumers

Architectonicidae(Sun Dials)--Feed on Sea Pansies
Janthinidae(Purple Sea Snail)--Portuguese-man-of-war and Velella
Epitoniidae(Wentletraps)--Sea Anemones and foraminifera
Ovulidae(Simnia and Flamingo Tongues)--Sea Fans and Sea Whips
Cypraeidae(Cowries)--Tunicates and hydroids
Cassidae(Helmet Shells)--Sea Urchins and Sand Dollars
Cymatiidae(Tritons)--Starfish
Tonnidae(Tun Shells)--Feed on various invertebrates
Muricidae(Murex Shells)--Bivalves, Freshly killed sea animals, barnacles, many intertidal gastropods.
Fasciolariidae(Tulip Shells)--Gastropods and bivalves
Olividae(Olives)--Carnivorous
Conidae(Cones)--Worms, gastropods and living fish.
Bullidae(Bubble Shells)--Carnivorous
Pyramidellidae--Parasitic snails on worms, starfish, bivalves and Crepidula
Nudibranchia(Sea Slugs)--Fish eggs, hydroids, sea anemones, small molluscs.
West Indian Starfish--bivalves and worms
Spiny Starfish--bivalves and worms
Sea Anemones--Fish and Crustaceans(Crabs and shrimp)
Many Decapods

Trophic Relationships continued

Scavengers or Detritus Feeders
- Strombiidae(Conchs)--Some feed on carrion
- Potamididae(Horn Shells or Ceriths)--detritus, and probably algae
- Muricidae(Murex Shells)--some feed on freshly killed sea animals.
- Echinoidea
  - Sea Urchins--all types of living and dead organic matter
  - Heart Urchins, Sea Biscuits and Sand Dollars--Minute organic matter
- Amphipods
- Isopods
- Probably many shrimps and crabs
- Polychaeta

Filter Feeders(Suspension Feeders)--feed on suspended organic matter dead or alive.
- Arcidae(Ark Shells)
- Mytilidae(Mussels)
- Isognomonidae(Tree Oysters)
- Pteriidae(Pearl Oysters)
- Pinnidae(Pen Shells)
- Pectinidae(Scallops)
- Lucinidae(Lucines)
- Chamidae(Jewel Boxes)
- Cardiidae(Cockles)
- Sanguinolariidae(Sanguin Clams)
- Calyptraeidae(Slipper Shells)
- Holothrioidea(Sea Cucumbers)
- Teredinidae(Shipworms)
- Sabellidae Worms
- Serpulidae Worms

Deposit Feeders--feed on miscellaneous organic matter on the substrate
- Tellinidae(Tellins)
- Holothurioidea(Sea Cucumbers)
- Polychaeta(Mop-headed worms) several other species of worms

Plankton Feeders--These animals feed on selective living planktonic organisms. They could be herbivores, primary or secondary consumers, depending on what they eat.
- Hydrozoa--zooplankton
- Alcyonaria(Soft Corals)--zooplankton
- Madreporaria(Stony Corals)--zooplankton
- Porifera(Sponges)
- Pteropoda(Sea Butterflies)
- Cirripedia(Barnacles)

A partial Summary of:

Stephenson, T.A. and Anne Stephenson.
1950. Life between tide-marks in North America.
I. Florida Keys
Journal of Ecology Vol. 38.

Upper Platform---A low but well-marked platform of rock extending from the edge of the land vegetation towards the sea.

Lower Platform---A much lower, sea ward platform of rock, sometimes absent.

Reef Flat---A low-lying area which rocky patches alternate with sand mud and gravel; this is commonly covered by shallow sea at low water, and its higher parts emerge as banks at the lowest tides.

The Distribution of Organisms

UPPER PLATFORM

I. Dry-land Vegetation
- A. Mangrove Communities
- B. Maritime Communities(Andros Island vegetation zone)

II. The Supralittoral Fringe and its Subzones
- A. White Zone
  1. More nearly dry land than an intertidal zone.
  2. Rarely and irregularly wetted by waves.
  3. Width varies considerably.
  4. Most animals are under rocks.
  5. Vegetation
     - a. Trees
       - White Mangrove
       - Black Mangrove
       - Buttonwood
     - b. Shrubs
       - Suriana maritima--yellow flowering
     - c. Vines
       - Ipomoea pes-caprae(Railroad Vine)
     - d. Fleshy Composites
       - Borrichia frutescens
       - Borrichia arborescens
     - e. Fleshy Herbs
       - Sesuvium portulacastrum(Sea-purslane)
       - Batis maritima
       - Philoxerus vermicularis
       - Salicornia perennis(Glasswort)
     - f. Grasses
  6. Characteristic Animals
     - Purple-clawed Hermit Crab
     - Isopod(Ligia baudiniana)
     - Rapid Crabs(Grapsidae)
       - Sesarma cinereum(Square-backed Crab or Wharf Crab)
       - Cyclograpsus integer
     - Ants
     - Earwigs
     - Scorpions
     - Spiders
     - Beaded Periwinkles
     - Cerionidae(Terrestrial gastropods)
     - Truncatella bilabiata(Torrestrial Gastropod)
     - Detracia bulloides(Melampus Salt-marsh Snail)

