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Editor: John Lawrence
Department of Biology
University of South Florida
Tampa, Florida 33620, U.S.A.

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The newsletter contains information concerning meetings and conferences, publications of interest to echinoderm biologists, titles of theses on echinoderms, and research interests and addresses of echinoderm biologists. Individuals who desire to receive the newsletter should send their name and research interests to the editor.

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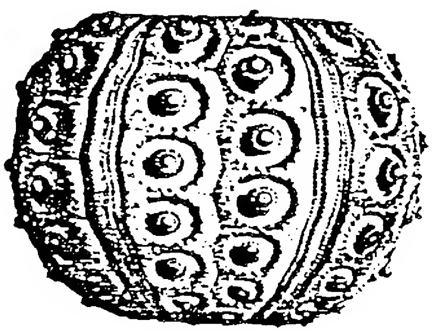

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Table of Contents

ECHINODERM SPECIALISTS

Albuquerque, Maria da. Universidad Santa Ursula, Dept de Ciencias Biologica, Rua Fernando Ferrari, 75 Botafol, Rio de Janeiro, Brasil

Aldrich, Frederick Allen. Department of Biology, Memorial University, St. John's, Newfoundland A1C 5SF, Canada

Ali, Mohamed Said M. Department of Geology, Faculty of Science, El Minia University, El Minia, Egypt

Alva, Victor. Laboratoire Biologie Marine (CP.160), Universite Libre de Bruxelles, 50, Av. F.D. Roosevelt, Bruxelles, Belgium

Alvarez, Leonardo Ramon. Colorado #79, Napoles, Mexico D.F. 03810, Mexico

Alvarez, Martinez de Saavedra. Departmento de Zoologia, Universidad de la Laguna, Tenerife, Canary Islands

Andrade, Hector. Universidad de Valparaiso, Instituto de Oceanogia, Casilla 13-D, Vina Del Mar, Chile

Arendt, Yurii A. Paleontological Institue of the Academy of Sciences, Profsojouznaja str., 113, 117321 Moscow USSR

Arnaud, Patrick M. Centre d'Oceanologie de Marseilles Station Marine d'Endoume, 13007 Marseilles France

Aronson, Richard B. 101-06 67 Drive, Forest Hills, NY 11375, USA

Ausich, William I. Department of Geology & Minerology, 125 South Oval Mall, The Ohio State University, Columbus, OH 43210, USA

Austin, William. Khoyatan Marine Laboratory, 4635 Alder Glen Rd., RR1, Cowichan Bay, British Columbia, VOR INO Canada

Baker, Alan, National Museum of New Zealand, Private Bag, Wellington, New Zealand

Ball, Brendan John. Zoology Department, University College, Galway, Ireland

Baron, Clifford. Department of Zoology, University of California, Berkeley, CA 94720, USA

Barker, Michael Frances. Protobello Marine Laboratory, P.O. Box 8, Portobello Dunedin, New Zealand

Baron, Clifford. Dept. of Zoology, University of California, Berkeley, CA 94720 USA

Bartsch, Ilse. Biologische Anstalt Helgoland, Notkestr. 31 2000 Hamburg, Federal Republic of Germany

Basch, Larry. City of San Diego Marine Biology Section, Point Loma Laboratory, 4077 N. Harbor Drive, San Diego, CA 92101, USA

Baskar, B.K. Central Marine Fisheries Research Institute, E.R.G. Road, Ernaculam, Cochin - 682031, India.

Baumiller, Tomasz K. Dept. of Geophysical Sciences, University of Chicago, 5734 S. Ellis Ave., Chicago, IL 60637, USA

Beamon, Joe. Geology Dept., West Georgia College, Carrollton, GA 30118, USA

Beaver, Harold H. Dept. of Geology, Baylor University, Waco, TX 76798, USA

Bell, Bruce. New York State Museum, Collections Management Section, State Education Bldg. Annex 962, Albany, NY 12234, USA

Belyaev, George M. Institute of Oceanology, USSR Academy of Sciences, Krassikova str., 23, Moscow 117218, USSR

Bergen, University of. Institute of Marine Biology, N-5065 Blomsterdalen, Norway

Berger, Jacques. University of Toronto, Department of Zoology, Toronto, Ontario M5S 1A1, Canada

Bermuda Biological Station, Library, St. George's West, 1-15, Bermuda

Bernasconi, Irene. Museo Argentino de Cienceas Naturales, "Bernadino Rivadavia", Avda Angel Gallardo 470, Casilla de Corea 10-Surcursal 5, 1405 Buenos Aires, Argentina

Billett, David Stewart Martin. The Institute of Oceanographic Sciences, Deacon Laboratory, Brook Rd., Wormley, Godalming, Surrey GU8 SUB, U.K.

Birkeland, Charles Evans. Marine Laboratory, UOG Station, Mangilao, Guam 96923

Birtles, Alastair. James Cook University of N. Queensland, School of Biological Sciences, Marine Biology Department, Townsville, QLD 4811, Australia

Black, W. Robert. Depart. of Zoology, The University of Western Australia, Nedlands, Western Australia, 6009, Australia

Blake, Daniel. Dept. Geology, 245 NHB, Univ. of Illinois, 1301 W. Green St., Urbana, IL 61801, USA

Bockelie, Johan Fredrik. Norsk Hydro Exploration, P.O. Box 200, N-1321 Stabekk, Norway

Boczarowski, Andrezej. Silesian University, Department of Earth Science, Mielczarskiego Str. 60, 41-200 Sosnowiec, Poland

Booth, Jr., Billy B. Mote Marine Laboratory, 1600 City Island Park, Sarasota, FL 33577, USA

Boudouresque, C.F. Faculte des Sciences de Luminy, Laboratoire d'Ecologie du Benthos et de Biologie Vegetale Marine, 13288 Marseille Cedex 9, France

Bouland, Catherine. Laboratoire de Biologie Marine, Universite Libre de Bruxelles, C.P. 160, B 1050, Bruxelles, Belgium

Bosch, Isidro. Harbor Branch, Oceanographic Institution, 5600 Old Dixie Highway, Fort Pierce, FL 33450, USA

Brandt, Danita. Dept. of Geography and Geology, Eastern Michigan University, Ypsilanti, MI 48197, USA

Branstrator, Jon W. Department of Geology, Earlham College, Richmond, IN 47374, USA

Bray, Richard D. 176 West Main St., Port Jervis, New York 12771, USA

Breimer, Albert. Rijksmuseum van Geologie en Mineralogie, Garenmarkt 1B, 2311 PG Leiden, Netherlands

Breton, Gerard. Museum d'Histoire Naturelle, Place du Vieux Marche, 76600 le Havre, France

Briscoe, C. Shannon, Dept. of Biology, Rider College, Lawrenceville, N.J. 08648, U.S.A.

British Museum (Natural History), Paleontological Library, Cromwell Road, London SW7, England

Brito, Ignacio Machado. Instituto de Geociencias, U.F.R.J. - C.C.M.N., Ilha o Fundao, 21910 Rio DeJaneiro, Brazil

Broadhead, Thomas W. University of Tennessee, Department of Geological Science, Knoxville, TN 37996-1410 USA

Broom, D.M. Department of Pure and Applied Zoology, University of Reading, Reading RGG 2AJ, England

Brower, James C. Dept. of Geology, Syracuse University, Syracuse, NY 13244-1070, USA

Brumbaugh, Joe H., Dept. of Biology, Sonoma State University, Rohnert Park, CA 94928, USA

Brunel, Pierre. Depart. de Sciences Biologiques, Universite de Montreal, Casier Postal 6128, Succursale A., Montreal, Quebec, H3C 3J7, Canada

Bundesanstalt fur Bodenforschung, Bibliothek-L., 3 Hannover-bucholz, Postfach 54, Stilleweg 2, Germany DBR(FRG)

Bureau, Fabrice. Laboratoire de Biologie Marine, 73, Avenue Marstriau (Batiment 4) 7000 Mons, Belgium

Burke, Robert D. Department of Biology, University of Victoria, Victoria, British Columbia V8W 2F2, Canada

Bussarawich, Somchai. Phuket Marine Biological Center, P.O. Box 60, Phuket 83000, Thailand

Byrne, Maria. Dept. of Zoology, University of Sydney, Sydney, N.S.W., Australia

California Academy of Sciences. Invertebrate Zoology Department, Golden Gate Park, San Francisco, California 94118 USA

Cameron, R. Andrew. Division of Biology 156-29, California Institute of Technology, Pasadena, CA 91125

Campbell, Andrew. School of Biological Sciences, Queen Mary & Westfield College, University of London, Mile End Rd., London E1 4NS, London, U.K.

Campbell, David B. Biology Dept., Rider College, Lawrenceville, NJ 08648, USA

Candia Carnevali, M. Daniele. Universita degli Studi, Dipartmento di Biologia, Via Celoria 26, 20133 Milano, Italy

Cannon, L.R.G. Curator of Lower Invertebrates, Queensland Museum, Gregory TCE, Brisbane QLD 4006, Australia

Carey, Andrew G. Jr., School of Oceanography, Oregon State University, Corvallis, OR 97331, USA

Carpenter, Robert C. Dept. of Biology, California State University, Northridge, CA 91330, USA

Carson, Sally. Department of Zoology, Biological Sciences Building, University of Alberta, Edmonton, T6G LE9

Caso Maria Elena. Inst. de Cinencias del Mar y Limnologia, La. de Ecologia de Equinodermos, Apartado Postal 70-305, 04510, Mexico

Caster, Kenneth. Department of Geology, University of Cincinnati, Cincinnati 21, OH, USA

Castillo, Juan Carolos. Ecologia Marina, Fac. C. Biologicas, U. Catonia de Chile, Casilla 114-D Stgo, Chile de Castro Manso, Cynthia Lara. Departamento de Zoologia, Universidade Federal do Parana, Cursio de Pes Graduacao - Zoologia, Centro Politecnico CX.P.19.020, 81.504-Cueitiba-PR, Brasil

Castro, Peter. Biological Sciences Department, California Poytechnic Institute, Pomona, CA 91768-4032, USA

Center for Marine Research. Library. "Rudjer Boskovic" Institute, 52210 Rovinj, Yugoslavia

Centro de Biologia Marinha, Librarian. C.P. 83, Sao Sebastiano, Sao Paulo, Brazil

Centro de Investigacion de Biologia Marina. cc No 157 (1650) San Martin, Buenos Aires, Argentina

Chaet, A.B. Dept. of Biology, University of West Florida, Pensacola, FL 32514, USA

Chao, Shyh-min. Department of Biology, Tunghai University, Taichung, Taiwan, Republic of China

Chauvel, Jean. Institut de Geologie, Laboratoire de Paleontologie, Avenue du General Leclerc. Campus de Beauticu, 35042 Rennes Cedex, France

Chen, Chang-Po., Institute of Zoology, Academia Sinica, Nankan, Taipei, Taiwan 11529, Republic of China

Cherbonnier, Gustave. Laboratoire du Biologie des Invertebres Marins, 55 rue de Buffon, 75005 Paris, France

Chita, Bernarda Guisado A. Ecologia Marina Pont, Universidad Catolica de Chile, Casilla 114-D, Santiago, Chile

Chia, Fu-Shiang. Dept. of Zoology, University of Alberta, Edmonton, Alberta, T6G 2E9, Canada

Chiu, Sein Tuck. Depart. of Biology, Hong Kong Baptist College, 224 Waterloo Road, Kowloon, Hong Kong

Christensen, Aage Moeller, Marinbiologisk Laboratorium Kobenhavns, Universitet Strandpromendaden, 30000 Helsinger, Denmark

Clark, Ailsa McGown. Gyllyngdune, South Road, Wivelsfield Green, Haywards Heath, RH17 7QS Sussex, Great Britain

Cobb, James L.S. Gatty Marine Lab, St. Andres, Fife, Scotland, Great Britain

Conand, Chantal. Universite de Bretagne Occidentale, Laboratoire de biologie animale, 29283 Brest, France

Concepcion, Marcos. Departamento de Ecologia, Facultad de Biologia, Universidad de Murcia, Murcia, Spain

Costelloe, John. Zoology Department, U.C.G., Galway, Ireland

Cuenca, Catherine. Museum Histoire de Nantes, 12 rue Voltaire, 44000 Nantes, France

Couillard, Pierre. Dept. Sc. Biologiauer, Universite de Montreal, CP6128 Succ A Montreal H3C3J7, Canada

Coulon, P. Laboratoire de Biologie marine CP 160, Universite Libre de Bruxelles, 50 av. F.D. Roosevelt, B-1050 Bruxelles

Cutress, Bertha M. Dept. of Marine Sciences, University of Puerto Rico, P.O. Box 5000, Mayaguez, PR 00709-5000

Dafni, Jacob. Interuniversity Institute, P.O.B. 469 Eilat 88103, Israel

David, Bruno. Institut des Sciences de la Terre, 6 bd Gabriel, 21100 Dijon, France

Davis, Karen K. University of California, Applied Siences Building, Santa Cruz, CA 95064, USA

Dayton, Paul K., III. Department of Zoology, PKO A001, Scripps Institution of Oceanography, La Jolla, CA 92093, USA

De Araujo, Mascarenhas, Bernardo Jose. Museu Nacional, Quinta Da Boa Vista S/No, Departmento de Invertebrados - Equinodermatologia Sao Cristovao, Rio de Janeiro, Brasil

De Greef, Yves. Laboratoire de Biologie Marine, C.P. 160, Universite Libre de Bruxelles, av. F.D. Roosevelt, 50, B-1050 Bruxelles, Belgium

De Moura-Britto, Mauro. Departmento de Zoologia, Universidad Federal do Parana, Cx. P. 3034 Curitiba, PR 80000, Brasil

De Ridder, Chantal. Laboratoire de Biologie Marine (C.P. 160), Universite Libre de Bruxelles, 50 W.F.D. Roosevelt, B-7050 Bruxelles, Belgium

Dearborn, John H. 321 Murray Hall, Department of Zoology, University of Maine, Orono, Maine 04469, USA

DeCelis, Alexandro K. National Museum, Executive Building, Rizal Park, Ermita, Manila, Philippines

Delavault, Robert. Laboratoire de Biologie Cellulaire et Animale, Universite d'Orleans, 45045 Orleans Cedex, France

Delmas, P. Laboratoire de Zoologie Marine, CERAM, Universite d'Aix-Marseille III, av. Escadrille Normandie-Niemen (CP 342) F-13397 Marseille Cedex 13, France den Besten, Pieter Jacobus. Experimental Zoology, University of Utrecht, P.O. Box 80058 3508 TB Utrecht, The Netherlands

Derstler, Kraig L. Dept. of Geology, University of New Orleans, New Orleans, LA, USA

Deutzmann, Helmut. Stueckerstr. 4, 4000 Duesseldorf, W. Germany

Dix, Trevor G. Fisheries Research Laboratory, Taroona, Tasmania 7006, Australia

Dobson, William E. Dept. of Science and Math, Coker College, Hartsville, SC 29550, USA

Donovan, Stephen Kenneth. Department of Geology, University of the West Indies, Mona, Kingston 7, Jamaica

Dravage, Philip. The Felsenbrau Brewery Bld., 244 W. McMicken Ave., Cincinnati, OH 45214, USA

Drozdov, Anatoly L. Institute of Marine Biology, Far East Branch Academy of Sciences of USSR Vladivostok, 690032, USSR

Dube, Francois. Dept. of Oceanography, Univ. of Quebec at Rimouski, Rimouski, Quebec, G5L3A1 Canada

Dubois, Philippe. Laboratoire de Biologie, Marine CP160, Universite Libre de Bruxelles, F.D. Rossevelt, 50, B1050 Bruxelles, Belgium

Dufresne-Dube, Louise. Universite du Quebec a Rimouski, Department d'Oceanographie, Rimouski, Quebec, Canada

Durbaum, Johannes. Ostermannsweg 5, 4830 Gutersloh, Federal Republic of Germany.

Durham, J. Wyatt. Depart. of Paleontology, University of California, Berkely, CA 94720, USA

Ebert, Thomas, Dept. of Biology, San Diego State University, San Diego, CA 92182-0057. U.S.A.

Eckelbarger, Kevin J. Darling Center, University of Maine, Walpole, ME, 04573, USA

Eckert, James D. 16 West Hampton Rd., St. Catharines, Ontario, L2T 3E5, Canada

Eeckhaut, Igor. Universite de Mons, Laboratoire de Biologie Marine, 19 Av. Maistriau, 7000 Mons, Belgium

Ellers, Olaf. Dept. of Zoology, Duke University, Durham, N.C. 27706, USA

Emlet, Richard B. Dept. of Biology, University of Southern California, Los Angeles, CA 94720, USA

Emson, Roland. Zoology Department, Kings College, Strand, London WC2 R2L5, England

Endean, Robert. Depart. of Zoology, University of Queensland. St. Lucia, Queensland, 4067, Australia

Endelman, Leonid G. Paleontological Institute, Academy of Sciences of the USSR, Profsojusnaaja ul., I23, II7868 GSP-7, Moscow v-321, USSR

Enrique, Bay-Schmith. Depto. Biologia Molecular, Universidad de Concecpion, Cas. 2407 Concepcion, Chile

Escoubet, P. Fondation Oceanographique Ricard, Ile des Embiez, Le Brusc, 83140 Six Fours Les Plages, France

Ettenson, Frank R. Depart. of Geological Sciences, University of Kentucky, Lexington, KY 40504-0059, USA

Eylers, John P. Depart. of Pharmacology, Box 3813, Duke University Medical Center, Durham, NC 27710, USA

Fankboner, Peter V. Department of Biological Sciences, Simon Fraser University, Burnaby, B.C. V5A 1S6 Canada

Farmanfarmaian, A. Verdi. Nelson Biology Lab, Rutgers University, Piscataway, NJ 08855, USA

Fechter, Hubert. Zoologische Staatssammlung, Munchhausenstr. 21, D-8000 Muenchen 60, Federal Republic of Germany

Feder, Howard. Institute of Marine Science, University of Alaska, Fairbanks, Alaska 99701, USA

Fenaux, Lucienne. Station Zoologique (CEROV) BP 28, 06230 Villefranche sur Mer, France

Feral, Jean-Pierre. Laboratoire Arago, 66650 Banyuls - sur Mer, France

Ferguson, John C. Department of Biology, Eckerd College, Box 12560, St. Petersburg, FL 33733, USA

Ferrand, Jean-Guy. Lab. Biologie Cellulaire et Animale, UER Sciences, Universite d'Orleans, F 45046 Orleans Cedex, France

Fishelson, Lev. Dept. of Zoology, Tel-Aviv University, Tel-Aviv, Israel

Flammang, Patrick. Universite de Mons, Laboratoire de Biolgoie Marine (Bat. IV) 19, Av. Maistriau, B-7000 Mons, Belgium

Fleming, Timothy Philip. Dept. Geology, University Montana, Missoula, Monatana 59812, USA

Fontaine, Arthur R. Depart. of Biology, University of Victoria, Victoria, B.C. V8W 2Y2, Canada

Foster, Merrill W. Dept. of Geological Sciences, Bradley University, Peoria, IL 61625, USA

Foster, Robert J. BHP Petroleum, GPO Box 1911R, Melbourne, Victoria 3000, Auatralia

Fouda, Moustafa M. Dept. of Zoology, Al-Ashar University, Nasr-City, Cairo, Egypt

Fournier, Daniel. Museum d'Histoire Naturelle, 1 rue Dolomieu, F-3800 Grenoble, France

Fox, David J., Zoology Department, The Univ. of Tennessee, Knoxville, TN 37996-0810, USA

Frankel, Edgar. Geology Dept., University of Technology, P.O. Box 123, Broadway 2007, Sydney, Australia

Franklin, Juan Troncoso Fierro. Museo Regional de Concepcion, Casilla 1054, Conceptcion, Chile

Franz, David R. Biology Dept., Brooklyn College, CUNY, Brooklyn, N.Y. 11210, USA

Franzen-Bengtson, Christina. Paleontologiska Institutionen, Box 558, S-751 22 Uppsala, Sweden

Fujita, Toshihiko. Ocean Research Institute, University of Tokyo, Minamidai, Japan

Gage, John D. Scottish Marine Biolgical Assoc., Dunstaffnage Marine Laboratory, P.O. Box 3, Oban, Argyll, Scotland PA34 4AD, U.K.