Stephenson--continued

UPPER PLATFORM

II. The Supralittoral Fringe and its Subzones

B. Grey Zone

1. Wetted by occasional high spring tides
2. Width varies considerably
3. Vegetation

This zone is not vegetated by flowering plants in some areas and extensively vegetated by flowering plants in other areas.

a. Trees
   Red Mangrove
   Black Mangrove
   White Mangrove
b. Fleshy Composites
   Borrichia frutescens
c. Fleshy Herbs
   Batis maritima
   Philoxerus vermicularis
   Salicornia perennis(Glasswort)
   Sesuvium portulacastrum(Sea-purslane)
d. Grasses
e. Macroscopic Marine Algae
   Bostrychia---moss like growth on roots of trees and hollows of rock.

4. Characteristic Animals
   Zigzag Periwinkle
   Beaded Periwinkle(Lower limit)
   Common Prickly-winkle
   False Prickly-winkle
   Bleeding Tooth Nerite
5. Animals of common occurrence
   Four-toothed Nerite(Upper limit)
   Angulate Periwinkle(Usually on mangrove)
   Isopoda(Ligia baudiniana)
   Rapid Crabs(Grapsidae)
      Sesarma cinereum(Square-backed Crab or Wharf Crab)
      Cyclograpsus integer
   Uca(Fiddler Crab)
   Melampus flavus(Salt-marsh Snail)
   Melampus coffeus(Coffee Bean Snail)
   Detracia bulloides
   Truncatella bilabiata--terrestrial snail
   Truncatella pulchella--terrestrial snail

C. Black Zone

1. Wetted completely by the sea at high water during spring tides, partially during lesser neap tides.
2. Very dissected
3. Rocks are discolored by lichens and marine algae.
4. Width is dependent upon the shape(slope) of the platform and the average level of high water. Vertical distance is usually 2½ feet and the horizontal distance varies from 6 in. to 17½ feet.
5. Vegetation
   Usually little to no flowering plants.
   a. Microscopic Algae
      Entophysalis deusta--blue-green algae
      Brachytrichia quoyi--blue-green algae
      Tollamia intricata--green algae

b. Macroscopic Algae
Bostrychia binderi
Bostrychia tenelli

6. Characteristic Animals
Zigzag Periwinkle
Common Prickly-winkle
Four-toothed Nerite
Pachygrapsus transverus(Mottled Shore Crab)

7. Animals of Common Occurrence
Bleeding Tooth Nerite
False Prickly-winkle
Dwarf Atlantic Planaxis
Tessellate Nerite
False Cerith(In depressions)
Isopoda(Ligia baudiniana)

III. The Midlittoral Zone

A. Yellow Zone

1. Truly an intertidal region
2. Regularly submerged or at least wetted to the top.
3. Upper Yellow Zone
a. Characteristic Organisms
Barnacles(Chthamalus)
Algae(Bostrychia two species)
4. Lower Yellow Zone
a. Characteristic Organisms
Valonia ocellata(Green algae)--nodulated sheets or masses of small bubbles, like vesicles.
Spiroglyphus irregularis(Vermetidae--Worm Snail)
5. Characteristic Animals of the Yellow Zone in General
Tessellate Nerite
Four-toothed Nerite
False Cerith
Siphonaria pectinata } either one or none present
Siphonaria alternata }
Lister's Keyhole Limpet
Spotted Limpet
Florida Rock Shell
Tinted Cantharus
Onchidium floridanum--small black sea slug
Scorched Mussel--extremely variable in occurrence
Flat Tree Oyster
Fuzzy Chiton
Pachygrapsus transversus(Mottled Shore Crab)
6. Characteristic Plants of the Yellow Zone in General
All algae which usually occurs in the form of short, mossy, turf-like or encrusting growths.

LOWER PLATFORM

Only exposed during the lows of the major spring tides.

1. Characteristic Animals
Spiroglyphus irregularis(Vermitidae--worm snail)
Hydroid(Zaenthus sociatus)
Echinometra lucunter--short-spined sea urchin
Arca imbricata(Mossy Ark)
Barbatia candida(White-bearded Ark)
Sea Anemones
Phymonthus crucifer

LOWER PLATFORM

1. Characteristic Animals
   Sea Anemones
      Bartholomea annulata
      Condylactis gigantea--violet tipped tentacles
2. Characteristic Algae
   Laurencia papillosa--low yellowish-green carpet
   Valonia ocellata
   Halimeda opuntia--calcareous green algae

MARINE ORGANISM ASSOCIATIONS

In general, observations are made keener and more enjoyable by knowing what to look for in a given environment. The following is a listing of various marine organism associations which might be found in the waters around Andros Island. Some of these organisms are highly specific as to there association, others are quite general, both types are generalized here.

Some definitions:

Endoecism--Describes a partnership in which one animal habitually lives within the tube or burrow of another.

Inquilinism--Denotes organisms which live together, one within the other, the former utilizing the host animal mainly as a refuge.

Phoresis--Indicates organisms which live together in such a way that the transport provided by one promotes the well-being of the other.

Mutualism--Denotes an association involving reciprocal benefit. A facultative or obligative relationship in which both organisms benefit.

Commensalism--Denotes organisms which live together, with no harm to either, and which generally share a source of food. Food is obtained by one partner, the other is really a non-paying guest.

Parasitism--Denotes a relationship in which one partner lives in or on the other partner and also derives nutriment from its host. Thus one partner benefits and the other is harmed.

May be found around Andros Island:

Inquilinism--Jellyfish and many species of young oceanic fish (live around the tentacles).

Physalia and Nomeus gronorii (Man-O-War fish). This is also commensalism.

Long-Spined Black Sea Urchin (Diadema) and Shrimp fish (Aeoliscus strigatus) and Cling fish (Diadenichthys deversor) are sheltered by the long spines.

Sea Cucumber and Carapus (Pearl Fish) The fish has no scales, no pelvic fins, and lives within the cucumber's cloaca.

Inquilinism--Queen Conch (Strombus gigas) and Cardinal Fish (Apogonichthys).

Mutualism----Large Sea Anemones and Damselfish (Amphiprion premnas).

Endoecism----Arrow gody (Clevelandia ios) finds refuge in the burrow of the burrowing shrimp (Callianassa and Upogebia).

Coral Gall Crab (Hapalocarcinidae) lives in coral.

Pistol Shrimp (Synalpheus) lives inside the Loggerhead Sponge.

Phoresis-----Barnacles of many kinds attach to whales, fish, sea snakes, and turtles.

Remora fish attach to sharks and large fish.

Cleaning Symbiosis (A very specialized form of mutualism)-- Forty species of fish, six species of shrimp, and one species of crab are recognized as cleaners.

Look for small species of brightly colored fish found around rock outcrops and coral heads. These fish have definite stations and fish which "come to be cleaned" congregate nearby. It has been proven that if all of the cleaner fish are removed from a given area, the other fish will eventually leave.

Commensalism-Crabs and Sea Anemones.

Pea Crabs (Pinnixa) and Porcelain Crabs (Polyonyx) live in the tube of the Parchment Tube Worm (Chaetopterus).

Shrimp in Amber pen shells.

Stenopid Shrimp (Spongicola) in Venus Flower Basket (Euplectella). (In Japanese waters only)

Pilot Fish (Naucrates ductor) swim with large sharks and manta rays.

Source: Grotto, R. V., 1969. "Marine Animals: Partnerships and Other Associations". American Elsevier Publishing Company, Inc.

Some Ecological Questions To Ask Yourself Concerning Each Dive

What were the dominant kinds of plants?
What were the dominant types of animals?
Which corals were dominant?
Did you see any zonation? Vertical or horizontal?
What were the most common species of fish?
Did you see any symbiotic relationships?
How high did the coral heads get?
Were there any trenches, caves and where were they in relation to the prevailing water and air currents, shoreline, reef?
Did you see any differences in the types of corals and fishes that were present on the outer fringe of the coral reef and the inner fringe of the coral reef?
Did you see any evidence of trauma in the reef?
Did you see any evidence of measurable coral growth?
Did you see any schooling fish? Any solitary fish?
Did you see any fish exhibiting territorialism?
How much evidence did you find concerning the food web of the coral reef?
Did you see any green corals?
What lives under the loose coral and rock on the bottom?
Was the bottom uniform?
What lives in the sandy areas? grassy areas? rocky areas?
What is the "sand" made up of?
Did you experience any thermoclines? How deep?
Did you experience any currents? In what direction?
Can you distinguish between soft, horny and hard corals?
Did you see any floating plants or animals?