Gagnon, Jean-Marc. Depart. of Biology, Memorial Univ. of Newfoundland, St. John's A1B-3X9 Canada

Gallemi, Jaume. Museu de Geologia, Parc de la Ciutadella S/N, 08003 Barcelona, Spain

Gebruk, Andrew V. Institute of Oceanography, USSR Academy of Sciences, Krassikova str., 23, Moscow 117 218, USSR

Gentil, Franck. Station Biologique, Place G. Teissier, F-29211 Roscoff, France

George, Sophie. Station Zoologique BP 28, Quai de la Darse, F-06230 Villefranche sur Mer, France

Ghiold, Joe. Depart. of Geology, Louisiana State University, Baton Rouge, LA 70808, USA

Ghyoot, Marianne. Laboratoire de Biologie Marine, Universite Libre de Bruxelles, 50 Av., F.D. Roosevelt, 1050 Bruxelles, Belgium

Giese, Arthur C. Dept. of Biology, Stanford University, Stanford, CN 97305, USA

Giordano de Freitas, Solange. Museu Nacional, Quinta da Boa, Vista/UFRJ, Departamentao de Invertebrados, Echinodermatologia, Sao Cristovao - RJ CEP 20942, Brasil

Giudice, Giovanni. Departimento di Biologia, Cellulare e dello Sviluppo, via Archirafi 20-90123, Palermo, Italy

Gluchowski, Edward. Depart. of Earth Sciences, Silesian University, Lab. of Paleontology & Stratigraphy, Mielczarskiego Str. 60, 41-200 SOSNOWIEC, Poland

Glynn, Peter W. RSMAS, University of Miami, 4600 Rickenbacker Causeway, Miami, FL 33149, USA

Golden, Julie. Dept. Geology, University of Iowa, Iowa City, IA 52242, USA

Gordon, Carla M. University of the West Indies, Mona, Kingston 7, Jamaica

Grange, Ken Robert. NZ Oceanographic Institute, DSIR, Private Bag Kilbirnie, Wellington, New Zealand

Guensburg, Thomas E. Dept. of Geography and Earth Science, Campus Box 1459, Southern Illinois University, Edwardsville, IL 62026, USA

Guille, Alain. Laboratoire Arago, 66650 Banyuls-Sur-Mer, France

Guillou, Monique. Laboratoire d'Oceanographie Biologique, 6 Avenue Le Gorgeu, 29283 Brest Cedex, France

Guisado Aranguiz, Chita B., Instituto de Zoologia, Universidad Austral de Chile, Casilla 567, Valdivia, Chile

Gulf Coast Research Lab., Library. East Beach, Ocean Springs, Mississippi 39564, USA

Gutt, Julian. Alfred Wegener Institute for Polar and Marine Research, Columbusstrasse, D-2850, Bremerhaven, Fed. Rep. of Germany

Haedrich, Richard L. Newfoundland Inst. for Cold Ocean Sci., Memorial University, St. John's, Newfoundland A1B 3X7, Canada

Hammond, Laurence Stuart. Victorian Institute of Marine Sciences, 14 Parliament Place, Melvourne, Victoria 5002, Australia

Harmelin, Jean-Georges, Station Marine d'Endoume, 13007 Marseille, France

Harris, Larry G. Zoology Department, University of New Hampshire, Durham, New Hampshire 03824, USA

Harrold, Christopher. Research Division, Monterey Bay Aquarium, 886 Cannery Row, Monterey, CA 93940, USA

Haude, Reimund. Institute u. Museum fur Geologie u. Palaontology, Goldschmidt-Str. 3, D-3400 Gottingen, Fed. Rep. of Germany

Hay, Mark. Institue of Marine Science, 3407 Arendell St., Morehead City, NC 28557

Heddle, Duncan. Department of Zoology, University of Aberdeen, Tillydrone Ave., Aberdeen AB9 2TN, Scotland

Hellal, A.M. Zoology Dept., Al-Azhar University, Nasr-City, Cairo, Egypt.

Hendler, Gordon. Natural History Museum, Section of Invertebrates, 900 Exposition Blvd., Los Angeles, CA 90007 USA

Herring, P.J. Institute of Oceanographic Sciences, Brook Road, Wormley, Surrey GU8 5UB, England

Hess, Hans K. Im Gerstenacker 8, CH-4102 Binngen, Switzerland

Hidemi, Sato. Sugashima Marine Biological Laboratory, Nagoya University, Sugashima, Toba, Mie 517, Japan

Highsmith, Raymond. Institute of Marine Science, University of Alaska, Fairbanks, Alaska 99775-1080, USA

Hill, Robert B. Dept. of Zoology, University of Rhode Island, Kingston, R.I. 02881, USA

Himmelman, John H. Department de Biologie, Universite Laval, Quebec G1K 7P4, Canada

Hiroshi, Mukai. Ocean Research Institute, University of Tokyo, 1-15-1 Minamidai, Nakano, Tokyo 164, Japan

Holland, Nicholas Drew. Marine Biology, Division A-008, Scripps Institution of Oceanography, La Jolla, CA 92093. U.S.A.

Hopkins, Thomas S. Dauphin Island Sea Lab, Box 369, Dauphin Island, AL 36528, USA

Horowitz, Alan Stanley. Depart. of Geology, Indiana University, Bloomington, Indiana, USA

Hoshi, Motonori. Dept. Life Science, Tokyo Inst. Technology, O-okyama, Tokyo 152, Japan

Hotchkiss, Frederick H.C. 26 Sherry Rd., Harvard, Mass. 01451, USA

Imaoka, Tohru. 2804-3 Katata, Shirahama, Nishimura, Wakayama 649-22, Japan

Instituto de Biocciencias, Librarian. Departamento de Fisiologia, Univ. of Sao Paulo, C.P. 11.461, Sao Paulo, Brazil

Irimura, Seiichi. Totsuka Senior High School, 2-27-1 Gumisawa, Totsuka-ku, Yokohama 245, Japan

Irvine, Gail V. U.S. Dept. of Interior, MMS, EA. P.O. Box 101154, Anchorage, AK 99510-1159, USA

Jablonski, David. Dept. of Geophysical Sciences, University of Chicago, Chicago, IL 60637, USA

James, D.B. Tuticorin Research Centre, Central Marine Fisheries Research Institute, 90 North Beach Road, Tuticorin 628001, India

Jangoux, Michel. Laboratoire de Biologie Marine, Universite Libre de Bruxelles, 50 Avenue F.D. Roosevelt, 1050 Bruxelles, Belgium

Jeal, Frank. Zoology Department, Trinity College, Dublin 2, Ireland

Jefferies, R.P.S. Department of Paleontology, British Museum (Natural History), Cromwell Rd., London SW7 5BD, England

Jellett, Joanne F. 47 Wake Up Hill Rd., RR.#1, Chester Basin, N.S. Bojiko, Canada

Jensen, Margit. Zoological Museum, Universitetsparken 15, DK-2100 Copenhagen O, Denmark

Jesionek-Szymanska, Wanda. Zaklad Paleobiologii PAN, al. Zwirki i Wigury 93, 02-089 Warszawa, Poland

Jones, Ira. Dept. of Biology, California State University, Long Beach, CA 90840, USA

Jyo, Taki. Hokkaido Abashiri Fisheries, Experimental Station, Abashiri, Hokkaido 099-31, Japan

Kammer, Thomas W. Dept. of Geology, West Virginia University, Morgantown, WV 26506, USA

Kanazawa, Kenichi. Dept. of Geology, Kyoto University, Kyoto 606, Japan.

Kasyanov, Vladimir L. Institute of Marine Biology, Vladivostok 690022, USSR

Kawamura, Kazuhiro. Hokkaido Central Fisheries, Experimental Station, Yoichi, Hokkaido, Japan

Kazuhiro, Kawamura. Hokkaido Central Fisheries, Experimental Station, Yoichi, Hokkaido, Japan

Keegan, Brendan F. Department of Zoology, University College, Galway, Erie

Keller, Brian D. Smithsonian Tropical Research Institute, APT Miami, FL 34002-0011, USA

Keough, M.J. Zoology Department, The University of Mebourne, Adelaide, S.A., Australia

Kesling, R.V. Museum of Paleontology, University of Michigan, Ann Arbor, MI 48109, USA

Kettle, Brett Thomas. P.O. Box 959, Townsville, Q 4810, Australia

Kikuchi, Taiji. Amakusa Marine Biological Laboratory, Kyushu University, Tomioka, Reihoku cho, Amakusa, Kumamoto 863-25, Japan

Klikushin, Vladimir G. Leningrad Mining Institute, 199026 Leningrad, USSR

Klinger, Thomas Scott. Department of Biological and Allied Health Sciences, Bloomsburg University, Bloomsburg, Pennsylvania 17815, USA

Kobayashi, Naomasa. Biological Laboratory, Doshisha University, Kamikyo-ku-Kyoto 602, Japan

Kojima, Manabu K. Department of Biology, Toyama University, Gofuku 3190, Toyama shi/ken 930, Japan

Kolata, Dennis R. Illinois State Geological Survey, Nautral Resources Building, 615 E. Peabody, Champaign, IL 61820, USA

Komatsu, Mieko. Department of Biology, Faculty of Science, Toyama University, Toyama 930, Japan

Kosir, Adrijan. Pot K Trojici 5, 61360 VRHNIKA, Yugoslavia.

Krishnan, Mary Bai. Marine Biological Station, Zoological Survey of India, 12, Leithcastle Street, Madras 28, India

Krishnarajah, Padmini. University of Jaffna, Dept. of Zoology, Jaffna, Sri Lanka

Kristan-Tollmann, Edith M.K. Scheibenbergstrasse 53, A-1180 Wien, Austria

Kyte, Michael A. ARDEA Enterprises, P.O. Box 2602, Lynnwood, WA 98290, USA

LaBarbara, Michael. Department of Anatomy, The University of Chicago, 1025 East 47th Street, Chicago, Illinois 60637, USA

Lahaye, Marie-Christine. Laboratoire de Biologie Marine, C.P. 160, Universite Libre de Bruxelles - 50 mr F.D. Roosevelt,1050 Bruxelles, Belgium

Lambert, Philip. Biology Section, Royal British Columbia Museum, 675 Belleville St., Victoria B.C., V8V 1X4, Canada

Lane, N. Gary. Geology Dept., Indiana University, Bloomington, IN 47405, USA

Larrain, Alberto P. Dept. of Zoology, University of Concepcion, Casilla 2407,APDP. 10, Concepcion, Chile

Laverack, M.S. Gatty Marine Lab., University of St. Andrews, Fife, Scotland KY168L3

Lawrence, J.M. University of South Florida, Department of Biology, 4202 Fowler Avenue, Tampa, FL 33620, USA

Leeling-Werder, Beatrix. Zoologisches Institut und Museum, Martin-Luther-King Platz 3, 2000 Hamburg 13, Federal Republic of Germany

Le Gall, Pierre. Laboratoire Maritime, rue Charcot, 14530 Luc sur Mer, France

Le Menn, Jean. Laboratoire de Paleontologie, G, av. le Gozgeu, 29283 Brest Cedex. France

Lessios, Harilaos. Smithsonian Tropical Research Institute, APO Miami, FL 34002, USA

Levin, Valery Semenovich. Institute of Marine Biology, Laboratory of Chorology, Vladivostok 690022, USSR

Levitan, Don Richard. Barnfield Marine Station, Barnfield, BC VOR 1BO, Canada

Lewis, Ronald O. Department of Geology, Auburn University, Auburn, AL 36849, USA

Lewis, David Neil. Depart. of Palaeontology, British Museum (Natural History), Cromwell Road, London SW7 5BD, England

Liao, Yulin. Institute of Oceanology, Academia Sinica, 7 Han-Hai Road, Tsingtao. People's Republic of China

Liddell, W. David. Department of Geology (07), Utah State University, Logan, UT, USA

Litvinova, Nina M. Institute of Oceanology, Academy of Sciences, Krasikova 23, Moscow 117259, USSR

Lopez-Ibor, Alicia. Catedra of Invertebrados, Facultad de Ciencias, Universidad Complutense, Madrid, Spain

Lubchenco, Jane. Department of Biology, Oregon State University, Corvallis, OR 97331-2914 USA

Lucas, John S. Zoology Department, James Cook University, Q. 4811, Australia

Mackie, A.M. Institute of Marine Biochemistry, St. Fittick's Rd., Aberdeen AB1 3RA. Scotland

Mackie, Steve A. Dept. Ecology & Evolutionary Biology, University of Arizona, Tucson. Arizona 85721, USA

Macurda, Jr., D. Bradford. The Energists, 10260 Westheimer, Suite 300. Houston, TX 77042, USA

Maczynska, Stefania-Stanislawa. Polish Academy of Sciences, Museum of the Earth, 20-26 Al. Na Skarpie, 00-488 Warsaw, Poland

Madsen, Fritz Sensenius. Universitetets Zoologiske Museum, Universitetsparken 15. DK-2100 Copenhagen, Denmark

Manchenko, Gennady P. Institute of Marine Biology, Vladivostok 690022, USSR

Maples, Christopher G. Kansas Geological Survey, 1930 Constant Ave., Lawrence, KS 66047, USA

Marcopoulou-Diacantoni, Anastasia. University of Athens-Subfac. Sciences of Earth, Dept. Stratigraphy-Geography-Climatology, Panepistimioupolis-Athens (15784), Greece

Marine Sciences Centre, Librarian, McGill University, 3600 University Street, Montreal, H3A 2T8, Canada

Markel, Konrad. Lehrstuhl f. Spezielle Zoologie, Ruhr-Universitat, Postfach 102148, D-4630 Bochum 1, Federal Republic of Germany

Marques, Vasco Manuel Alves Monteiro. Departmento de Zoologia and Antropologia, Faculdade de Ciencias de Lisboa, Rua da Ecola Politecnica - 1200, Lisbon, Portugal

Marsh, Loisette Matilda. Western Australian Museum, Francis Street, Perth, Western Australia, 6000, Australia

Marshall, Charles R. University of Chicago, Dept. of Geophysical Sciences, 5743 5th Ellis Ave., Chicago, IL 60637 USA

Martin, Richard B. Division of Fisheries, CSIRO Marine Laboratories, GPP Box 1538, Hobart, Tasmania 7001, Australia

Martin, R. Erik. Applied Biology, Inc. P.O. Box 974, Jensen Beach, FL 34958. USA

Massin, Claude. Institut Royal des Sciences Naturelles de Belgiqne, 29 rue Vautier, 1040 Bruxelles, Belgium

Maturo, Jr., Frank. Zoology Department, University of Florida, Gainesville, FL 32611 USA

McClintock, James B. Dept. of Biology, University of Alabama at Birmingham, Birmingham, AL 35294, USA

McEdward, Larry. Department of Zoology, 223 Bartram Hall, University of Florida, Gainesville, FL 32611, USA

McIntosh, George Clay. Rochester Museum and Science Center, 657 East Ave., P.O. Box 1480, Rochester, NY 14620-1480, USA

McKenzie, Douglas. Dept. of Animal Biology, The University of Sheffield, Sheffield S10 2TN, U.K.

McKenzie, J. Douglas. Department of Zoology, Queen's University, Belfast, Northern Ireland

McKinney, Michael. Dept. Geology, University of Tennessee, Knoxville, TN 37966, USA

McNamara, Kenneth J. Western Australian Museum, Francis Street, Perth, 6000, Western Australia

Meijer, Laurent. CNRS, Station Biologique, 2911 Roscoff, France

Mein, Birgit. Zoologisches Institut und Zoologishces, Museum der Universitat Hamburg, Martin-Luther-King Platz 3, 2000 Hamburg 13, Federal Republic of Germany

Menge, Bruce A. Department of Zoology, Oregon State University, Corvallis, OR 97331-2914, USA

Messing, Charles. Nova University Oceanographic Center, 8000 N. Ocean Dr., Dania, FL 33004, USA

Meyer, Christian Andreas. Geological Institute, Baltzerstr: 1, CH-3012 Bern, Switzerland

Meyer, David L. Department of Geology, 45221-0013, University of Cincinnati, Cincinnati, OH 45221-0013 U.S.A.

Mintz, Leigh W. Department of Geological Sciences, California State University, Hayward, CA 97452, USA

Mizonov, Alexander. Institute of Oceanology, Academy of Sciences, Krasikova 23, Moscow 11721S Moscow USSR

Mladenov, Philip V. Portobello Marine Laboratory, P.O. Box 8, Portobello, New Zealand.

Mooi, Richard John. Dept. on Invertebrate Zoology, California Academy of Sciences, Golden Gate Park, San Francisco, CA 94118 USA

Moore, Andrew. Gatty Marine Lab., East Sands, St. Andrews, Fife, Scotland

Moran, Peter. Australian Institute of Marine Science, P.M.B. 3, Townsville, Q 4810, Australia.

Morrill, John. Division of Natural Sciences. New College - USF, 5700 N. Trail, Sarasota, FL 34243, USA

Motokawa, Tatsuo. Department of Biology, University of Ryukyus, Nishihara, Okinawa 903-01, Japan

Moura-Britto, Mauro de. Instituto de Terras, Cartofrafia E Florestas - Rua Desembargador, Motta, 3384 - 80610 Writiba - PR. Brasil

Mu, En-zhi. Nanjing Institute of Geology and Palaeontology, Academia Sinica Nanjing, China

Mukai, Hiroshi. Ocean Research Institute, University of Tokyo, Minamidai 1-15-1, Nakano, Tokyo, 164, Japan

Munar Bernat, Jaime. Department Geologia, Fac. Chencies, Univ. Palma de Mallorca, Cartra Valldemossa, KM 7'5, 07071 Palma de Mallorca, Baleares, Spain

Muscat, Ann M. California Museum of Science & Industry, 700 State Drive, Los Angeles, CA 9037, USA

Musei Oceanographique. Biblioteque, Avenue Saint-Martin, Mc-Monaco-Ville, Monaco

Museum de Grenoble, Library. 1 Rue Dolomieu, Grenoble 38, France

Mynssen, Claudine Massi. Centro de Ciencias Biologicas, Universidade Santa Ursula, Departamento de Equinodermos, Rua Jornalista Orlando Dantas, 59 Rio de Janeiro, Brasil

Nagaoki, Satoko. Department of Biology, Keio University, 4-1-1 Hiyoshi, Kohoku-ku, Yokohama 223, Japan

Nakano, Eizo. Department of Biology, Nagoya University, Chikusa, Nagoya 464-01, Japan

Nateewathana, Anuwat. Phuket Marine Biological Center, P.O. Box 60, Phuket 83000, Thailand

Nebelsick, James. Institut fur Palaontologie der Universitat Wien, A-1010, Universitatsstrasse F, Austria.