Some Questions Concerning Observations on an Individual Organism or Species

What does it eat?
What feeds upon it?
Where exactly does it eat?
Where does it stay during the day? During the night?
Is it territorial?
Is it solitary or colonial?
Does it occur in clumps or groups?
How often did you see it?
Was the animal aggressive, passive, bold, shy, inactive, or secretive at any time? Why?
What kind of special adaptations does it possess?
When does it reproduce?
How does it reproduce?
Where does it reproduce?

BIOLOGICAL DATA RECORD FOR DIVING

Name_____ Date_____

Diving Partner(s)_____ Time_____

_____

Locality_____

_____

_____

Depth_____ Water Clarity(Visibilty)_____

Thermocline(s)_____

Type of Bottom_____

_____

Current_____ Water Temperature_____

General Description of the Area_____

_____

_____

Predominant Organisms Present_____

_____

Organisms Collected_____

_____

_____

_____

Unusual or Interesting Observations_____

_____

_____

_____

_____

_____

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Appendix K

Bibliography

By Susan Cook, Trip Leader
&
Eugene Keferl

Bond, James
1971. The Birds of the West Indies.
Houghton Mifflin Company, Boston.
Borradaile, L.A., L.E.S. Eastham, F.A. Potts and J.T. Saunders
1961. The Invertebrata.
At the University Press, Cambridge.
Breder, Charles M.,Jr.
1948. Field book of marine fishes of the Atlantic Coast from Labrador to Texas. Revised Edition
G.P. Putnam's Sons, New York.
* Carson, Rachel
1955. The Edge of the Sea.
Houghton Mifflin, Boston
* Carson, Rachel
1961. The Sea Around Us.
Oxford University Press.
Coe, W.R.
1943. Biology of the Nemerteans of the Atlantic Coast of North America.
Trans. Conn. Acad. 35: 129-328.
** Dall, William H.
1905. Report on land and freshwater shells collected in the Bahamas in 1904 by Mr. Owen Bryant and others.
Smithsonian Miscellaneous Collection Vol. 47; 433-52.
Davis, Charles C.
1955. The Marine and Fresh-water Plankton.
Michigan State University Press.
Dawson, E. Yale
1956. How to Know the Seaweeds.
W.C. Brown, Dubuque, Iowa.
Ekman, Sven
1953. Zoogeography of the Sea.
Sidgewick and Jackson, Ltd., London.
* Engel, Leonard and the Editors of Life
1961. The Sea.
Time, Inc.
* Farb, Peter and The Editors of Life
1963. Ecology.
Time, Inc.
Fraser, C. McL.
1944. Hydroids of the Atlantic Coast of North America.
Universty of Toronto Press, Toronto.
Grotto, R.V.
1969. Marine Animals: Partnerships and Other Associations.
American Elsevier Publishing Company, Inc.
Harvey, E. Newton
1952. Bioluminescence.
Academic Press, Inc. New York.
Hausman, Leon A.
1949. Beginner's Guide to Seashore Life.
G.P. Putnam's Sons, New York.
Hylander, Clarence J.
1950. Sea and Shore.
Macmillan Co., New York.

Hyman, L.H.
1940. The Invertebrates. Vol. 1 Protozoa through Ctenophora.
McGraw-Hill, New York.
1951. The Invertebrates. Vol. 2 Platyhelminthes and Rhynchocoela
The acoelomate Bilateria.
McGraw-Hill, New York.
1951. The Invertebrates. Vol. 3 Acanthocephala, Aschelminthes,
and Entoprocta. The Pseudocoelomate Bilateria.
McGraw-Hill, New York.
1955. The Invertebrates. Vol. 4 Echinodermata.
McGraw-Hill, New York.
1959. The Invertebrates. Vol. 5 Smaller Coelomate Groups.
McGraw-Hill, New York.
1967. The Invertebrates. Vol. 6 Mollusca I.
McGraw-Hill, New York.
Jordan, D.S. and B.W. Evermann
1900. The Fishes of North and Middle America.
Bull. U.S. Nat. Mus. No. 47, Washington D.C.
Kendeigh, S. Charles
1961. Animal Ecology.
Prentice-Hall, Inc., New Jersey Chapter 28.
Lewis, J.R.
1964. The Ecology of Rocky Shores.
English Universities Press.
Mayer, A.G.
1910. Medusae of the World.
Carnegie Institute of Washington, Washington, D.C.
Mayer, A.G.
1912. Ctenophores of the Atlantic Coast of North America.
Carnegie Institute of Washington, Washington, D.C.
Miner, R.W.
1950. Field Book of Shore Life.
Putnam's Sons, New York.
Moore, H.F.
1910. The commerical sponges and the sponge fisheries.
Bulletin of the U. S. Bureau of Fisheries, Vol 28, Part I,
p. 399-511.
Moore, Hilary B.
1958. Marine Ecology.
John Wiley and Sons, Inc., New York.
Morris, Percy A.
1951. A field guide to the shells of our Atlantic and Gulf coasts.
Revised and enlarged edition.
Houghton Mifflin Co., Boston.
Mooney, Charles N.
1905. Soils of the Bahama Islands.
The Geographical Society of Baltimore.
** Newell, N., J. K. Rigby, A.S. Whiteman and J.S. Bradley
1951. Shoal-water Geology and Environments, Eastern Andros
Island, Bahamas.
Bull. Am. Mus, Nat. Hist., Vol. 97.
Nicol, J.A. Colin.
1960. The Biology of Marine Animals.
Interscience Publishes, Inc., New York.

** Northrop, A.R.
1902. Flora of New Providence and Andros(Bahama Island). Memoirs Torrey Botanical Club Vol. 12; p. 1-98.
Odum, Eugene P. and Howard T. Odum
1959. Fundamentals of Ecology. Saunders Company, Philadelphia. Chapter 10.
Old, M.C.
1941. The taxonomy and distribution of the boring sponges (Clionidae) along the Atlantic Coast of North America. Chesapeake Biol. Lab. Publ. 44.
Ommanney, F.D. and The Editors of Life
1964. The Fishes. Time, Inc., New York.
** Osborn, Henry Fairfield, ed.
1910. A Naturalist in the Bahamas, John I. Northrop. The Columbia University Press.
** Otterbein, Keith F.
1966. The Andros Islanders. A Study of Family Organization in the Bahamas. University of Kansas Press, Lawrence, Kansas.
Pearse, A.S., H.J. Humm, and G.W. Wharton.
1942. Ecology of sand beaches at Beaufort, N.C. Ecological Monographs 12: 135-190.
Pearse, A.S. and L.G. Williams
1951. The biota of the reefs off the Carolinas. J. Elisha Mitchell Sci. Soc. 67(1): 133-161.
Perlmutter, Alfred.
1961. Guide to Marine Fishes. New York University Press, New York.
Pimentel, Richard A.
1967. Invertebrate Identification Manual. Reinhold Publishing Corporation, New York.
* Ray, Carleton, and Elgin Ciampi
1956. The Underwater Guide to Marine Life. A.S. Barnes and Co., New York.
Rathbun, Mary J.
1918. The grapsoid crabs of America. U.S. Nat. Mus. Bull. 97: 1-461.
1925. The spider crabs of America. U.S. Nat. Mus. Bull. 129: 1-613.
1930. The cancroid crabs of America of the families Eryalidae, Portunidae, Atelecyclidae, Cancridae and Xanthidae. U.S. Nat. Mus. Bull. 152:
1937. The oxystomatous and allied crabs of America. U.S. Nat. Mus. Bull. 166: 1-278.
Reid, George K.
1961. Ecology of Inland Waters and Estuaries. Reinhold, New York.
Richardson, Harriet
1905. Monograph on the isopods of North America. U.S. Nat. Mus. Bull. 54: 1-727.
Schultz, George A.
1969. How to Know The Marine Isopod Crustaceans. Wm. C. Brown Company Publishers, Dubuque, Iowa.
Smith, B. Webster
1940. The World Under the Sea D. Appleton-Century Co., New York.

Smith, F.G. Walton
1948. Atlantic Reef Corals.
University of Miami Press, Miami, Florida.
Stephenson, T.A. and Anne Stephenson
1950. Life between tide-marks in North America I. Florida Keys.
Journal of Ecology Vol. 38.
Storer, Tracy I. and Robert L. Usinger
1955. General Zoology.
McGraw-Hill Book Company, New York.
* Straughan, Robert P.L.
1968. Exploring the Reef.
A.S. Barnes and Company, New York.
Van Name, W.G.
1945. The North and South American Ascidians.
Bull. Amer. Mus. Nat. Hist. 84: 1-476.
Verrill, A.E.
1901. Variations and nomenclature of Bermudian, West Indian, and Brasilian reef corals, with notes on various Indo-Pacific corals.
Trans. Conn. Acad. Arts and Sci. Vol. XI.
Warmke, G.L. and R.T. Abbott.
1961. Caribbean Seashells.
Livingston, Narberth, Pa.
Wilson, Douglas P.
1951. Life of the Shore and Shallow Sea. 2d revised edition
Nicholson and Watson, London.
Yonge, Charles M.
1949. The Sea Shore.
Collins, London.
* Zim, Herbert S. and Lester Ingle.
1955. Seashores.
Simon and Schuster, New York.