Neill, Bruce. Biology Department, Montana State University, Bozeman, MT 59717, USA

Nestler, Helmut. Sektion Geologische Wissenschaftern der, Ernst-Moritz-Arndt-Univer. Greifswald, Friedrich Ludwig Jahn Str. 17 a, DDR-2200 Greifswald, German Democratic Republic

New Zealand Oceanographic Institute. c/o Librarian, P.O. Box 12346, Wellington, New Zealand

Nichols, David. Department of Biological Sciences, Hatherly Laboratories, University of Exeter, Prince of Wales Road, Exeter, Ex 4 4PS, UK

Niesen, Thomas M. Department of Biological Sciences, San Francisco State University, San Francisco, CA 94132, USA

Nojima, Satoshi. Amakusa Marine Biological Laboratory, Kyushu University, Tomioka, Reihoku-cho, Amakusa, Kumamoto-ken 863-25, Japan

Oguro, Chitaru. Department of Biology, Faculty of Science, Toyama University, Toyama 930, Japan

Ohta, Suguru. Marine Ecology Division, Ocean Research Institute, University of Tokyo, Minamidai 1-15-1, Nakano-ku, Tokyo 164, Japan

Ojeda, F. Patricio. Departamento de Ecologia, Facultad de Ciencias Biologicas, Pont. Universidad Catolica, Casilla 114-D, Santiago, Chili

Oji, Tatsuo. Geological Institute, University of Tokyo, Hongo, Tokyo 113, Japan

Okada, Minoru. Science Educa. Inst. of Osaka Prefecture, Karita 4-chome, Sumiyoshi-ku, Osaka 558, Japan

Oklahoma Geological Survey. The University of Oklahoma, 830 S. Uval, Norman, OK 73019

Olver, J.B.S. 27, Westfield Avenue, Countesthorpe, Leics. LE8 3PL, United Kingdom

O'Connor, Brendan D.S. Zoology Department, University College, Galway, Ireland

O'Neill, Patricia Lynn. Dept. Zoology, University of Western Australia, Nedlands, 6009 W.A., Australia

Orler, Paricia Mabel. Cadic CC. 92 Usuaia, Tierra del Fuego, Argentina

Pabian, Roger K. Conservation & Survey Division, University of Nebraska, Lincoln, NE 68588-9517, USA

Pagett, Richard Michael. Gibb Environmental Sciences, Centruion Court, Milton Park, Milton, Nr. Abingdon, Oxfordshire, UK

Paine, Robert T. Department of Zoology, University of Washington, Seattle, WA 98195, USA

Paller, Marc S. 301 Nott St., Suite 100, Schenectady, NY 12305, USA

Parsley, Ronald L. Dept. of Geology, Tulane University, New Orleans, LA 70118, USA

Passamonte, Joseph Noel. Marine Science Institute, University of the Phillippines, P.O. Box 1, Diliman, Quezon City, Philippines

Paul, C.R.C. Dept. of Geology, Liverpool University, Liverpool, L69 3BX, England

Paulay, Gustav. Dept. of Zoology NJ-15, University of Washington, Seattle, WA 98195, USA

Pawson, David L. Room W323, National Museum of Natural History, Smithsonian Institution, Washington D.C. 20560, USA

Pearse, John S. Institute of Marine Sciences, University of California, Santa Cruz, CA 95064, USA

Pedrotti, M.L. Station Zoologique, Quai de la Darse, F-06230 Villefranche-sur-mer, France

Penchaszadeh, Pablo. INTECMAR, Univ. Simon Bolivar, Apartado 80659, Caracas, Venezuela

Pennington, J. Timothy. Kewalo Marine Lab., 41 Ahui Street, Honolulu, HI 96813, USA

Pentreath, Victor Wilson. Biological Sciences, University of Salford, Salford M5 4WT, UK

Petr, Vaclav. Geological Library, Charles University, Albertov 6, 128 43 Praha 2, Czechoslovakia

Phelan, Thomas. 122 Winnebago St., Walla Walla, WA 99362 USA

Philip, G.M. Department of Geology and Geophysics, University of Sydney, Sydney NSW, Australia

Philippe, Michel. Musee d'Histoire Naturelle, 18 Bd des Belges, 69006 Lyon, France

Pinela, Juan. Institut fur Allgemeine und Spezielle Zoologie, Stephanstrasse 24,6300 Giesen, Federal Republic of Germany.

Prestedge, Geoffrey. 16 Geeves Crescent, Midway Point, Tasmania 7171, Australia

Prince, Jane. Department of Zoology, University of Western Australia, Nederlands 6009, Western Australia, Australia

Prokop, Rudolf Jan. National Museum, Praha, Vitezneho Unora 74, 115 79 Praha 1, Czechoslovakia

Regis, Marie-berthe. CERAM - Case 3U1, Faculte der Sciences et Techniques de St. Jerome, 13397, Marseille Cedex 13, France

Regnault, Serge. Museum D'Histoire Naturelle, 12, rue Voltaire, 44000 Nantes, France

Regnell, Gerhard. Geologiska Institutionen, Solvegatan 13, S-223 62 Lund, Sweden

Rezende Ventura, Carolos Renato. Universidade Federal de Rio de Janeiro, Dept. de Biologia Marinha - UFRJ, Bl. A-CCS - liha do Funddo, Rio de Janeiro, RJ-21910, Brasil

Riddle, Steven. The Ohio State University. 125 South Oval Mall, Columbus, OH 43210 USA

Roa, Ruben. Dpto. Oceanologia, U. Concepcion, Casilla 2907-10, Conceptcion, Chile

Roberts, Dai. Zoology Department, Queen's University, Belfast BT1 1NN, N. Ireland

Robison, Richard A. Department of Geology, University of Kansas, Lawrence, Kansas 66045 USA

Rowley, Robert. Dept. Biological Sciences, Univ. of California, Santa Barbara, CA 93106, U.S.A.

Roman, Jean Paul. Institut de Paleontologie, Muscum National D'Histoire Naturelle, 8 Rue de Buffon, F 75005 Paris, France

Rose, Edward P.F. Department of Geology, Royal Holloway & Bedford New College, University of London, Egham Surrey TW20 OEX, UK

Rotman, Helen E., Shearburn Clark. National Museum of New Zealand, P.O. Box 467, Wellington, New Zealand.

Roux, Michel. Universite de Reims, Laboratoire de Geologi, B.P. 347, 51062 Reims Cedex, France

Salvat, Mariana Beatrie. Depto. de ciencias Biologicas, Fac. De Ciencias Exactas, Naturales, Ciudad Universitaria, Pab. II, 1428 Capital, Argentina.

Sastry, D. R. K. Zoological Survey of India, 27 - Jawaharlal Nehru Road, Calcutta, 700 016, India

Schigeru, Katsura. Department Oral Anatomy, School of Dentistry, Tokushima University, Tokushima, Japan

Schuhmacher, H. Universitat Essen GHS, FB 9 - Hydrobiologie, Universitatsstr 5, D-4300 Essen 1, Federal Republic of Germany

Schatt, Philippe. Museum National d'Histoire Naturelle, Laboratory Arago, 66650 Banyuls - sur-mer, France

Scheibling, Robert Eric. Department of Biology, Dalhousie Univ., Halifax, Nova Scotia, B3H 4J1, Canada

Scheltema, Rudolf S. Department of Biology, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts, 02543, U.S.A.

Schinner, Gottfried. Dept. of Biology, Univ. of Alabama at Birmingham, Birmingham, AL 35294 U.S.A.

Schmincke, Sabine. Palaontologisches Institut der Univ., Wirzburg, Pleicherwall 1, 8700 Wurzburg, Federal Republic of Germany

Schneider, Jay. Department of Geophysical Sciences, University of Chicago, Chicago, IL 60637, U.S.A.

Schoppe, Sabine. Institut fur Allgemeine und Spezielle Ziologie, Justus - Liebig - Universitat, Giesen, Germany.

Schroeter, Stephen. 531 Encinitas Blvd., Suite 113, Encinitas, California 02024, U.S.A.

Schuetz, Allen Walter. Department of Population Dynamics, John Hopkins School of Hygiene, Baltimore, MD 21205, U.S.A.

Sebens, Kenneth. Marine Science Center, Northeastern University, East Point, Nahaut, Massachusetts 01908, U.S.A.

Serafy, Donald Keith. Department of Biology, Southampton College of Long Is. Univ., Southampton, NY, 11968, U.S.A.

Sevastopnlo, George D. Geology Department, Trinity College, Dublin 2, Ireland

Sewell, Mary. Zoology Department, University of Alberta, Edmonton, Alberta, T6G 2E9, Canada

Shepherd, Scoreby A. Department Fisheries, Box 1625 G.P.O., Adelaide, S. Austratia 5001, Australia

Shick, Malcolm. Department of Zoology, University of Maine, Orono, ME 04469-0146, U.S.A.

Shigeru, Katsura. Dept. Oral Anatomy, School of Dentistry, Tokushima University, Tokushima, Japan.

Shirley, Thomas C. School of Fisheries, University of Alaska, 11120 Glacier Hwy., Juneau, AK 99801, U.S.A.

Sibuet, Myriam. IFREMER, Centre de Brest, BP 70, 29263 Plouzane, France

Sieverts-Doreck, Hertha. 7000 Stuttgart-Moehringen, Reichenberger Strabe 72, People's Republic of Germany

Simms, Michael J. Department of Geology, Wills Memorial Bldg., Queen's Road, Bristol BS8 IRJ, England

Simpson, Rodney D. Department of Zoology, University of New England, Armidale, N5W 2351, Australia

Singletary, Robert L. Biology Department, University of Bridgeport, Bridgeport, CT 06601, U.S.A.

Slamova, Radana. Stavebni geologie n.p., Pod Rapidem 8, Strasnice, Praha 10, Czechoslovakia

Smirnov, Alexey Vladimirovich. Zoological Institute Academy of Sciences, Universitetskaya nab., I, Leningrad, 00034, USSR

Smirnov, I. S. Zoological Institute, Academy of Sciences of the USSR, Leningrad 199034, USSR

Smiley, Scott. Institute of Arctic Biology, University of Alaska, Fairbanks, Alaska, 9775-0180, U.S.A.

Smith, Albert C. Laboratory Service (113), Veterans Administration Medical Center, Bay Pines, FL, 33504, U.S.A.

Smith, Andrew. Department of Palaeontology, British Museum (Natural History), Cromwell Road, London SW7 5BD, England

Solovjev, Andrey N. Paleontological Institute, USSR Academy of Sciences, Profsoyusnaya str., 123, Moscow V-321, USSR

South, G. Robin. Biology Annexe, Memorial Univ. Newfoundland, St. John's, NFLD A1C 5S7, Canada

Spencer, Larry T. Natural Science Department, Plymouth State College, Plymouth, NH, 03264, U.S.A.

Sprinkle, James. Department of Geological Sciences, University of Texas, Austin, TX 78713-7909, U.S.A.

Stancyk, Stephen E. Belle W. Baruch Institute, University of South Carolina, Columbia, SC 29208, U.S.A.

Stephenson, David Godfrey. Department of Geology, University of Keele, Keele, Staffordshire, ST5 5BG, U.K.

Stickle, Jr., William B. Zoology and Physiology Department, Louisiana State University, Baton Rouge, LA 70803, U.S.A.

Stokes, Robert Brendan. School of Geological Sciences, Kingston Polytecnic, Kingston Upon Thames, Surrey, KT1 ZEE, U.K.

Strathmann, Richard R. Friday Harbor Laboratories, 620 University Road, Friday Harbor, WA 98250, U.S.A.

Sroka, Steven D., Dept. of Geology, University of Illinois, 245 NHB, Urbana, IL 61801. U.S.A.

Stump, Richard Julian Witherington. Zoology Department, James Cook University, Townsville, Q. 4811, Australia

Sullivan, Kathleen M. Marine Science Program, University of Miami, PO Box 249118, Coral Gables, FL, 33124, U.S.A.

Suzuki, Norio. Noto Marine Laboratory, Kanazawa University, Ogi, Uchiura, Ishikawa 927-05, Japan

Suter, Sherman J. Committee on Evolutionary Biology, Geophysical Sciences, University of Chicago, Chicago, IL, 60637, U.S.A.

Tahara, Yutaka. Department of Biology, Osaka Kyoiku University, Tennoji, Osaka 543, Japan

Tajika, Ken-Ichi. Department of Biology, Nihon University School of Medicine, Oyaguchi, Itabashi, Tokyo 173, Japan

Takahashi, Keiichi. Zoological Institute, Faculty of Science, University of Tokyo, Hongo, Tokyo, 113, Japan

Taki, Jyo. Hokkaido Abashiri Fisheries Experimental Station, Abashiri, Hokkaido 099-31, Japan

Tegner, Mia J. A-001, Scripps Institution of Oceanography, La Jolla, California, 92093, U.S.A.

Telford, Malcolm. Department of Zoology, University of Toronto, Ontario M5S 1A1, Canada

Thandar, A. S. Department of Zoology, University of Durbaw-Westville, P/BAG X54001, Durban 4000, Republic of South Africa

Thierry, Jacques. Universit De Bourgogne, Centre des Sciences de la Terre, 6 Bd - Gabriel, 21100 Dijon, France

Thomassin, Bernard. Centre d' Oceanographic de Marseille, Station Marine d'Endoume, Rue de la Batterie des Lions, 13007 Marseille, France

Tommasi, Luiz Roberto. Instituto Oceanografico da Universidade, De Sao Paulo, Caixa Postal No 9075, Sao Paulo, SP, Brasil

Turner, Richard L. Department of Biological Sciences, Florida Institute of Technology, Melbourne, FL, U.S.A.

Tyler, Paul. Department of Oceanography, The University, Southampton, SO9 5NH, U.K.

Ubaghs, Georges. 28 Bois Le Comte, B-4841 Gomeze-Andoumont, Belgium

University Marine Biological Station, Librarian, Millfort, Isle of Cumbrae, KA28 OEG, Scotland

Vadas, Robert L. Department of Botany, University of Maine, Orono, ME 04469, U.S.A.

Vadet, Alain. 67 Blvd Furviny, 62200 Boulogne- sur-mer, France

Vail, Lyle. Northern Territory Museum, Echinoderm Department, G.P.O. Box 4646, Darwin, N.T. 5794, Australia

Valentincic, Tine. Institute of Biology, Askerceva 12, 61000 Ljubljana, Yugoslavia

Valentine, John. University of Alabama, Dauphin Island Sea Lab, Box 369-370, Dauphin Is. AL 36528, U.S.A.

Vandenspiegel, Didier. Laboratoire de Biologie Marine, Universite de Mons, 19 ave Maistriau (Bat 4), 7000 - MONS, Belgium

Velarde, Ronald G. City of San Diego, Marine Biology Laboratory M.S. 45, 4077 North Harbor Dr., San Diego, CA, 92101, U.S.A.

Viviani, Carlos A. Centro de Investigaciones Submarinas, Universidad del Norte, Casilla 117, Coquimbo, Chile

Walenkamp, Josef H.C. Rijksmuseum van Natuurlijke Historie, P.O. Box 9517, 2300 RA, Leiden, The Netherlands

Walker, Ch. W. Department of Zoology, University of New Hampshire, Durham 03824, New Hampshire, U.S.A.

Waren, Anders. Riksmuseet, Box 50007, S-10405, Stokholm, Sweden

Waters, Johnny A. West Georgia College, Department of Geology, Carrollton, GA 30118, U.S.A.

Watts, Stephen Andrew. Department of Biology, University of Alabama at Birmingham, UAB Station, Birmingham, AL 35294, U.S.A.

Webster, Gary D. Department of Geology, Washington State University, Pullman, WA, 99164-2812, U.S.A.

West, Ron. Department of Geology, Kansas State University, Manhattan, Kansas, 66506-3201, U.S.A.

Wiedman, Lawrence. Department of Geology, Monmonth College, Monmouth, IL, 61462, U.S.A.

Wilkie, I.C. Department of Biological Sciences, Glasgow College of Technology, Cowcaddens Road, Glasgow G4 ObA, Scotland

Wilks, Matthew A. Hopkins Marine Station, Pacific Grove, CA, 93950, U.S.A.

Witzke, Brian J. Iowa Department of Natural Resources, Geological Survey Bureau, Iowa City, Iowa, 52242, U.S.A.

Woodley, Jeremy David. Discovery Bay Marine Laboratory, PO Box 35, Discovery Bay, Jamaica, WI

Woollacott, Robert M. Museum of Comparative Zoology, Harvard University, Cambridge, MA 02138, U.S.A.

Wray, Gregory. Friday Harbor Laboratories, Friday Harbor, WA 98250. U.S.A.

Wright, Claud William. Old Rectory, Seaborough., Beaminster, Dorset DT8304, Great Britain

Yakovlev, Yuri. Institute of Marine Biology, 690032 Vladivostok, USSR

Yamaguchi, Masashi. Department of Marine Sciences, University of the Ryukyus, Nishihara, Okinawa, 903-01, Japan

Yanagisawa, Tomio. Tokyo Metropolitan Univ., Dept. of Biology, Fukazarra 2-1-1, Setagayaka, Tokyo, Japan

Yoshiaki, Ishida. 4-15-2-405, Seki-machi Minami, Nerima-ku, Tokyo, Japan

Yoshizato, Katsutoshi. Department of Biology, Tokyo Metropolitan University, Setagaya-ku, Tokyo, Japan

Young, Craig M. Harbor Branch Oceanographic Institute, RR 1, Box 196, Fort Pierce, FL 33450, U.S.A.

Zaghbib-Turki, D. Departement des Sciences de la Terre, Faculte des Sciences de Tunis, Campus universitaire, 1060 Tunis, Tunisia

Zavodnik, Dusan. Center for Marine Research Rovinj, "Rudjer Boskovic" Institute, 52210 Rovinj, Yugoslavia

Zeidler, Wolfgang. South Australian Museum, North Terrace, Adelaide, S. A. 5000, Australia

Zmarzly, Debbie. City of San Diego, Ocean Monitoring Program (MS-45), 4077 North Harbor Drive, San Diego, CA 92101, U.S.A.

CONFERENCES

Regional conferences: These conferences are held in years in which the International Echinoderm Conference does not take place.

Third European Colloquium on Echinoderms

Organizer: Prof. C. Canicatti
Department of Biology
University of Lecce
Prov. Lecce-Monteroni
73100 Lecce, Italy

Site of conference: Lecce, Italy
Date of conference: 9-12 September 1991
Abstracts due: before 30 April 1991

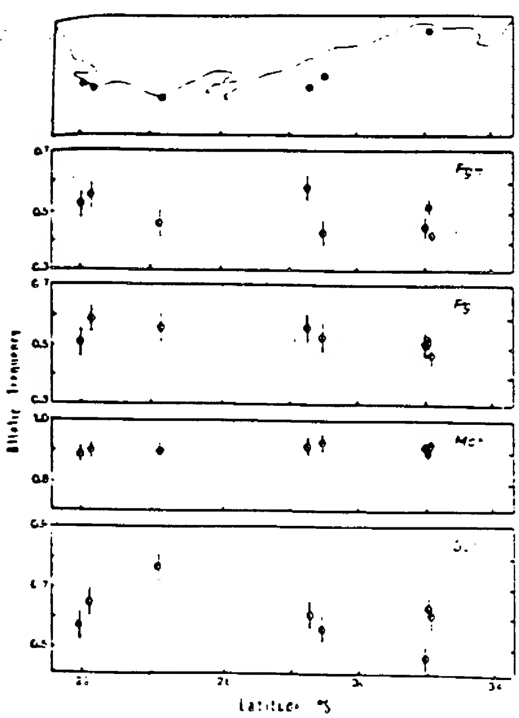


Fig. 2. *Echinometra mathaei*. Sample sites and frequencies of most common alleles at four polymorphic loci for the three Rottnest Island populations and for five sites along approx. 1 300 km of Western Australian coastline; vertical lines indicate standard errors. Points for the three Rottnest Island samples (32° S, 115 30'E) are slightly offset for clarity. Watts, Johnson + Black 1990. 'Mar. Biol'.

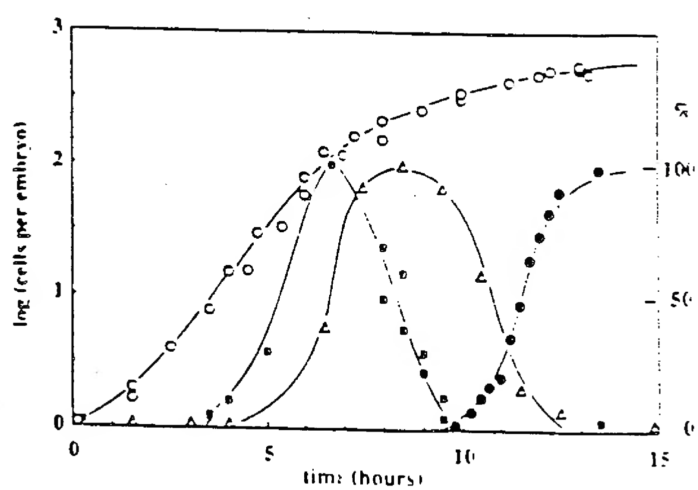


Fig. 8. Time course of cell divisions, embryo hatching, HE transcriptional activity and transcript accumulation. Embryos were raised at 18°C in Millipore-filtered sea water at a density of 10^{4} ml with stirring (30 r.p.m.) and vigorous aeration. Data were obtained with different batches of embryos sometimes treated differently (e.g. removal of the fertilization envelopes, decantation of large volumes to prepare nuclei). All the data were compiled into a single normalized time table with the best possible accuracy (± 30 min). Fertilization is at zero time. (○), average cell number per embryo (data from several experiments); (●), hatched embryos (%); (△), transcript abundance as a percentage of the maximal value (sum of the two transcripts, densitometric scanning from the Northern blot in Figure 6); (■), relative transcriptional activity as a percentage of the maximal value (densitometric scanning of the run-on in Figure 7 and other experiments). Lepage + Gache. 1990. EMBO Journal

<u>8th International Echinoderm Conference. 1993</u>.

Organizer: Bruno David
Centre des Sciences de la Terre
Universite de Bourgogne
6, Bd. Gabriel
F-21000 Dijon, France

Site of conference: Dijon
Date of conference: September 1993

DIJON (145,600 inhab.; 21,000 in 1801; 77,300 in 1901), préfecture of the *Côte d'Or*, and once the capital of the Duchy of Burgundy, is situated at the confluence of the Ouche with the Suzon and the Canal de Bourgogne. It is a busy commercial and industrial town, an important railway junction, and the centre of the Burgundy wine trade. It is also the gastronomic capital of the region, and its gingerbread, *cassis* (a blackcurrant liqueur), and mustard—its name whimsically connected with Philippe le Hardi's motto 'moult me tarde'—are reputed. It preserves a number of important buildings, and well-restored medieval houses, while the Musée des Beaux-Arts contains one of the richest collections outside Paris: indeed its old centre is one of the more attractive and interesting of provincial capitals.

Dijon (*Divio* or *Castrum Divionense*) is said to have been first fortified by Aurelian in c 273, and converted to Christianity by a 2C martyr, St Benignus, in whose honour an abbey was founded in c 525. This capital of the early Burgundian kingdom, which became under Robert I a powerful Valois duchy, was destroyed by fire in 1137. It was rebuilt and fortified by Duc Hugues II. Under Philippe le Hardi (the Bold, 1342–1404), Jean sans Peur (the Fearless, 1371–1419), and Philippe le Bon (the Good, 1396–1467), the splendours of the Burgundian court reached their height, but the death of Charles le Téméraire (the Bold, 1433–76, at the Battle of Nancy) left the Valois dukes without a male heir, and Louis XI, who, in spite of the protestations of the states of Burgundy, seized the province, set up a 'parlement' at Dijon and re-fortified the place. Although it survived a siege by 30,000 Swiss, Germans, and Francs-Comtois in 1513, it opened its gates to Henri IV in 1595. From 1631 until the Revolution it was governed by the princes of Condé, and enjoyed a second period of prosperity. The enlightened Academy of Dijon was founded in 1740, and a decade later crowned Rousseau's essay on the morality of the Arts and Sciences. It resisted the Prussians in 1870, with the help of Garibaldi's corps of volunteers, but later capitulated, and suffered occupation, after which eight detached forts were built for its future defence. The railway station and some 700 houses were destroyed in 1944.

It was the birthplace of Jacques-Bénigne Bossuet (1627–1704), Crébillon the Elder (1674–1762), the dramatist, Jean-Philippe Rameau (1683–1764), the composer; the Comte de Vergennes (1717–87), Maret Duc de Bassano (1763–1839), Jean Dubois (1626–94), Claude Ramey (1751–1838), and François Rude (1784–1855), sculptors; Philippe Quantin (died 1636), J.-F.-G. Colson (1733–1803), Claude Hoin (1750–1817), artists, and the engraver Alphonse Legros (1837–1911, in England from 1863), présidents Jean Bouhier (1673–1746), and Charles de Brosses (1709–77), Gustave Eiffel (1832–1923), the engineer, Alexis Piron

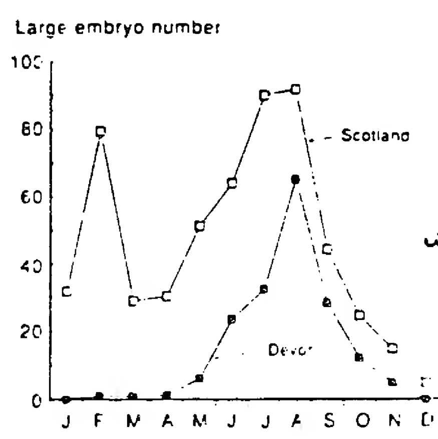
Robertson. 1988. Blue Guide France.

The series of International Echinoderm Conferences began in 1972 at the Smithsonian conference in Washington, D.C. organized by David Pawson and Maureen Downey. At that meeting, the participants decided that meetings should be held every three years and that the site should be held sequentially in different parts of the world to ensure that all echinoderm workers would have the opportunity to attend at some time. The general areas designated were the Americas, Europe-Africa, and Asia-Antipodes. Subsequent meetings were held in Rovinj, Yugoslavia; Sydney, Australia; Tampa Bay, USA; Galway, Ireland; Victoria, Canada, and Atami, Japan.

The site of each conference since the Tampa Bay meeting has been selected by the attendees of the previous meeting. To address the possibility that a host selected might be unable to organize the meeting as planned, and to ensure that invitations are extended for the subsequent meeting, the participants at the Atami meeting decided to establish a continuing committee for these functions. The committee will consist of the hosts of the immediate previous meeting, the current meeting, and the immediate future meeting. If it becomes not possible for the conference to be held at the site selected, this committee will have the responsibility of selecting a new site and host. The committee will also solicit invitations from the appropriate region for the next meeting if none is volunteered.

The current committee consists of Robert Burke (University of Victoria), Tomio Yanagisawa (Saitama Medical School), and Bruno David (University of Bourgogne).

The Atami conference noted that Prof. David Nichols (University of Exeter) is the only individual to have attended all of the international conferences.



Emson et al.
Amphipholis squamata

Emson, Jones, & Whitfield. 1989. in Ryland & Tyler

Figure 3
Graph showing the number of potentially releasable embryos in the Devon and Scottish populations by month.

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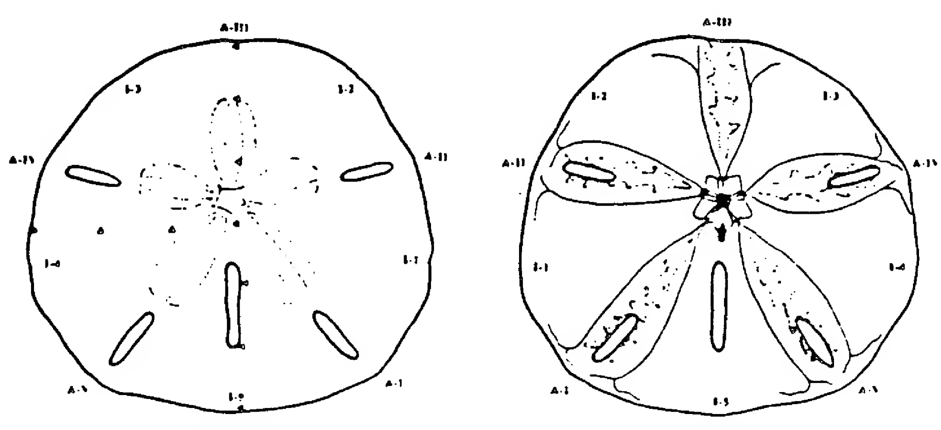

Fig. 1. Main features of *Mellita*, aboral surface. Alpha-numeric codes refer to rays of Lovén (1892). Areas enclosed by solid lines are lunules; elongate stippled areas, petaloids, central pentagon, madreporite, solid triangles, locations of test thickness measurements.

Fig. 2. Main features of *Mellita*, oral surface. Radiating bifurcate lines are food grooves, stippled areas, pressure drainage channels; mouth, central, and encircled by basicoronal plates, periproct immediately posterior of mouth. HAROLD + TELFORD 1990 J. Nat. Hist.

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鶴見良行 つるみ・よしゆき

1926年ロスアンゼルス生。現在、龍谷大学教授。
著書に、「マラッカ物語」(時事通信社)、「マングローブの沼地で」、
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BRUSSELS / BELGIUM / 18-21 SEPTEMBER 1989

Echinoderm Research

Edited by
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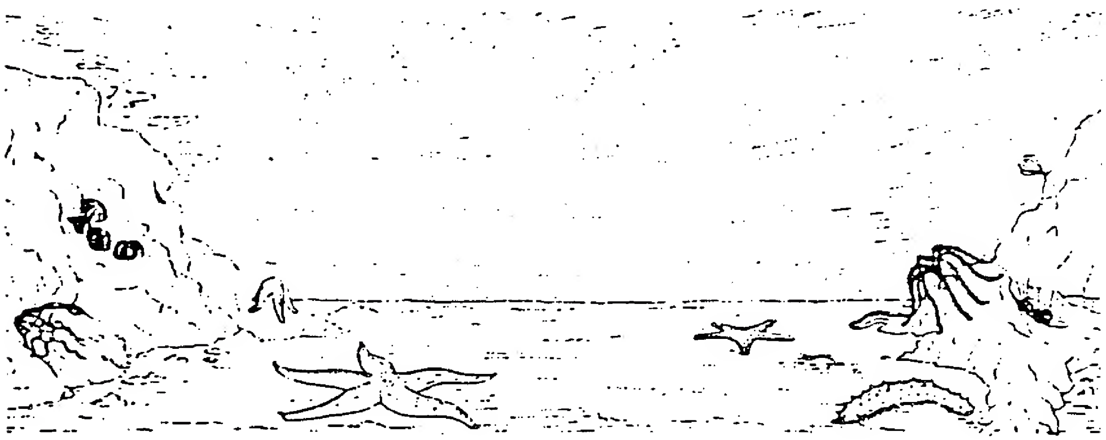

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Wray, G.A., R.A. Raff. 1990. Novel origins of lineage founder cells in the direct-developing sea urchin, Heliocidaris erythrogramma. Dev. Biol. 141, 41-54.

Xu, R.A., M.F. Barker. 1990. Laboratory experiments on the effects of diet on the gonad and pyloric caeca and biochemical composition of tissues of the New Zealand starfish Sclerasterias mollis (Hutton) (Echinodermata: Asteroidea). J. Exp. Mar. Biol. Ecol. 136, 23-46.

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Young, C.M., J.L. Cameron. 1989. Developmental rate as a function of depth in the bathyal echinoid Linopneustes longispinus. In: J.S. Ryland, P.A. Tyler (eds.). Reproduction, genetics and distributions of marine organisms. pp.225-231.

PAPERS PRESENTED AT CONFERENCES

Papers presented at the 1990 Benthic Ecology Meeting, Mobile, Alabama

Aronson, R.B. Hurricane effects on back reef echinoderms.
Golde, H.M. A method for measuring respiration of infaunal brittlestars.
Hopkins, T.S., J.B. McClintock, K.R. Marion, S.A. Watts. Differential arm loss in two sympatric species of sand stars.
Sheild, C.J. Feeding ecology of the sea star, *Henricia sanguinolenta*, in rocky subtidal communities in the Gulf of Maine.
Valentine, J.F., K.L. Heck, Jr. Role of sea urchin herbivory in regulating seagrass meadow size.

Papers presented at the meeting of the Society for Experimental Biology, University of Warwick, March 1990

Elphick, M.R., D.A. Price, M., M.C. Thorndyke. The molecular biology of echinoderm neuropeptides.
Elphick, M.R., C. Moss, M.C. Thorndyke. Action of the starfish neuropeptide GFNSALMFamide, structurally related neuropeptides and neurotransmitter substances on isolated tube feet of Asterias rubens.

Papers presented at the 1990 annual meeting of the Canadian Society of Zoologists, Burnaby, B.C.

Janies, D. The scanning electron microscopic description of a novel starfish larva, *Teraster tesselatus*.
McEdward, L.R. Experimental analysis of life history evolution in echinoderms.
Gilmour, T.H.J. Control of metamorphosis in echinoid larvae.

Papers presented at the 1989 Centennial Meeting of the American Society of Zoologists, Boston, Massachusetts

Mooi, R. Heterochronic miniaturization in the phylogeny of the sand dollars.
Rumrill, S.S. Substratum selectivity, post-larval growth and survival following extended competence in *Strongylocentrotus droebachiensis*.
Colwell, S.W., D.T. Manahan. Sugar and fatty acid transport and metabolism in invertebrate larvae. (echinoid)
Briscoe, C.S. Omnivory in the green sea urchin *Strongyulocentrotus droebachiensis* (Muller) (Echinodermata: Echinoidea) The contribution of mussel versus kelp diets for somatic growth and reproductive effort.
Cavey, M.J., T.P. Laudel. Epidermal contributions to a putative neuronal net in the connective tissue of an ophiuroid tube foot.

Hines, A., S.A. Watts, C.W. Walker, P.A. Voogt. Steroid metabolism in somatic and gametic tissues of the sea star *Asterias vulgaris*.

Morales, M., J. Del Castillo, D.S. Smith. Cholinergic sensitivity of the ligament of the sea urchin spine.

Justice, R.W. Immunological evidence for conservation of hyalin proteins in echinoids and ophiuroids.

McEdward, L.R. Development and evolution of a novel type of starfish larva.

Watts, S.A., G.B. Cline. Ornithine decarboxylase and polyanmine synthesis in embryos of the brine shrimp *Artemia*.

Litvaitis, M.K., M.M. Ecker, C.W. Walker. Light and electron micrscopy of the alveolar pedicellariae in the asteroid *Hippasteria phrygiana* (Echinodermata)

Pearse, J., K. Yamazato, A. Heyward, T. Uehara, K. Sakai. Marine invertebrate reproduction: Studies at the Sesoko Marine Science Center, University of the Ryukyus, Okinawa, Japan. (echinoid)

Balser, E.J., E.E. Ruppert. Organization and ultrastructure of the axial complex of *Davidaster rubiginosa* and *D. discoidea* (Crinoidea).

Walker, C.W., D. Jaffurs, J.D.G. Boom, M.J. Smith. Cloning and characterization of expression of ODC and c-myc cell cycle genes from the sea star, *Asterias vulgaris*.

Campbell, D.B. Selective predation of sea stars on two species of mussels.

Klinger, T.S. A preliminary investigation of the effect of food quality and quantity and quantity on levels of alpha- and beta-glucosidase and nucleic acids in the gut tissues of *Lytechinus variegatus* (Lamarck) (Echinodermata: Echinoidea).

Lawrence, J.M., P.Moran. Allocation of material and energy to the body of *Acanthaster planci* (Asteroidea: Echinodermata).

Levitan., D.R. Changes in the relative size of the jaws and tests of sea urchins when food limited.

Young, C.M., J.L. Cameron, I. Bosch. Feeding ecology of planktotrophic deep-sea echinoderm larvae.

Lares, M.T., J.B. McClintock. Temperature tolerance and the effects of temperature on the nutrition of the tropical sea urchin *Eucidaris tribuloides*.

Vernon, J.D., J.B. McClintock. Chemical defense in the eggs and embryos of antaractic sea stars.

Emlet, R.B. Models of ciliated surfaces and the evolution of body form in marine invertebrate larvae.

LETHAIA 22 (1989) *Crinoid columnal ontogeny*

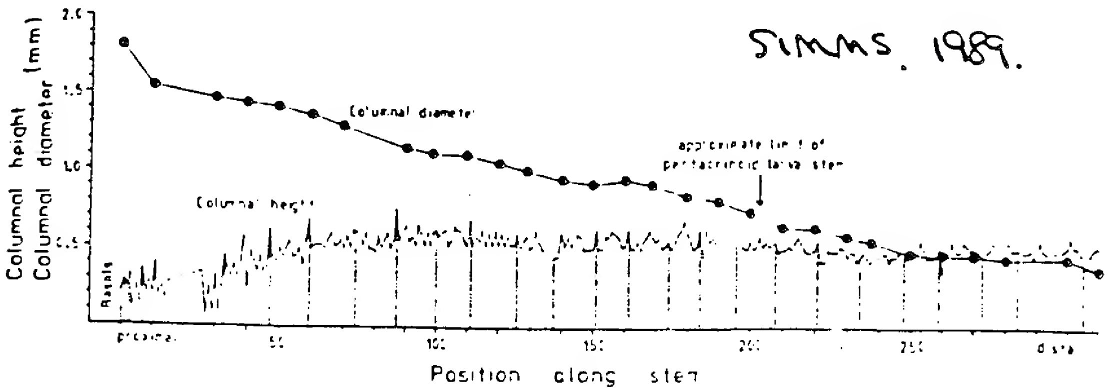


Fig. 1. Changes in columnal height and diameter along the stem of an immature [illegible] (WARMS G[illegible]). Vertical dotted lines indicate position of nodal

Papers presented at the 23rd Annual Meeting of the Japanese Society of Developmental Biologists (Hiroshima). 1990. Abstracts published in Development, growth and differentiation. 32 (4). 1990.