Suggested Reading List for

Bahamas Trip, January 29 to February 8, 1971

ABSOLUTELY OPTIONAL

Carson, Rachel, 1963. "The Edge of the Sea", pages 167-216. Signet Science Library (P2360). Covers some ecology of the Florida Keys and reviews some of the same ecological habitats found in the Bahamas.

Ray, Carleton, and Elgin Ciampi, 1956. "The Underwater Guide to Marine Life". A.S. Barnes and Co., New York.

Odum, Eugene P., 1961. "Fundamentals of Ecology". W. B. Saunders Company, Philadelphia. Chapter 10, Particularly pages 356-358 on coral reefs.

Kendeigh, S. Charles, 1961. "Animal Ecology". Prentice-Hall, Inc., New Jersey. Chapter 28, particularly pages 366-367 on coral reefs.

Benjamin, George J., 1970. Diving into the Blue Holes of the Bahamas, in "National Geographic Magazine", September, 1970, pages 347-365.

Benton, Allen H., and William E. Werner Jr., 1966. "Field Biology and Ecology", McGraw-Hill Book Co., New York. Pages 287-290 on coral reef communities.

Straughan, Robert P. L., 1968. "Exploring the Reef", A. S. Barnes and Company, New York.

Otterbein, Keith F., 1966. "The Andros Islanders: A Study of Family Organization in the Bahamas", Univ. of Kansas Press, Lawrence, Kansas.

Bond, James, 1961. "Birds of the West Indies", Houghton Mifflin Company, Boston.

Newell, N., J. K. Rigby, A. S. Whiteman, and J. S. Bradley, 1951. "Shoal-water Geology and Environments, Eastern Andros Island, Bahamas". Bull. Am. Museum Nat. Hist., Vol. 97.

Smith, F. G. Walton, 1948. "Atlantic Reef Corals", Univ. of Miami Press, Miami, Florida.

Any good general zoology text or invertebrate zoology text will help the biologically oriented student review the characteristics of the major phyla which will be observed.

Appendix L

International Field Studies
Non-profit Status in the U.S.

B690 982

RECEIPT AND CERTIFICATE Nº 15896

INTERNATIONAL FIELD STUDIES INC.

NAME

400173

NUMBER

DOMESTIC CORPORATIONS

- ARTICLES OF INCORPORATION
- AMENDMENT
- MERGER/CONSOLIDATION
- DISSOLUTION
- AGENT
- RE-INSTATEMENT
- CERTIFICATES OF CONTINUED EXISTENCE
- MISCELLANEOUS

FOREIGN CORPORATIONS

- LICENSE
- AMENDMENT
- SURRENDER OF LICENSE
- APPOINTMENT OF AGENT
- CHANGE OF ADDRESS OF AGENT
- CHANGE OF PRINCIPAL OFFICE
- RE-INSTATEMENT
- FORM 7
- PENALTY

MISCELLANEOUS FILINGS

- ANNEXATION/INCORPORATION—CITY OR VILLAGE
- RESERVATION OF CORPORATE NAMES
- REGISTRATION OF NAME
- REGISTRATION OF NAME RENEWALS
- REGISTRATION OF NAME—CHANGE OF REGISTRANTS ADDRESS
- TRADE MARK
- TRADE MARK RENEWAL
- SERVICE MARK
- SERVICE MARK RENEWAL
- MARK OF OWNERSHIP
- MARK OF OWNERSHIP RENEWAL
- EQUIPMENT CONTRACT/CHATTEL MORTGAGE
- POWER OF ATTORNEY
- SERVICE OF PROCESS
- MISCELLANEOUS
- ASSIGNMENT—TRADE MARK, MARK OF OWNERSHIP, SERVICE MARK, REGISTRATION OF NAME

I certify that the attached document was received and filed in the office of TED W. BROWN, Secretary of State, at Columbus, Ohio, on the 23rd day of July A. D. 19 70, and recorded on Roll B690 at Frame 982 of the RECORDS OF INCORPORATION and MISCELLANEOUS FILINGS.