Ookata, K., T. Okano, K. Tachibana, T. Kishimoto. Cell cycle dynamics of cdc2/cyclin complex during meiotic maturation in starfish oocytes (p.481)
Miura, D., K. Sano, N. Fusetani, T. Yasumoto. Possible presence of two types of phosphatases which inhibit activation of M-phase-specific histone H1 kinase of starfish ooocytes (p. 418).
Fujiwara, A., I Yasumasu. Pulse treatment of sea urchin embryos with A23187 blocks their hatching out. (p. 425)
Ohyama, M. T. Kominani, Y.D. Noda. Cell adhesiveness change in cleavage stage embryuos of Hemicentrotus pulcherrimus. (p. 425)
Fujita, H., T. Kominani. Behavior of cell surface molecules during embryogenesis of the sea urchin Hemicentrotus pulcherrimus. (p. 426).
Ishihawa, M., R. Nakao. Cleavage of partially fertilized sea urchin eggs induced by UV-irradiated sperm. (p. 432)
Mitsunaga, K., M. Hatoh, K. Yamazaki, K. Akasaka, H. Shimada, I. Yasumasu. Cloning of a cDNA encoding Na+, K+-ATPase alpha-subunit in embryos of the sea urchin Hemicentrotus pulcherrimus. (p. 434).
Yamada, K., K. Akasaka, H. Shimda. Expression of an aryl sulfatase-CAT fusion gene injected into sea urchin eggs. (p. 434).
Yamamoto, T., K. Yamada, K. Akasaka, H. Shimada. A novel structure of enhancer element of sea urchin Ars gene. (p. 434).
Mita, M. Precition of intracellular amount of 1-methyladenine precursor in follicle cells of the starfish Asterina pectinifera. (p. 437).
Mikami-Takei, K., I. Yasumasu. G-proteins of sea urchin spermatozoa. (p. 437).
Tosuji, H., K. Miyaji, T. Nakazawa, Y. Tako, N. Fusetani. Effect of calyculin A on the movement of actin in sea urchin eggs. (p. 438).
Yasaki, I. Identification of egg-surface specific substance of sea urchins, Hemicentrotus pulcherrimus, by monoclonal antibodies. (p. 438).

Papers presented an the Annual Meeting of the American Society of Zoologists. (San Antonio, Texas). 1990. Abstracts published in American Zoologist 30 (4). 1990.

Hines, G.A., S.A. Watts. Sex-steroid levels in the testes, ovaries and pyloric caeca during the annual reproductive cycle of the sea star Asterias vulgaris. (p. 13A)
Ruediger, N.K., J.B. Morrill. Morphogenetic effects of b-aminopropiontrile (BAPN) during gastrulation in the sea urchin,Lytechinus vriegatus revisited. (p. 37A)
Craig, J.A., S.A. Stricker. Factors influencing development of the starfish Pisaster ochraceus. (p. 39A).
Stricker, S.A., S. Weiner. Matrixlike proteins in the calcareous skeleton of a holothurian echinoderm. (p. 47A)

Marsh, A.G., C.W. Walker. Interaction of estradiol and progesterone during initiation of spermatogenesis in a starfish. (p. 53A)

Hart, M.W. Performance allometry and life history evolution in echinoderms. (p. 58A)

Burnett, L., D. Jorgensen, A. Carroll, D. Scholnick, N. Terwilliger. Physiological responses of the purple sea urchin to air exposure. (p. 62A)

Aronson, R.B. Physical vs. biotic influence on Recent and fossil ophiuroid populations. (p. 85A)

Vernon, J.D., J.B. McClintock, T.S. Hopkins. Reproductive and population biology of the irregular echinoid Clypeaster ravenelii in offshore waters of the Gulf of Mexico. (p 89A)

Stickle, W.B., L.A. Breitrick, R.A. Roller. Comparative effects of salinity on the tolerance, feeding rate and righting response of two sympatric species of sea stars, Leptasterias epichlora and L. hexactis.

Good, T.P. Avian predation along New England rocky shores: the role of gulls in low intertidal and shallow subtidal communities. (Asterias vulgaris). (p. 98A)

Bosch, I. Symbiotic bacteria beneath the cuticle of clona sea star larvae from oceanic waters of the northwest Atlantic. (p. 99A)

Jaeckle, W.B. Fine structure of the digestivbe system of subtropical auricularia larvae. (p. 100A)

Gilmour, T.H.J. The feeding behaviour of echinoderm larvae. (p. 100A)

Balser, E.J. The fine structure of the axial complex in the brittlestars, Ophiothrix angulata & Ophiactis savignyi. (p. 114A).

Justice, R.W., C. Sassaman. Reproduction in a viviparous sea cucumber. (p. 116A).

Klinger, T.S. Abundance, body indices, and size-class distribution of Strongylocentrotus droebachiensis in the Gulf of Maine. (p. 117A)

Lawrence, J.M. A chemicl alarm response in Pycnopodia helianthoides (Echinodermata: Asteroidea). (p. 117A)

Lares, M.T., J.B. McClintock. The effects of food quality and temperature on the nutritional biology of the tropical sea urchin Eucidaris tribuloides (p. 131A).

Turner, R.L., R.H. Femmer. Ophiuroids and hemichordates: an alleolochemic role for2,4-dibromophenol? (p. 130A)

Morgan, M.B., D.L. Cowles. Observations on the distribution and physiology of Phataria unifascilis (Echinodermata: Asteroidea): temperature as a limitng factor? (p. 131A)

<u>Papers presented at the Annual Meeting of the Western Society of Naturalists</u> 1990. (communicated by J.B. McClintock)

Carroll, J.C., J.M. Engle, R.F. Ambrose, J.A. Coyer. Long-term interactions among populations of sea urchins, orange cup corals, andmacroalgae at Anacapa Island, California.

Mcalary, F.A. Population gnetics and enhancement of the fissiparous seastar Linckia columbiae at Palos Verdes, California.

Pennington, J.T., R.R. Strathmann. Consequences of the calcite skeletons of planktonic echinoderm larvae for orientation, sinking and shape.

Whale, C.M., A.A. Totah. Variable arm number in a pentamerous starfish: patterns and implications of autotomy among the cannibals.

Levitan, D.R., M.A. Sewell. Influence of population size and density on fertilization in the sea urchin Strongylocentrotus franciscanus.

Carney, D. A comparison of reproductive potential, relative movements, densities and size distributions of red sea urchins (Strongylocentrotus franciscanus).

ACTES DU VI° SÉMINAIRE INTERNATIONAL SUR LES ÉCHINODERMES

Ile des Embiez (Var - France) / 19 - 22 septembre 1988

ÉCHINODERMES : ACTUELS ET FOSSILES

Vie Marine. Hors série No. 10: 1989.

1. PALEONTOLOGIE

2. MORPHOLOGIE

4. ECOLOGIE

5. LARVES - REPRODUCTION - CROISSANCE

6. SYMBIOSE - PARASITISME

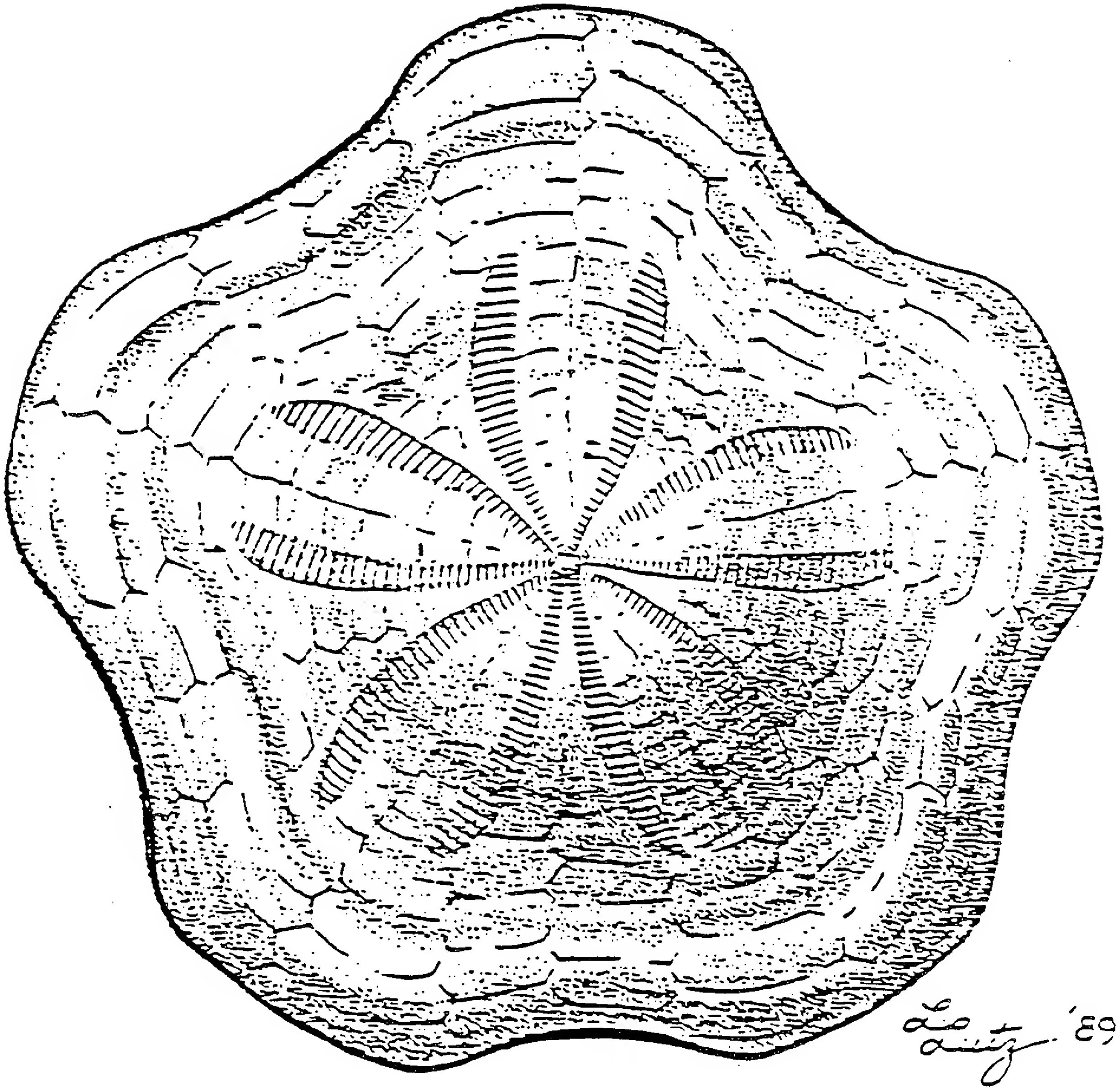
7. POLLUTION - TOXICOLOGIE

8. POSTERS

FRIENDS OF ECHINODERMS CONFERENCE AND WORKSHOP

JUNE 1-3, 1989

DAUPHIN ISLAND, ALABAMA



DAUPHIN ISLAND SEA LAB

MARINE ENVIRONMENTAL SCIENCES CONSORTIUM

DAUPHIN ISLAND, ALABAMA

36528

Abstracts published in Northeast Gulf Science vol. 11, no. 1. 1990

Papers presented at the Friends of Echinoderms Conference and Workshop, Dauphin Island, Alabama. June, 1989. Organized by Thomas S. Hopkins, James B. McClintock, John F. Valentine, and Stephen A. Watts. Hosted by the Dauphin Island Sea Laboratory.

C.W. Walker, J. Boom and D. Jaffurs. Strategies for Cloning c-MYC and ODC Genes from the Testes of the Starfish Asterias vulgaris.

A. Marsh and C.W. Walker. Initiation of Cell Cycling in the Testes of the Starfish Asterias vulgaris.

G.A. Hines, S.W. Watts, C.W. Walker and P.A. Voogt. Androgen Metabolism in Somatic and Gametic Tissues of the Sea Star Asterias vulgaris.

N. Saito and S.A. Watts. Activities of Hexokinase, Phosphofructokinase and Pyruvate Kinase in the Body Wall, Pyloric Caeca and Tube Feet of Asterias vulgaris: Evidence of Body Wall as a Major Source of Glycolytic Activity.

J. Leverone. The Effects of Intracellular Cation Concentrations on the Specific Activities of Glucose-6-Phosphate Dehydrogenase and Pyruvate Kinase in the Pyloric Caeca, Tube Feet, and Gonads of Luidio clathrata (Say) (Echinodermata: Asteroidea)

W.E. Dobson, S.E. Stancyk and L.A.J. Clements. Nutrient Translocation During Early Disc Regeneration in the Brittlestar Microphiopholis gracillima (Stimpson) Echinodermata: Ophiuroidea)

J.P. Eylers. A synthetic Biomaterial Made from an Extract of Holothurian body Wall Which Retains the Ion-dependent Mechanical Properties of the "Catch" Mechanism.

D.B. Massey and S.A. Watts. Preliminary Electorphoretic Characterization of Histone Proteins Isolated from the Pyloric Caeca and Testes of the Sea Star Asterias vulgaris.

C.S. Cekolin. The Effects of a Polyacrylamide Based Polymer and Polyacrylate on Embryos and Gametes of Arbacia punchulata.

J.B. McClintock and S.A. Watts. A preliminary Study of the Effect of Photoperiod on Gametogenesis in the Tropical Sea Urchin Eucidaris tribuloides.

S.A. Watts and J.D. Curtis. Mechanisms Controlling Intestinal Growth in the Sea Urchin Lytechinus variegatus.

T.A. Ebert. Gonad Allometry and the Size at First Reproduction: Problems with Data Analysis and Interpretation.

M. Komatsu and C. Oguro. Relationship Between the Bipinnaria and the Barrel-Shaped Larvae in Astropectinidae (Asteroidea).

J. Lawrence. The Relationship between the Major and Minor Radii and the Internal Anatomy of Acanthaster planci.

M. Telford and O. Ellers. Estimating Lantern Forces in Clypeaster rosaceus: or, The Biscuit Bites Back.

K.E. Kwast and W.B. Stickle. Genetics and Systematics of the Leptasterias hexactis Species Complex (Echinodermata: Asteroidea)

M.T. Lares and J.B. McClintock. Short Term Effects of Temperature on Feeding, Organismal Activity and Survival of the Caralvorous, Tropical Sea Urchin Eucidaris tribuloides.

D.A. John, T.J. Mencken and T.S. Klinger. Feeding and Digestion of Prepared Protein and Carbohydrate Rich Diets by Strongylocentrotus drobachiensis (O.F. Muller) (Echinodermata: Echinoidea)

J.F. Valentine. Spatial Distribution Patterns of the Sympatric Brittlestars, Hemiphiolis elongata and Microphiopholis atra in Eastern Mississippi Sound.

S.E. Stanck, W.E. Dobson, K.T. Fielman and L.A.J. Clements. Less of Secondary Production by a Burrowing Ophiuroid via Partial Predation.

M.A. Litchko, K.A. Martin and T.S. Klinger. Digestion, Respiration and Movement of Eucidaris tribuloides (Lamarck) (Echinodermata: Echinoidea) Fed Plant or Animal Material.

P. McEachern and M. Telford. The Allometry of Plate Size and Number in the Sea Urchin Stronglyocentrotus drobachiensis.

D. West and M. Telford. Lantern and Podial Allometry in the sand Dollar, Echinarachnius parma.

J.D. Vernon and J.B. McClintock. Chemical Defense in Antarctic Lecithotrophic Echinoderm Larvae.

T.S. Hopkins. A Comparison of Clypeaster durandi Cherbonnier to other Carribbean-Gulf of Mexico Clypeaster sp.

B.A. Brown and J.B. McClintock. Effects of Quality of Diet on Feeding Rates, Fecal Production and Gravimetric Absorption Efficiencies of the Tropical Sea Urchin Eucidaris tribuloides.

J.F. Valentine and K.I. Heck, Jr. Studies on the Effects of the Sea Urchin, Lytechinus variegatus on Thalassia testudinum Seagrass Meadows in St. Josephs Bay, Florida.

J.B. McClintock, T.S. Hopkins, K.R. Marion, and S.A. Watts. Preliminary Notes on Depth Distribution, Substrate Type, and Reproductive Mode of Offshore Echinoderms from the Northern Gulf of Mexico.

Ojeda + Dearborn Mar. Ecol. Prog. Ser. 57: 147–161, 1989

Table 2. Average density (ind. m^{-2}) and average biomass (g m^{-2}) of the 22 most abundant macroinvertebrate taxa found in the 133 subtidal benthic samples collected at Pemaquid Point, Maine. In parentheses: standard error

Taxon	Density	Biomass
Strongylocentrotus droebachiensis	100.4 (74.0)	2699.0 (1416.4)
Modiolus modiolus	14.4 (11.2)	1303.2 (960.0)
Tonicella ruber	13.3 (6.8)	1.5 (0.8)
Ophiopholis aculeata	8.8 (7.2)	7.2 (5.6)
Polychaetes	8.8 (2.0)	1.6 (0.4)
Asterias vulgaris	6.0 (2.0)	4.4 (2.8)
Tectura testudinalis	4.0 (0.8)	2.4 (0.8)
Lacuna vincta	0.2 (0.1)	0.2 (0.1)
Amphipods	3.7 (2.1)	*
Idothea spp.	2.4 (1.1)	*
Caprella spp.	1.7 (0.9)	*
Cancer spp.	1.0 (0.3)	0.3 (0.1)
Crepidula spp.	0.9 (0.4)	0.9 (0.3)
Dendrodoa carnea	0.7 (0.3)	*
Balanus balanoides	0.6 (0.1)	4.0 (2.7)
Mya arenaria	0.5 (0.1)	0.7 (0.2)
Nucella lapillus	0.6 (0.3)	0.2 (0.1)
Hiatella arctica	0.5 (0.1)	0.9 (0.2)
Buccinum undatum	0.5 (0.2)	0.2 (0.1)
Crangon septemspinosa	0.5 (0.2)	*
Pagurus pubescens	0.3 (0.1)	0.1 (0.1)
Eualus pusiolus	0.3 (0.1)	*

* Less than 0.1 g

WORKSHOP ON FOSSIL CRINOIDS

The first Workshop on Fossil Crinoids was held on July 15-16, 1989 in conjunction with the 28th International Geological Congress, Washington, D.C. The workshop was organized by Thomas W. Broadhead; and participants included R. B. Aronson, W. I. Ausich, J. C. Brower, F. J. Collier, S. K. Donovan, M. W. Foster, C. Franzen-Bengtson, T. E. Guensberg, P. Holterhoff, P. A. Jell, N. G. Lane, R. D. Lewis, D. L. Meyer, T. Oji, J. A. Schneider, R. E. Terry, C. Warren, J. A. Waters, and T. Weaver. Workshop arrangements in the Department of Paleobiology, U. S. National Museum, were made by Frederick Collier.

Participants spent two full days in fruitful discussion on fossil and living crinoids. Important conclusions reached include the following:
1, Participants agreed with recent suggestions that the Subclass Inadunata is not a monophyletic clade. This group of crinoids should be subdivided into at least three subclasses the Disparida, Cladida, and Hybocrinea. 2, Additional information on the ecology and natural history of stalked and unstalked living crinoids is urgently needed. 3, Various heterochronic processes played a dominant role in the evolution of the Crinoidea. 4, Important new discoveries of Early Ordovician crinoids by Guensburg will have a significant impact on our understanding of the first adaptive radiation and classification of crinoids.

Other discussion included the role of heterochrony in providing many options for evolutionary change (Ausich), the functional morphology and evolution of Ordovician crinoid columns (Donovan), how mobile were Paleozoic stalked crinoids? (Lane), the potentially very great growth rates for the column of Metacrinus rotundus (Oji), the role of heterochrony in the evolution of arms and the support structure of the anal sac (Broadhead), taxonomic affinities of the unusual "camerate" Reteocrinus (Guensburg), origin of articulate and comatulid crinoids (Schneider and Lane), commercial exploitation of fossil crinoids from Crawfordsville, Indiana (Lane), and trophic structure of Middle Ordovician echinoderm paleocommunities (Brower).

The final conclusion reached in the Workship was that this format for discussion among crinoid paleontologists was invaluable and that Workships on Fossil Crinoids should continue on a regular basis. The next Workshop on Fossil Crinoids is tentatively scheduled to be held in conjunction with the 1990 Annual Geological Society of America Meeting.

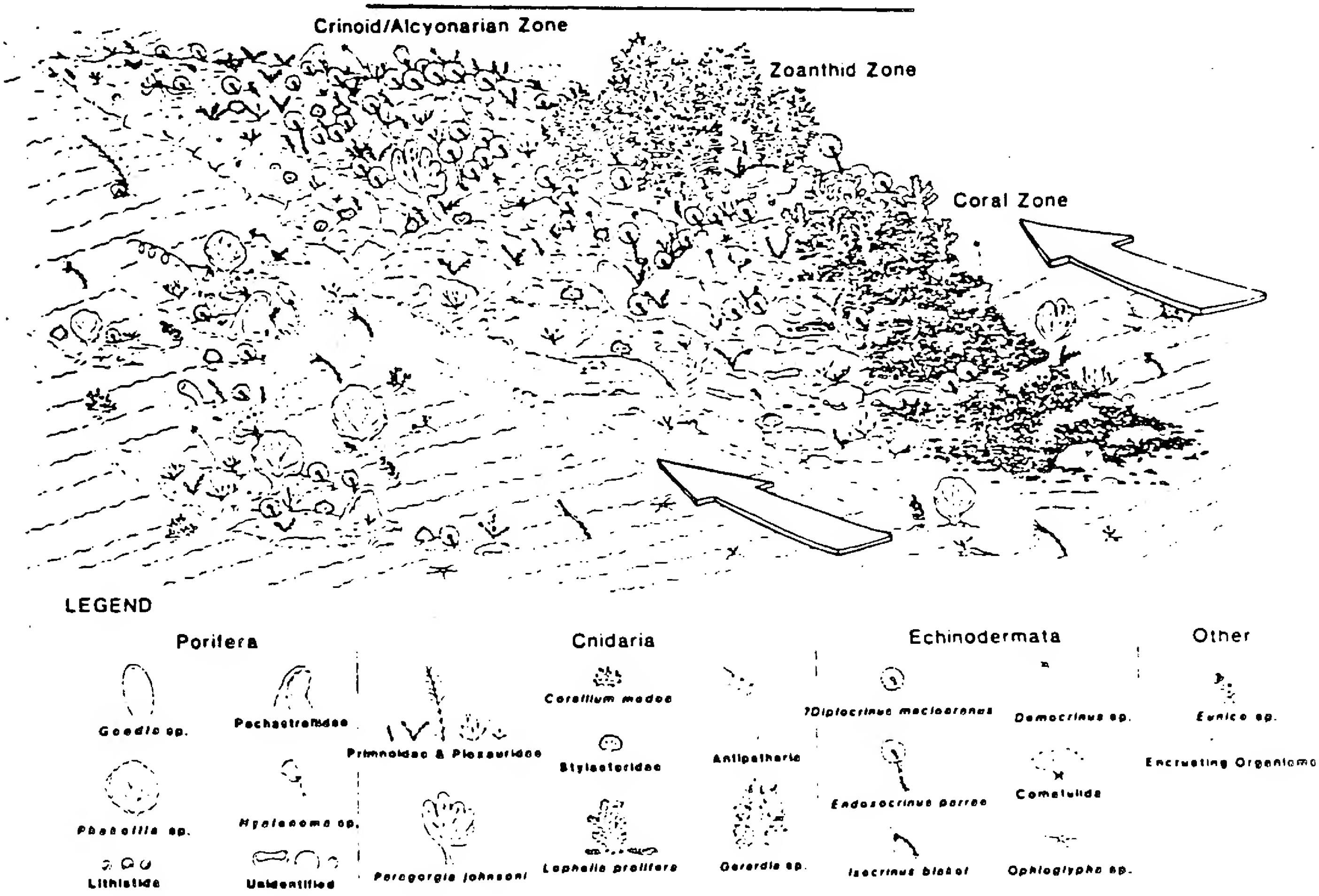


FIGURE 4—Schematic composite diagram of lithoherm biozonation (oblique view) showing distribution of major taxa. Taxonomic icons (identified in legend) are large in proportion to size of mound. The Crinoid/Alcyonarian Zone is truncated for simplicity. Inter-mound hardgrounds are shown at lower left. Arrows indicate current direction. Messing, Neumann & Carey, 1990.

Palaios. 5

Papers presented at the Seventh International Echinoderm Conference, 9-14 September, Atami, Japan (Proceedings in press. N. Suzuki, ed. Balkema.)

ORAL SESSION

10. September (Monday) Morning

Room H

Plenary Lecture 9:00-12:00

9:00- 9:40: The Cell Cycle Data Of Early Cleavage Of Echinoderm. ---- Dan. Katsuma (Tokyo Metropolitan Univ.. JAPAN)

9:40-10:20: ---- Lawrence. John (Univ. South Florida. U.S.A.)

10:20-10:40: Coffee Break

10:40-11:20: Metabolism Of Carbohydrate In Sea Urchin Eggs. ---- Yasumasu. Ikuo (Waseda Univ.. JAPAN.)

11:20-12:00: ---- Meyer. David (Univ. Cincinnati. U.S.A.)

10. September (Monday) Afternoon

Room A

Symposium A 13:00-17:00 (Not correspond to presentation order)

How Successful Is The Fertlization Process In The Echinoderm?

(Organizer: Epel. David. Stanford Univ.. U.S.A.)

13:00-13:30: Second Messengers In Fertilization Or Artificial Parthonogenesis Of Sea Urchin Eggs. ---- Ciapa. Brigitte (Lab. Physiol. Cell. Comp. Fac. Sci.. FRANCE)

13:30-14:00: How Successful Is The Fertilization Process In The Echinoderm? ---- Epel. Devid (Stanford Univ.. U.S.A.)

14:00-14:30: Egg Signals For Triggering The Acrosome Reaction In Starfish Spoermatozoa. ---- Hoshi. Motonori (Tokyo Inst. Technol.. JAPAN)

14:30-15:00: Evolution Of Fertilization Barriers In Closely Related Sea Urchins. ---- Palumbi. Stephen (Univ. Hawaii. U.S.A.)

15:00-15:30: Coffee Break

15:30-16:00: Substances Controlling Oocyte Maturation And Spawning In Starfish. ---- Shirai. Hiroko (Okayama Univ.. JAPAN)

16:00-16:30: Sea Urchin Egg Activation At Fertilization: Enzymatic Basis. ---- Swezey. Robert (Stanford University. U.S.A.)

10.September (Monday) Afternoon

Room B

Morphology

#10-B-1 13:00-13:20: Functional Morphology Of The Apical System And Periproct Of Echinoids (Euechinoidea: Echinodermata).----Jensen. Margit (Univ. Copenhagen. DENMARK)

#10-B-2 13:20-13:40: Species Specificity Of A Monoclonal Antibody To Polypeptides Present In The Egg Of The Starfish. _Asterina pectinifera_.----Ikegami. Susumu (Hiroshima Univ.. JAPAN)

#10-B-3 13:40-14:00: Histological And Ultrastructural Techniques For Examining The Water-Vascular And Peripheral Nervous Systems In The Ambulacrum Of The Starfish Arm.----Cavey. Michael (Univ. Calgary. CANADA)

#10-B-4 14:00-14:20: Some Peculiar Morphological Features Of _Neothyonidium arthroprocessum_. A New Phyllophorid Holothurian From South Africa.----Thandar. Ahmed (Univ. Durban-Westville. SOUTH AFRICA)

14:20-14:40: Coffee Break

Paleontology

#10-B-5 14:40-15:00: Mid-Carboniferous Echinoderms From The Luocheng Formation, Guangxi Province, Peoples Of Republic China.----Maples, Christopher (Kansus Geological Survey, U.S.A.)

#10-B-6 15:00-15:20: Morphologic Modeling Of The Blastoid Theca.----Waters, Jonny (West Georgia Coll., U.S.A.)

#10-B-7 15:20-15:40: Crinoid Distribution In Shoaling-Upward Carbonate-Clastic Sequences: Upper Ordovician (Maysvillian) Of Ohio And Kentucky, U.S.A.----Meyer, David (Univ. Cincinnati, U.S.A.)

#10-B-8 15:40-16:00: Recent Echinoid Taphonomy: Implications For The Echinoid Fossil Record.----Meyer, David (Univ. Cincinnati, U.S.A.)

#10-B-9 16:00-16:20: Establishing Pelagic Criteria In Mesozoic Crinoids.----Milsom, Clare (Liverpool Univ., ENGLAND)

#10-B-10 16:20-16:40: Biogeography Of The Centrozoic Isocrinidae (Stalked Crinoids) In The Indo-Pacific Area.----Oji, Tatsuo (Univ. Tokyo, JAPAN)

11, September (Teusday) Morning

Room A

Symposium B 8:30-12:15

Molecular Biology Of Echinoderm Development

(Organizer:Shimada, Hiraku, Hiroshima Univ., JAPAN)

8:30- 9:00: Regulation Of Meiotic Cycles By MPF In Starfish Oocytes. ---- Kishimoto, Takeo (Tokyo Inst. Technol., JAPAN)

9:00- 9:30: Sea Urchin Cell Lineages. ---- Cameron, Andrew (Calf. Inst. Technol., U.S.A.)

9:30- 9:50: Expression Of Na+, K+-ATPase α-Subunit In Embryos Of The Sea Urchin, _Hemicentrotus pulcherrimus_ During Early Development. ---- Mitsunaga, Keiko (Waseda Univ., JAPAN)

9:50-10:10: Arylsulfatase Gene Of Sea Urchin Embryo. ---- Shimada, Hiraku (Hiroshima Univ., JAPAN)

10:10-10:25: Coffee Break

10:25-10:55: Patterns Of Gene Expression During Sea Urchin Development, And The Role Of Cell-Cell Interactions. ---- Angerer, Robert (Univ. Rochester, U.S.A.)

10:55-11:20: Structures And Function Of Exogastrula-Inducing Peptides (EPIG) Isolated From Sea Urchin Embryos. ---- Ishihara, Katsutoshi (Saitama Univ., JAPAN)

11:20-12:00: Regulation Of Ectoderm Differentiation. ---- Angerer, Lynne (Univ. Rochester, U.S.A.)

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11. September (Teusday) Morning

Room B

Reproduction (1)

#11-B-1	9:00- 9:20:	A New Mode Of Reproduction In Holasteroids: Echinoid "Birth" In Antarctic Seas.----David. Bruno (Univ. Burgundy. FRANCE)
#11-B-2	9:20- 9:40:	Gonadal Development Of The Sea Urchin. Diadema setosum Of The Coast Of Singapore.---Hori. Reiji (Ogaki Women's Coll.. JAPAN)
#11-B-3	9:40-10:00:	Brooding And Fission In Shallow Water Echinoderms Of Southern Australia.----O'Loughlin. Mark (Museum Victoria. AUSTRALIA)
#11-B-4	10:00-10:20:	Seasonal Reproductive Periodicity In The European Comatulid Crinoid Antedon bifida (Pennant).----Nichols. David (Univ. Exeter. U.K.)
	10:20-10:40:	Coffee Break

Others

#11-B-5	10:40-11:00:	Long-Term Movements Of Some Tropical Sea-Cucumbers Monitored By Tagging And Recapture.----Conand. Chantal (Univ. Bretagne Occidentale. FRANCE)
#11-B-6	11:00-11:20:	A New Technique For The Individual Tagging Of Sea-Urchins.----Hagen. Nils (Nordland Coll.. NORWAY)
#11-B-7	11:20-11:40:	Effects Of A Coastal Throwing Out Of Iron Chloride On Paracentrotus lividus (Lam.) Populations From Marseilles-Cortiou (France)----Regis. Marie-Berthe (Fac. Sci. Tech. St-Jerome. FRANCE)
• #11-B-8	11:40-12:00:	Laboratory Cultivation Of Five Species Of Sea Urchins From The Sea Of Japan.----Naidenko. Kh. (Inst. Marine Biol.. U.S.S.R.)

11. September (Teusday) Afternoon

Room P

13:30-14:30	Poster Explanation	Category: Morphology Behavior Paleontology
14:30-15:30	Poster Explanation	Category: Ecology Physiology Evolution Reproduction
15:30-16:30	Poster Explanation	Category: Developmental Biology Molecular Biology Others

11. September (Teusday) Evening

Room A

FILM AND VIDEO SESSION

(Organizer:Amemiya. Shonan. Univ. Tokyo. JAPAN)

12. September (Wednesday) Morning

Room A
Physiology

#12-A-1 9:00- 9:20: The Effect Of Arm Number And Regeneration On Allocation Of Resources In _Luidia clathrata_ (Echinodermata: Asteroidea).----Lawrence. John (Univ. South Florida. U.S.A.)

#12-A-2 9:20- 9:40: Events Of Autotomy In The Starfish _Asterias forbesi_ And _A. vulgaris_.----Hotchkiss. Fredrick (Panametrics Inc.. U.S.A.)

#12-A-3 9:40-10:00: Ultraviolet Light-Absorbing Compounds In Coral Reef Holothurians: Organ Distribution And Possible Sources.----Shick. Malcolm (Univ. Maine. U.S.A.)

#12-A-4 10:00-10:20: Comparative Biochemical Studies Of Carotenoids In Sea Cucumbers.----Matsuno. Takao (Kyoto Pharmaceu. Univ.. JAPAN)

#12-A-5 10:20-10:40: Comparative Biochemical Studies Of Carotenoids In Sea Urchin. ----Matsuno. Takeo (Kyoto Pharmaceu. Univ.. JAPAN)

10:40-11:00: Coffee Break

Reproduction (2)

#12-A-6 11:00-11:20: Community Patterns Of Echinoderms Associated With Substrate And Depth In The Northern Gulf Of Mexico.----Hopkins. Thomas (Univ. Alabama. U.S.A.)

#12-A-7 11:20-11:40: Delayed Spawning Activity In Dispersed Individuals Of _Acanthaster planci_ (L.). In Okinawa.----Okaji. Ken (Univ. Ryukyus. JAPAN)

#12-A-8 11:40-12:00: Reproductive Biology In Sea-Urchins. _Strongylocentrotus nudus_ In Relation With Anthropogenic Influence.----Yakovlev. Serghey (Inst. Marine Biol.. U.S.S.R.)

Room B
Evolution

#12-B-1 9:00- 9:20: Partial Sequence Of The 28s Ribosomal RNA And The Taxonomy And Phylogeny Of Echinids.----Feral. Jean-Pierre (Cnt. Ntl. Recherche Sci.. FRANCE)

#12-B-2 9:20- 9:40: DNA-DNA Hybridization Phylogeny Of Sand Dollars:Lack Of Concordance With Morphological Phylogenies.----Marshall. Charles (Indiana Univ.. U.S.A.)

#12-B-3 9:40-10:00: Ossicles In Stomach Wall Of Ophiuroidea And Their Taxonomic Significance II.----Irimura. Seiichi (Totsuka High Sch.. JAPAN)

#12-B-4 10:00-10:20: Phylogeny Of Extant Crinoids:A Reappraisal At The Ordinal Level.----Messing. Charles (Nova Oceanogr. Cnt.. U.S.A.)

#12-B-5 10:20-10:40: Frequency Of Regeneration And Its Bathymetric Change In _Endoxocrinus parrae_ (Gervais). A West Atlantic Stalked Crinoid.----Oji. Tatsuo (Univ. Tokyo. JAPAN)

10:40-11:00: Coffee Break

Behavior

#12-B-6 11:00-11:20: Role Of The Neural Ring In Integrating Brittlestar Behavior.----Fox. David (Univ. Tennessee. U.S.A.)

#12-B-7 11:20-11:40: Feeding Biology And Life History Of Deep-Sea Echinoids In Relation To Their Food Supply.----Campos. Lucia (Univ. Southampton. U.K.)

13. September (Thursday) Morning

Room A

Symposium C 8:30-12:10

Echinometra: A Complex Under Speciation.