Ted W. Brown

TED W. BROWN,
Secretary of State

Filed by and Returned To: Walter Benson Bohl

34 Sheffield Rd.

Columbus, Ohio 43215

FEE RECEIVED: $ 25.00

NAME: INTERNATIONAL FIELD STUDIES INC.

189-131

Form C-102 Corporation Not For Profit
Prescribed by Secretary of State—Ted W. Brown

400173

APPROVED
FOR FILING
By: [illegible]
Date: 1/23/80
Amount: 25.00
FOR OFFICIAL
USE ONLY 189-131

Articles of Incorporation

—OF—

B69(983

International Field Studies Inc.
(Name of Corporation)

The undersigned, a majority of whom are citizens of the United States, desiring to form a corporation, not for profit, under Sections 1702.01 et seq., Revised Code of Ohio, do hereby certify:

FIRST. The name of said corporation shall be

International Field Studies Inc.

SECOND. The place in Ohio where the principal office of the corporation is to be located is

~~Columbus~~, ~~Franklin~~ County.
(City, Village or Township)

THIRD. The purpose or purposes for which said corporation is formed are:

(a) - Exclusively for scientific and educational purposes.

(b) - To provide opportunities for students to learn about their environment, in all disciplines, through direct field experiences; to provide the structure for developing an intensive field study program with competent leadership; to promote educational and scientific activities through direct field experiences; to cooperate with school systems so that students may receive academic credit for field studies.

(c) - To solicit, collect, and otherwise raise money for said purposes.

FOURTH. No part of the net earnings of the corporation shall inure to the benefit of or be distributed to its members, trustees, officers, or other private persons, except that the corporation shall be authorized and empowered to pay reasonable compensation for services rendered and to make payments and distributions in furtherance of the purposes set forth in Article Third hereof. No substantial part of the activities of the corporation shall be the carrying on of propaganda, or otherwise attempting, to influence legislation, and the corporation shall not participate in, or intervene in (including the publishing or distribution of statements) any political campaign on behalf of any candidate for public office. Notwithstanding any other provision of these articles, the corporation shall not carry on any other activities not permitted to be carried on (a) by a corporation exempt from Federal income tax under section 501(c)(3) of the Internal Revenue Code of 1954 (or the corresponding provision of any future United States Internal Revenue Law) or (b) by a corporation, contributions to which are deductible under Section 170(c)(2) of the Internal Revenue Code of 1954 (or the corresponding provision of any future United States Internal Revenue Law).

FIFTH. Upon the dissolution of the corporation, the Board of Trustees Shall, after payment or making provision for the payment of all the liabilities of the corporation, dispose of all of the assets of the corporation exclusively for the purposes of the corporation in such a manner, or to such organization or organizations organized and operated exclusively for charitable, educational, religious, or scientific purposes as shall at the time qualify as an exempt organization of organizations under section 501(c)(3) of the Internal Revenue Code of 1954 (or the corresponding provision of any future United States Internal Revenue Law), as the Board of Trustees shall determine. Any of such assets not so disposed of shall be disposed of by the Court of Common Pleas of the county in which the principal office of the corporation is then located, exclusively for such purposes or to such organization or organizations, as said Court shall determine, which are organized and operated exclusively for such purposes.

SIXTH
~~FOURTH~~ The following persons, not less than three, shall serve said corporation as trustees until the first annual meeting or other meeting called to elect trustees.

GIVE STREET AND POST OFFICE ADDRESS

~~Walter B. Bohl~~
34 Sheffield Rd., Columbus, Ohio
Herbert K. Linzell
~~183 E. College Ave., Westerville~~, O.

Robert H. McBurney
~~6616 Worthington-Galena Rd.~~
Worthington, Ohio
David Holl
200 West Granville Rd. Worth. O.

IN WITNESS WHEREOF, We have hereunto subscribed our names, this 15th day of July, 19 70.

Walter B. Bohl
Walter B. Bohl

Herbert K. Linzell
Herbert K. Linzell

Robert H. McBurney
Robert H. McBurney

(INCORPORATORS' NAMES SHOULD BE TYPED OR PRINTED BENEATH SIGNATURES)

N. B. Articles will be returned unless accompanied by Form C-103 designating statutory agent.

See Section 1702.06, Revised Code.