(Organizer: Motokawa. Tatsuo. Univ. Ryukyus. JAPAN)

8:30- 9:00:	*Echinometra mathaei* Complex: Habitat Preference And Ecological Distribution On Okinawan Coral Reefs. ---- Nishihara. Moritaka (Univ. Ryukyus. JAPAN)
9:00- 9:30:	Physiological Adaptations And Reproduction Of The Four Types Of *Echinometra mathaei* (Blainville). ---- Arakaki. Yuji (Kounan-Gakuen. JAPAN)
9:30-10:00:	Behavioral Characteristics Of The Sea Urchin *Echinometra mathaei* Complex : Re-Colonization Process On The Depopulated Sites And Agonistic Behavior. ---- Tsuchiya. Makoto (Univ. Ryukyus. JAPAN).
10:00-10:30:	Coffee Break
10:30-11:00:	Karyotype Difference And Cross-Fertilization Among Four Types Of Echinometra mathaei (Blainville) From Okinawa And Guam. ---- Shingaki. Mineo (Univ. Ryukyus. JAPAN)
11:00-11:30:	Genetic Differentiation And Reproductive Isolation Of Indo-Pacific Sea Urchins. Genus *Echinometra*.---- Metz. Edward (Univ. Hawaii. U.S.A.)
11:30-12:10:	Speciation Of Indo-Pacific *Echinometra*. ---- Uehara. Tsuyoshi (Univ. Ryukyus. JAPAN)

Room A

Ecology

#13-A-1	13:30-13:50:	Hurricane Effects On Caribbean Echinoderm Faunas: Preliminary Results.----Aronson. Beer (Smithonian Inst.. U.S.A.)
#13-A-2	13:50-14:10:	Sea Urchin Fisheries In British Columbia. Canada.----Campbell. Alan (Pacific Biol. Stat.. CANADA)
#13-A-3	14:10-14:30:	Considerations On The Intertropical Edible Sea-Urchin Populations In The Indo-Pacific.----Regis. Marie-Berthe (Fac. Sci. Tech. St-Jerome. FRANCE)
#13-A-4	14:30-14:50:	Life History Traits Of Caribbean Ophiuroids That Brood Their Young.---- Byrne. Maria (Univ. Sydney. AUSTRALIA)
	14:50-15:10:	Coffee Break
#13-A-5	15:10-15:30:	Independent Assessment Of Aged *Acanthaster planci* (L.) From The GBR Using Spine Ossicle Length And Estimated Reproductive Effort.----Stump. Richard (James Cook Univ. North Queensland. AUSTRALIA)
#13-A-6	15:30-15:50:	Biotic Associates And Ecology Of Reef Dwelling Unstalked Crinoids Of Bonaire. Netherlands Antilles.----Meyer. David (Univ. Cincinnati. U.S.A.)
#13-A-7	15:50-16:10:	Foraging Behaviour And Feeding Habits Of *Astropecten latespinosus* Meissner (Asteroidea:Astropectinidae).----Nojima. Satoshi (Kyushu Univ.. JAPAN)
#13-A-8	16:10-16:30:	Caribbean Coral Reef And Bathyal Ophiuroidea:Ecology And Adaptations.---- Hendler. Gordon (Natural History Museum Los Angels County. U.S.A.)
#13-A-9	16:30-16:50:	Burrowing Mechanism And Adaptive Significance Of Test Profile In Spatangoid Echinoid.---Kanazawa. Ken'ichi (Univ. Tokyo. JAPAN)

13. September (Thursday) Morning

Room B

Developmental Biology (1)

#13-B-1 9:00- 9:20: Calcium And Cell Cycle Control In Sea Urchin Embryos.----Whitaker. Michael (Univ. Coll. London. U.K.)

#13-B-2 9:20- 9:40: Morphological And Biochemical Changes In Sperm At Fertilization.----Hino. Akiya (Kanagawa Univ.. JAPAN)

#13-B-3 9:40-10:00: Cleavage Of The Partially Fertilized Sea-Urchin Egg Induced By Insemination Of The UV-Irradiated Sperm.----Ishikawa. Masaru (Sugiyama Women's University. JAPAN)

#13-B-4 10:00-10:20: Effects Of TMB-8 And CTC On Oxygen Consumption Enhanced By Treatments With Activating Reagents In Sea Urchin Eggs.----Kojima. Manabu (Toyama Univ.. JAPAN)

10:20-10:40: Coffee Break

#13-B-5 10:40-11:00: Coordinate Gene Expression During Skeletogenesis In Sea Urchin Embryos.----Whiteley. Arthur (Washington Univ.. U.S.A.)

#13-B-6 11:00-11:20: The Effects Of Collagenase And "Galactosidase" On The Morphogenesis Of Starfish Embryo.----Kaneko. Hiroyuki (Osaka City Univ.. JAPAN)

#13-B-7 11:20-11:40: A Comparative Study Of Echinoderm Phagocytes *In Vitro*.----Dan-Sohkawa. Marina (Osaka City Univ.. JAPAN)

13. September (Thursday) Afternoon

Room B

Developmental Biology (2)

#13-B-8 13:30-13:50: The Ultrastructure Of Cortical Cytoskeleton In Eggs And Zygotes In Sea Urchins And Its Morphogenetic Role In Normal Embryogenesis And In Development Of Sea Urchin Twins.----Drozdov. Anatoly (Inst. Marine Biol.. U.S.S.R.)

#13-B-9 13:50-14:10: Heterogeneity And Assembly-Disassembly Of Microtubules In Dividing Sea Urchin Eggs.----Oka. Mikako (Tokyo Inst. Tech. JAPAN)

#13-B-10 14:10-14:30: Role Of A Primary Mesenchyme Cell Surface Antigen During Early Morphogenesis In Sea Urchin Embryos.----Katow. Hideki (Rikkyo Univ.. JAPAN)

#13-B-11 14:30-14:50: Initial Characterization Of Primary Mesenchyme Cell Homing Site In Sea Urchin Blastulae.----Nakajima. Yoko (Keio Univ.. JAPAN)

14:50-15:10: Coffee Break

#13-B-12 15:10-15:30: Adaptive Heterochronic Plasticity In Development Of The Arms And Echinus Rudiment Of Food-Limited Plutei.----Strathmann. Richard (Univ. Washington. U.S.A.)

#13-B-13 15:30-15:50: Comparisons Of Larval Development And Growth Of The Sea Cucumber *Actinopyga echinites*: Ovary-Induced Ova And [illegible]-Induced Ova.----Chen. Chang-Po (Acad. Sinica. TAIWAN)

#13-B-14 15:50-16:10: Histological And Scanning Electron Microscopical Studies On Development And Metamorphosis Of An Echinothurioid Echinoid. *Asthenosoma ijimai*.----Amemiya. Shonan (Univ. Tokyo. JAPAN)

#13-E-15 16:10-16:30: A Comparison Of Development In Three Species Of The Genus. *Luidia* (Echinodermata: Asteroidea) From Florida.----Komatsu. Mieko (Toyama Univ.. JAPAN)

#13-E-16 16:30-16:50: Development Of The Asteroid *Patiriella regularis* (Verrill).----Byrne. Maria (Univ. Sydney. AUSTRALIA)

POSTER SESSION

10-11. September (Monday-Teusday)

Room P

Ecology

P-1-1 Nutrition And Gut Contents Of Deep-Sea Echinoids From The Bahamas.----Campos. Lucia (Univ. Southampton. U.K.)

P-1-2 Size Structure Of Dense Populations Of *Ophiura sarsii* In The Bathyal Zone Around Japan.----Fujita. Toshihiko (Univ. Tokyo. JAPAN)

P-1-3 Population Dynamics And Shorewards Migration Of The Spatangoid Echinoid *Echinocardium cordatum* In The Bay Of Seine (Norway).----DeRidder. D. (Univ. der Librede Bruxelles. BELGIUM)

Evolution

P-2-1 The Eastern Caribbean As A Relictual Center Of Survivorship For *Clypeaster* spp.----Hopkins. Thomas (Univ. Alabama. U.S.A.)

Reproduction

P-3-1 Reproductive Cycle. Larval Development. Juvenile Growth And Size Distribution Of *Patiriella pseudoexigua* Dartnall (Echinodermata: Asteroiea).----Chen. Bih-Yuh (Acad. Sinica. TAIWAN)

P-3-2 Variation In Reproductive Patterns Of Echinoderms From The Northern Gulf Of Mexico.----Hopkins. Thomas (Univ. Alabama. U.S.A.)

P-3-3 Seasonal Coelomic Brooding In Small Southern Australian Cucumariids (Echinodermata: Holothurioidea).----Materia. Christine (Museum Victoria. AUSTRALIA)

P-3-4 Enzymes And Proteins Involved In Formation And Hardening Of Sea Urchin Fertilization Envelopes.----Nomura. Kohji (Tokyo Metropolitan Inst. Gerontol.. JAPAN)

P-3-5 Chromatographic Studies On Acid-Soluble Nucleotides In Unfertilized Eggs Of Echinoderms.----Seki. Toshinori (Nippon Med. Sch.. JAPAN)

P-3-6 Seasonal Changes In The Gonads Of *Eupentacta fraudatrix* And *Cucumaria japonica* (Hokothuroidea. Echinodermata) From Peter The Great Bay. Sea Of Japan.----Yakovlev. Serghey (Inst. Marine Biol.. U.S.S.R.)

P-3-7 Characterization Of Proteasomes Isolated From Sea Urchin Gametes.----Yokosawa. Hideyoshi (Hokkaido Univ.. JAPAN)

Morphology

P-4-1 Morphological Changes Of *Culcita novaeguineae* During Growth.----Kano. Yasuo (Uozu Aquarium. JAPAN)

P-4-2 Calcium Translocation In Catch Connective Tissue.----Motokawa. Tatsuo (Univ. Ryukyus. JAPAN)

Molecular Biology

P-5-1 Cloning Of The Sea Urchin Outer Arm Dynein -Heavy Chain cDNA.----Ogawa. Kazuo (Ntl. Inst. Basic Biol.. JAPAN)

Developmental Biology

P-6-1 Heavy Bodies In Sea Urchin Embryos Detected By NOR-Silver Staining.----Amikura Reiko (Tokyo Women's Med. Coll.. JAPAN)

P-6-2 Steady Ionic Currents Around The Unfertilized Egg Of The Sea Urchin. *Holopneustes purpurescens*.----Chrystal. Jane (Univ. Sydney. AUSTRALIA)

P-6-3 The Early Embryonal Development And Metamorphosis In The Far Eastern Sea Cucumber (*Stichopus japonicus*).----Drozdov. A. L. (Inst. Marine Biol.. U.S.S.R.)

P-6-4 A 70Kd Microtubule-Binding Protein (70Kd-Protein) From Starfish Eggs.----Hosoya. Natsumi (Univ. Tokyo. JAPAN)

P-6-5 Aspects Of Metamorphosis In Crinoid Larvae (Antedon bifida).----Jangoux. Michel (Univ. der Librede Bruxelles. BELGIUM)

P-6-6 Phorbol Ester And Ca2+ Synergestically Stimulate Na+/H+ Exchanger In Activated Sea Urchin Eggs.----Kuroda. Hideyo (Nagoya Univ.. JAPAN)

P-6-7 Spiral Arrays Of Microtubles In Sea Urchin Eggs.----Iiki-Noumura. Taiko (Ochanomizu Univ.. JAPAN)

P-6-8 Phosphatidylcholine Metabolism In Sea Urchin Spermatozoa.----Iita. Masatoshi (Teikyo Univ.. JAPAN)

P-6-9 Change In Na+.K+-ATPase Activity In Embryos Of The Sea Urchin. *Hemicentrotus pulcherrimus*. During Early Development.----Mitsunaga. Keiko (Waseda Univ.. JAPAN)

P-6-10 Cytoskeletal Framework Of Sea Urchin Embryos.----Uemura. Isao (Tokyo Metropolitan Univ.. JAPAN)

P-6-11 Formation Of The Hyaline Layer In Sea-Urchin Eggs.--As Revealed By Deformation Induced By Fixation With Glutaraldehyde.----Usui. Noriko (Teikyo Univ.. JAPAN)

P-6-12 Studies On The Conditions To Produce Parthenogenetic Embryos In Starfish Eggs And The Behavior Of Nuclei And Chromosomes During The Process Where The Parthenogenetic Embryos Become Tetraploids.----Washitani-Nemoto. Setsuko (Hitotsubashi Univ.. JAPAN)

P-6-13 Localization And Expression Of Collagen Molecules In An Echinothurioid Echinoid. *Asthenosoma ijimai*.----Arakawa. Emi (Univ. Tokyo. JAPAN)

P-6-14 High External pH Can Activate The Ca2+ Transport System Of Sea Urchin Sperm.----Sendai. Yutaka (Hokkaido Univ.. JAPAN)

P-6-15 Species Specificity Of Egg Jelly Molecule. Fucose Sulfate Glycoconjugate. In Induction Of The Acrosome Reaction Of Sea Urchin Spermatozoa.----Shimizu. Takeshi (Kanazawa Univ.. JAPAN)

P-6-16 Appearance Of The Egg Jelly Molecules. Fucose Sulfate Glycoconjugate And Sperm-Activating Peptide In The Growing Oocyte Of The Sea Urchin *Hemicentrotus pulcherrimus*.----Kinoh. Hiroaki (Kanazawa Univ.. JAPAN)

P-6-17 Effects Of External High K Concentration On Activation Of Sea Urchin Spermatozoa By Sperm-Activating Peptide I.----Harumi. Tatsuo (Kanazawa Univ.. JAPAN)

P-6-18 Identification Of The Egg-Surface Substance Of Sea Urchin. *Hemicentrotus pulcherrimus*. By Monoclonal Antibodies.----Yazaki. Ikuko (Tokyo Metropolitan Univ.. JAPAN)

P-6-19 Two Novel Brominated Amino Acids-Containing Sperm-Activating Peptides From The Egg Jelly Of Sea Urchins. *Tripneustes gratilla* And *Clypeaster japonicus*.----Yoshino. Ken-ichi (Kanazawa Univ.. JAPAN)

Physiology

P-7-1 Oxygen Consumption By Intertidal Holothurians From Southern Australia.----Bardsley. Maree (Museum Victoria. AUSTRALIA)

P-7-2 Photo-Activated CO Insensitive Respiration In Sea Urchin Sperm.----Fujiwara. Akiko (Waseda Univ.. JAPAN)

P-7-3 Strucute Of The Pore Canal Of The Echinoid Madreporite.----Takahashi. Keiichi (Univ. Tokyo. JAPAN)

P-7-4 Isolation Of Single Pore Canals From The Sea-Urchin Madreporite.----Tamori. Masaki (Univ. Tokyo. JAPAN)

P-7-5 Physiological Properties And Structure Of The Radial Muscle Of An Echinothurid Sea Urchin. Asthenosoma.----Tsuchiya. Teizo (Teikyo Univ. JAPAN)

Behavior

P-8-1 Feeding Activity In A Dendrochirotid Holothurian. Cucumaria miniata.----Perz-Ruzafa. Angel (Univ. Murcia Campus de Espinardo. SPAIN)

Paleontology

P-9-1 Some Fossile Echinodermata From The Middle Miocene Morozaki Group In The Chita Peninsula. Central Japan.----Mizuno. Yoshiaki (Nagoya. JAPAN)

P-9-2 On The Fossil Ophiuroids From The Tertiary System In Japan.----Ishida. Yoshiaki (Hitotsubashi High Sch.. JAPAN)

Others

P-10-1 Trends In Tropical Sea-Cucumber Fisheries.----Conand. Chantal (Univ. Bretagne Occidentale. FRANCE)

P-10-2 Evaluation Of Viability Of Sea Urchins Larvae After Cryoconservation Of Embryos.----Naidenko. Kh (Inst. Marine Biol.. U.S.S.R.)

P-10-3 Karyotypic Comparison Of Japanese Sea Urchins.----Saotome. Kyoko (Yokohama City Inst. Health. JAPAN)

P-10-4 Geographic And Bathymetric Distribution Of Southern African Deep Sea Holothuroidea--A Preliminary Analysis.----Thander. Ahmed (Univ. Durban-Westville. SOUTH AFRICA)

Rowley: Growth of newly settled sea urchins

Rowley. 1990.

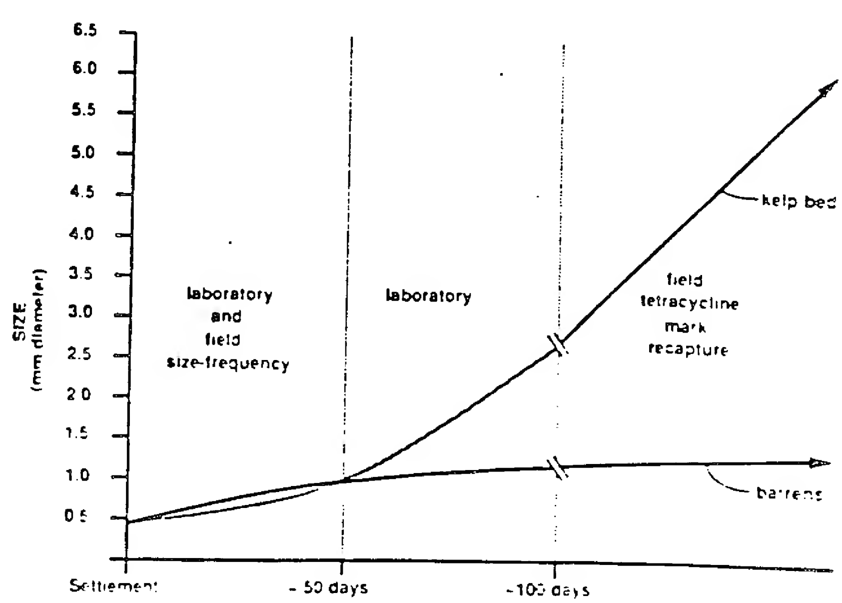


Fig. 6. *Strongylocentrotus purpuratus.* Composite graph of the growth of sea urchins in the kelp bed (or on fleshy algal turf) and in the barrens (or on crustose coralline algae). Approximate age ranges over which growth was measured, and the different methods used, are shown in the 3 sections

Mar. Ecol. Prog. Ser.

1988 ANNUAL MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA -- CENTENIAL CELEBRATION DENVER, COLORADO, October 31 to November 3 1989 (communicated by William I. Ausich)

Ausich, W.I., and D.L. Meyer. Waulsortian banks, crinoid banks and crinoid turbidites: fill of the Lower Mississippian Fort Payne Basin.

Axon, A.G., and F.R. Ettensohn. Anatomy of a Late Ordovician (Cincinnatian) crinoid-garden community, southwestern Ohio.

Beadle, S.C. Morphogenesis in sand dollars, and its implications for the rapid evolution of Dendraster.

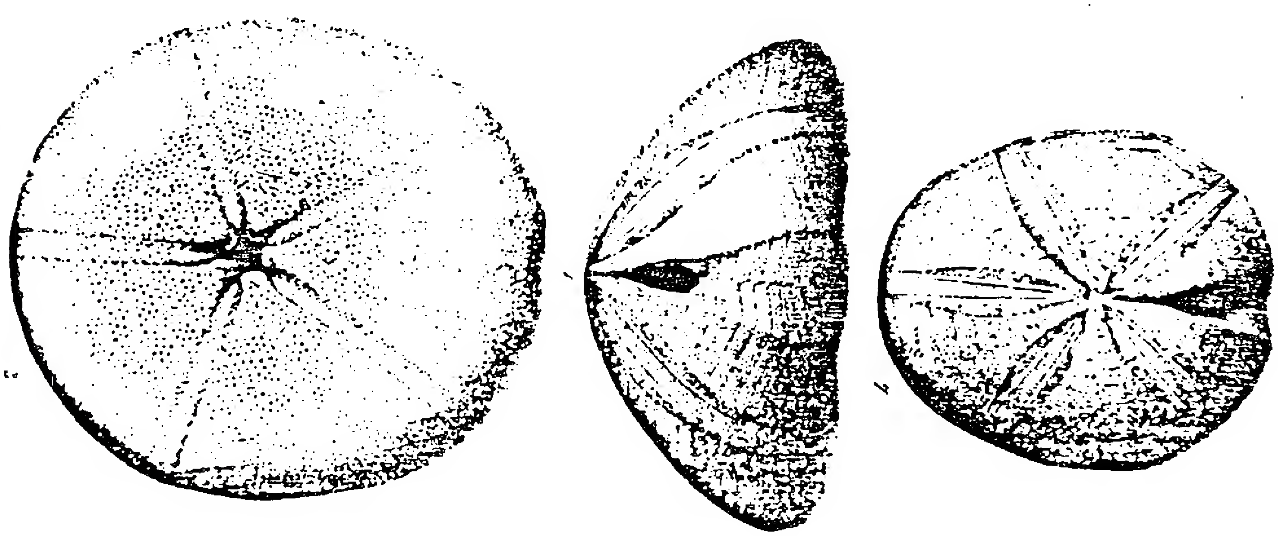
Blake, D.B. Adaptive zones of the Class Asteroidea (Echinodermata)

Lewis, R.D., and M.W. Peebles. Surface textures on Nemaster rubiginosa (Crinoidea; Echinodermata) San Salvador, Bahamas.