Form C-103 Prescribed by Secretary of State Ted W. Brown B690 985

Original Appointment of Agent

The undersigned, being at least a majority of the incorporators of _____
(Name of Corporation)

International Field Studies Inc.,

hereby appoint Walter Benson Bohl,
(Name of Agent)

a natural person resident in the county in which the corporation has its principal office, ~~a corporation having a business address in the county in which~~ International Field Studies Inc.,
(Name of Corporation)

~~has its principal office~~ (strike out phrase not applicable), upon whom (~~which~~) any process, notice or demand required or permitted by statute to be served upon the corporation may be served. His (~~Its~~)

complete address is 34 Sheffield Road, Columbus,
(Street or Avenue) (City or Village)

Franklin County, Ohio, 43214.
(Zip Code)

International Field Studies Inc.
(Name of Corporation)

Walter Benson Bohl
Walter Benson Bohl

Herbert K. Linzell
Herbert ~~Kinkead~~ Linzell

Robert McBurney
Robert McBurney

David Holl
David Holl

(INCORPORATORS NAMES SHOULD BE TYPED OR PRINTED BENEATH SIGNATURES)

34 Sheffield Road Columbus, Ohio

July 14, 1970

International Field Studies Inc.
(Name of Corporation)

Gentlemen: I, ~~It~~ (strike out word not applicable) hereby accept(~~s~~) appointment as agent of your corporation upon whom process, tax notices or demands may be served.

Walter Benson Bohl
(Signature of Agent or Name of Corporation)

By Walter Benson Bohl
(Signature of Officer Signing and Title)

Remarks: All articles of incorporation must be accompanied by an original appointment of agent. There is no filing fee for this appointment.

Appendix M

International Field Studies
Tax Exempt Status in the U.S.

Address any reply to: P. O. Box 476, Cincinnati, Ohio 45201

Department of the Treasury

Internal Revenue Service

MAY 2 8 1971

442:22:JMR
CIN:EO:71:409

International Field Studies, Inc.
280 E. Broad Street
Columbus, OH 43215

Purpose(s): Educational & Scientific
Accounting Period Ending: June 30

Gentlemen:

Based on information supplied, we have determined that you are exempt from Federal income tax under section 501(c)(3) of the Internal Revenue Code as it is shown that you are organized and will be operated exclusively for the purpose(s) listed above.

This determination assumes your operations will be as stated in your exemption application. Any changes in operations from those described, or in your character or purposes, must be reported immediately to our office for consideration of their effect upon your exempt status. You must also report any change in your name or address.

In this letter we are not determining whether you are a private foundation as defined in new section 509(a) of the Code. When regulations are developed to implement the provisions of section 509 of the Code, we will let you know how to establish your foundation status if you believe you are not a private foundation.

If upon issuance of the regulations we determine that you are a private foundation, you will be required to comply with the provisions of section 508(e), which specifies that a private foundation is not exempt unless its governing instrument includes certain provisions set forth in that section and the regulations thereunder. Failure to comply with the requirements of section 508(e) will result in retroactive revocation of this determination.

For years beginning on and after January 1, 1970, you may be required to file an information return, Form 990. Please refer to the instructions accompanying the Form 990 for that particular year to determine whether you are required to file. If filing is required, you must file the Form 990 by the 15th day of the fifth month after the close of your annual accounting period as shown above. Failure to file the Form 990 by this date may subject you to a penalty of $10.00 for each day during which such failure continues, up to a maximum of $5,000.00.

You are not required to file Federal income tax returns unless you are subject to the tax on unrelated business income under section 511 of the Code. If you are subject to this tax, you must file an income tax return on Form 990-T. In this letter we are not determining whether any of your present or proposed activities is unrelated trade or business as defined in section 513 of the Code.

You are not liable for Federal unemployment taxes. You are liable for social security taxes only if you have filed waiver of exemption certificates as provided in the Federal Insurance Contributions Act.

Contributions made to you are deductible by donors as provided in section 170 of the Code. Bequests, legacies, devises, transfers or gifts to or for your use are deductible for Federal estate and gift tax purposes as provided under sections 2055, 2106, and 2522 of the Code.

This is a determination letter.

Very truly yours,

Paul A. Schuster
District Director

Appendix N

International Field Studies
Public Status in the U.S.

Address any reply to: P. O. Box 476, Cincinnati, Ohio 45201
Department of the Treasury
Tel. (513) 684-2826
District Director
Internal Revenue Service

Date: NOV 2 1971

In reply refer to: 442:22 :BLM

International Field Studies, Inc.
280 E. Broad Street
Columbus, OH 43215

We have reevaluated your foundation status notice and have determined you are not a private foundation within the meaning of section 509(a) of the Code because you are an organization described in section 509(a)(2).

Very truly yours,

Paul A. Schuster

Paul A. Schuster
District Director