Meyer, D.L., and T. Oji. Eocene crinoids from Seymor Island, Antarctic peninsula: paleobiogeographic and paleoecologic implications.

Schneider, J.A. The teleost radiation and the disappearance of shallow water stalked crinoids.

Waters, J.A., and K. Bohnenstiehl. Anatomy of Deltablastus and Pentremites (Echinodermata: Blastoidea).



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<u>1989 SOUTHEASTERN SECTION MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA</u> ATLANTA, GEORGIA, April 6 to 7, 1989 (communicated by William I. Ausich)

Broadhead, T.W., M.A. Gibson, C.R. Clement, D.A. Capaccioli, R. McComb, and S.R. Reid. Sedimentary environments and biotas across the Silurian-Devonian boundary in shallow marine shelf setting, western Tennessee.

Waters, J.A. Further comments on the Meramecian/Chesterian (Mississippian) boundary.

<u>1989 NORTH-CENTRAL SECTION MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA</u> NOTRE DAME, INDIANA, April 20 to 21 (communicated by William I. Ausich)

Ausich, W.I., and D.L. Meyer. Component assembly of Fort Payne Formation paleocommunities (Lower Mississippian; south-central Kentucky).

Ausich, W.I., D.L. Meyer, and J.A. Waters. The role of extinction in the evolutionary history of Middle Mississippian echinoderms.

Blake, D.B. Evolutionary and functional significance of two new Jurassic species of the family Asteriidae (Echinodermata; Asteroidea)

Guensburg, T.E. Lifestyles and functional evolution of Middle Ordovician crinoids, Lebanon Limestone, Tennessee.

Kammer, T.W., and W.I. Ausich. The Osagean-Meramecian (Mississippian) boundary problem revisited: the forgotten role of James Hall's Geode Bed.

Meyer, D.L. An edrioasteroid-brachiopod symbiosis from the Upper Ordovician of the Cincinnati Arch region.

Parsley, R.L. Functional morphology and paleoecology of <u>Aristocystites bohemicus</u> (Diploporida: Echinodermata) from the Prague Basin, Bohemia, CSSR.

Terry, R.E. Echinoderm assemblages of the Fort Payne Formation (Lower Mississippian), Dale Hollow Reservoir, Tennessee.

<u>JOINT MEETING OF THE CORDILLERAN AND ROCKY MOUNTAIN SECTIONS OF THE GEOLOGICAL SOCIETY OF AMERICA</u> SPOKANE, WASHINGTON, May 8 to 11, 1989 (communicated by William I. Ausich)

Fleming, T.P. New echinoids from the Triassic of North and South America.

28TH INTERNATIONAL GEOLOGICAL CONGRESS WASHINGTON, D.C., July 9 to 19, 1989 (communicated by William I. Ausich)

WORKSHOP ON FOSSIL CRINOIDS -- see report below.

SYMPOSIUM ON PELMATOZOAN EVENTS organized by C.C. Brett and C. Franzen-Bengtson.

Waters, J.A. Evolutionary history of the Blastoidea (Echinodermata).

Broadhead, T.W. Conserved characters -- A major theme in the evolution of the crinoid crown.

Donovan, S.K. The significance of the British Ordovician crinoid fauna.

Ausich, W.I., T.W. Kammer, and D.L. Meyer. Crinoid community paleoecology of the late Osagean (Visean) Eastern Interior Seaway (Lower Carboniferous, midcontinental United States).

Schneider, J.A. Teleost fish and the retreat of stalked crinoids.

Oji, T. Biogeography of the Indo-Pacific Isocrinidae (stalked crinoids during the Cenozoic Era.

Brower, J.C. Trophic structure of a Middle Ordovician echinoderm fauna.

OTHER PAPERS

Hart, C. Cryogenic preservation of Holocene marine benthos in the McMurdo Ice Shelf, Antarctica.

Jablonski, D., and D.J. Bottjer. Origin and radiation of post-Paleozoic marine invertebrates: Ecological patterns and macroevolutionary lags.

Meyer, D.L., W.I. Ausich, and R.E. Terry. Interpretation of Paleozoic crinoid taphonomy: limitations of recent models.

<u>1989 ANNUAL MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA</u> -- ST. LOUIS, MISSOURI, November 6 to November 9 1990. Geological Society of America Abstracts with Program 21(6). (communicated by William I. Ausich)

Aronson, R.B. The Devonian predation increase in shallow marine ecosystems: Evidence from the occurrence of crinoid populations.

Ausich, W.I., and T.W. Kammer. Mode of microevolotion in <u>Platycrinites</u> (Middle Mississippian, Crinoidea)

Baumiller, T.K. Drillholes in Mississippian crinoids: A case of non-predatory gastropod drilling.

Blake, D.B., and W.J. Zinsmeister. Extraordinary Cretaceous marsupiate echinoid from Antarctica: Morphology and eimplications.

Greenstein, B.J. The effect of taphonomic bias on the fossil record of echinoids.

Schubert, J.K., and D.J. Bottjer. The beginning of the Mesozoic: Paleoecology of Lower Triassic carbonates, southwestern Utah and southern Nevada.

Sprinkle, J. Origin of the Echinoderm class Rhombifera based on new Early Ordovician discoveries from the Rocky Mountains.

Suter, S.J. The paleoenvironmental pattern of the decline of cassiduloid echinoids: No retreat, but surrender.

Terry, R.E., D.L. Meyer, and W.I. Ausich. Comparative taphonomy of debris flow echinoderms: A key to understanding the deopostion of the Fort Payne Formation (Lower Mississippian) of Tennessee and Kentucky.

Water, J.A., C.G. Maples, and N.G. Lane. Early Late Carboniferous echinoderms from the Luocheng Formation , Guangxi Province, Peoples Republic of China

<u>1990 SOUTH-CENTRAL SECTION MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA</u> STILLWATER, OKLAHOMA, March 5 to 6, Geological Society of America Abstracts with Program 22(1). (communicated by William I. Ausich)

Maples, C.G., and T.L. Thompson. Age of the Hindsville Limestone, southwestern Missouri, based on conodonts and echinoderms.

Wernlund, R.J. Permian holothurian sclerites from the Pinery Member, Bell Canyon Formation of the Delaware Basin, west Texas.

<u>1990 NORTHEASTERN SECTION MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA</u> SYRACUSE, NEW YORK, March 4 to 7, Geological Society of America Abstracts with Program 22(2). (communicated by William I. Ausich)

Brower, J.C. The paleoecology of food-gathering in two cupulocrinids from the Middle Ordovician of middle North America.

<u>1990 SOUTHEASTERN SECTION MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA</u> TUSCALOOSA, ALABAMA, April 5 to 6, 1990, Geological Society of America Abstracts with Program 22(4). (communicated by William I. Ausich).

Carter, B. Paleobiogeography of Paleozoic echinoids.

Clement, C.R., and T.W. Broadhead. Biogeographic implications of Late Silurian-Early Devonian echinoderm faunas, western Tennessee.

Waters, J.A., A.S. Horowitz, and D.B. Macurda, Jr. The paleobiogeography of <u>Pentremites</u> (Blastoidea: Echinodermata).

<u>1990 NORTH-CENTRAL SECTION MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA</u> MACOMB, ILLINOIS, April 26 to 27, Geological Society of America Abstracts with Program 22(5). (communicated by William I. Ausich)

Ausich, W.I., and C.P. Hart. Cryogenic taphonomy of crinoids (Echinodermata) on the McMurdo Ice Shelf, Antarctica.

Blake, D.B. Paleobiological implications of some juvenile Upper Ordovician asteroids.

<u>INTERNATIONAL SEDIMENTOLOGICAL CONGRESS</u> NOTTINGHAM, ENGLAND, August 26 to August 31, 1990. (communicated by William I. Ausich)

Ausich, W.I. Regional encrinites: A vanashed lithofacies.

THESES AND DISSERTATIONS

BACHELOR'S THESES

Canada

McDaniell, N. 1971. The starfish *Solaster dawsoni* as a predator of asteroids. Univ. of British Columbia.

Australia

Klemke, J.E. 1985. Habitats and diets of adults and juveniles of the seastar Coscinasterias calamaria (Gray) in Port Philip. Univ. of Melbourne.

O'Callaghan, B. 1986. Some aspects of asexual reproduction in the fissiparous starfish Allostichaster polyplax (Muller & Troschel). Univ. of Melbourne.

Laedgsgaard, P. 1989. Reproduction of sympatric populations of *Heliocidaris tuberculata* and *Heliocidaris erythrogramma*. Univ. of Sydney.

Peckham, K.P. 1984. The effect of size, starvation, and temperature on nutrient partitioning and respiration of *Acanthaster planci*. James Cook Univ.

Japan

Sugiyama, T., K. Tori. 1986. Ecological studies on juveniles of *A. planci* at Iriomote Island: Distribution, morphogenesis and change in feeding habit, and tolerance against environmental stresses. Tokai Univ.

Ohtaki, T., T. Toyoguchi. 1986. Tolerances of *A. planci* against water temperatures, lowered salinities and lowered levels of dissolved oxygen. Univ. Ryukyus.

Ireland

Grehan, A. 1982. Aspects of the biology and ecology of *Amphiura filiformis* (O.F. Muller) (Echinodermata: Ophiuroidea). University College, Galway.

O'Sullivan, S. 1988. Aspects of the ecology and culture of the purple sea urchin Paracentrotus lividus (Lamarck). University College, Cork.

Belgium (Liciencie)

Dominique, F. 1973. Contribution a l'etude du cycle annuel de reproduction de deux especes d'echinoides (Echinodermata) des cotes de Bretagne. Univ. Libre Bruxelles.

Temara, A. 1990. Caracteres d'une symbiose bactewrienne intradigestive chez l'echinide Fouisseur Echinocardium cordatum (Echinodermata). Univ. Libre Bruxelles.

Ireland

Grehan, A. Aspects of the biology and ecology of *Amphiura filiformis* (O.F. Muller) (Echinodermata, Ophiuroid. Univ. College, Galway.

MASTER'S THESES

Germany

Schoppe, S. 1990. The association between *Acyrtus rubignisosu* (Gobiesocidae), *Clastotoechus vanderhorsti* (Porcellanidae), *Ophiothrix* sp. (Ophiotrichidae) and their burrowing host *Echinometra lucunter* (Echinometridae) on the rocky shores of Santa Marta, Columbia. Univ. of Giessen.

Republic of South Africa

Sweijd, N. A. 1990. The digestive mechanisms of an intertidal grazer,the sea urchin *Parechinus angulosus* (Leske). Rhodes Univ.

New Zealand

Fell, H.B. 1938. The direct development of a New Zealand ophiuroid. Wellington Univ.

Dawbin, W.H.I. 1942. Autoeviscertation and regeneration in *Stichopus mollis* (Hutton). Wellington Univ.

di Menna, M.E. 1947. The anatomy and ecology of *Trochodota dunedinensis* (Parker), a synaptid holothurian. Univ. of Otago.

Boyle, A. 1954. The anatomy and systematic position of *Evechinus chloroticus* (Val. 1846), an endemic New Zealand echinoid. Wellington Univ.

Laurenson, D.F. 1970. Behavioural and physiological studies of the escape response elicited in trochid gastropods by thaid and asteroid predators. Univ. Auckland.

Marin, R.B. 1970. Asteroid feeding biology. Univ. Auckland.

Don, G.L. 1975. The effects of grazing by *Evechinus chloroticus* (Val.) on populations of *Ecklonia radiata* (Ag.). Univ. Auckland.

Walker, M. 1977. Local variation in the population biology of *Evechinus chloroticus* (Val.). Univ. Auckland.

Andrew, N.L. 1982. An experimental study of the distribution and abundance of *Evechinus chloroticus* (Echinoidea: Echinodermata). Univ. Auckland.

Burgett, J.M. 1982. The feeeding ecology of *Patiriella regularis* (Verrill) in the rocky intertidal. Univ. Auckland.

La Barre, S. 1978. The ecology of a subtidal fringing reef at Nouville, New Caledonia, with special reference to the Echinodermata. Univ. Auckland.

Sewell, M. A. 1990. The reproductive biology of *Stichopus mollis* (Hutton). Univ. of Auckland.

Australia

Connolly, R.M. 1986. Behavior and ecology of the sea urchin *Heliocidaris erythrogramma* (Valenciennes). Univ. of Adelaide.

Nash, W.J. 1983. Population genetic and morphological studies on the Crown-of-thorns starfish, *Acanthaster planci* (L.), in the Great Barrier Reef region. James Cook University of North Queensland, Townsville.

Duyverman. 1976. Factors affecting the local distribution of the sea star *Patiriella exigua* L. Flinders University.

Dartnell, A. 1971. The taxonomy and biogeography of the sea star genus *Patiriella* in Tasmania. Univ. of Tasmania.

Stump, R. 1987. Preliminary investigationsinto ageing the crown-of-thorns starfish *Acanthaster planci* (L.) (Echinodermata, Asteroidea) using intracellular autofluorescent pigment analysis. James Cook Univ.

France (Doctorate de 3eme Cycle)

Bourgoin, A. 1987. Ecologie et demographie d'*Acrocnida brachiata* (Montgu) (Echinoderma en baie de Douarnenez (Bretagne). Universite de Bretagne Occidentale.

Gentil, F. 1976. Distribution des peuplements benthiques en baie de Seine. Univ. de Paris VI.

Canada

Brooks, E.J. 1973. Some aspects of the taxonomy and biology of the genus Leptosynapta (Holothuroidea) in British Columbia. Univ. Victoria.

McClary, D.J. 1989. The biology and ecology of reproduction in the brooding and broadcasting sea star, *Pteraster militaris* (O.F. Muller) (Echinodermata: Pterasteridae). Mount Allison University, Sackville.

Raymond, B.G. 1985. Behaviour and growth of the early life history stages of *Strongylocentrouts droebachiensis*. Dalhousie University.

Younglao, D. 1987. Spawning, aggregation and recruitment in the black sea urchin *Diadema antillarum*. McGill University.

Carson, S.F. 1989. Development and reproductive biology of three species of *Solaster* sea stars from the northeast Pacific Ocean. Univ. of Alberta.

U.K.

Lewis, D.N. 1987. The fossil Echinoidea from the Barton Beds (Eocene) of the type locality. Birkbeck College.

Ruswahyuni. 1986. Studies of tropical benthic organisms. Univ. of Newcastle upon Tyne.

U.S.A.

Lahaye, C.A. 1985. Electron microscopic study of the ontogeny of digestive phgocytosis during the development of an asteroid (*Patiria miniata*) and an echinoid (*Lytechinus pictus*). San Diego State University.

Brookbank, J. W. 1953. The urease activity of the eggs and embryos of the sea urchin *Strongylocentrotus purpuratus* Stimpson. Univ. of Washington.

Litchfield, J.B. 1954. Studies on the mechanism of phosphate accumulation by sea urchin embryos. Univ. of Washington.

Lares, M.T. 1990. The effects of temperture on the survival, organismal activity, nutrition, growth, and reproduction of the carnivorous, tropicl sea urchin, *Eucidaris tribuloides*. Univ. of Alabama at Birmingham.

Briscoe, C.S. 1988. Omnivory in the green sea urchin *Strongylocentrotus droebachiensis* (Muller) (Echinodermata: Echinoidea): the contribution of mussel versus kelp diets for somatic growth and reproductive effort. Northeastern Univ.

Padilla, D. 1981. Selective factors influencing the morphology of coralline algae. Oregon State Univ. (echinoids)

Schneider, J. A. 1988. Evolutionary ecology of post-Paleozoic crinoids. Univ. of Chicago.

Truchon, S.P. 1988. Growth and reproduction in kelp bed and barren populations of *Strongylocentrotus droebachiensis* (Muller), the green sea urchin. Univ. of New Hampshire, Durham.

Kwast, K.E. 1989. Genetics and systematics of the *Leptasterias hexactis* species complex (Echinodermata: Asteroidea). Louisiana State Univ.

Hadfield, M.G. 1961. The morphology of a psolid holothurian. Univ. Washington.

Jones, S. 1960. Early embryology of Psolus chitinoides. Univ. Washington.

Randall, R.H.1971. Tanguisson-Tumon, Guam reef corals before, during, and after the crown-of-thorns (*Acanthaster planci*) predation. Univ. Guam.

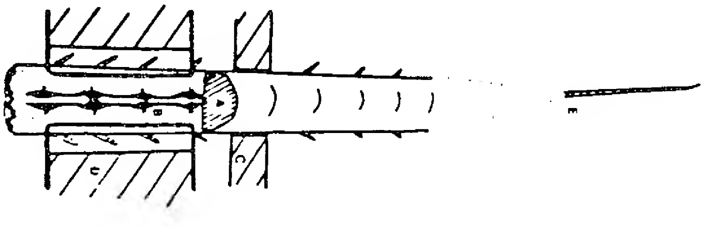


Figure 1 Single arm with several segments dissected from the aboral surface. The nerve cord is exposed by removing the aboral intervertebral muscles and ossicles (A) with the hyponeural ganglia and the associated severed motor axon bundles on the top surface (B). The intact arm is held clamped close to the dissected region (C) but the rest is free to move (E). The dissected part is further clamped (D) such that there is access to stimulate the undamaged parts of the lateral plates, spines and oral region

Cobb. 1990. Mar. Behav. Physiol.

Greenstein, B.J. 1986. Mass mortality of the echinoid *Diadema antillarum* at Bonaire, Netherlands Antilles: a natural experiment in taphonomy. Univ. of Cincinnati.

Roeser, E.W. 1986. A Lower Mississippian (Kinderhookian - Osagean) crinoid fauna from the Cuyahoga Formation of northeastern Ohio. Univ. of Cincinnati.

Thies, J.L. 1988. Analysis of crinoid communities and their associated lithofacies within the Fort Payne Formation (Lower Mississippian) in the vicinity of Burkesville, Kentucky. Univ. of Cincinnati.

Terry, R.E., 1990. Echinoderm Paleoecologyo and taphonomy of carbonate debris flows, Fort Payne Formation (Late Osagean, Lower Mississippian), Dale Hollow Reservoir, Tenneśsee. Univ. of Cincinnati.

Schneider, J. 1988. Evolutionary ecology of Post-Paleozoic crinoids. Univ. of Cincinnati.

Republic of China

Chen, B.-Y. 1989. Life history of *Patiriella pseudoexigua* Dartnell (Echindoermata: Asteroidea). Sun Yat-Sen University, Kaohsiung.

Japan

Arakaki, Yuuji. 1990. A comparative ecological and reproductive study on the four types of sea urchin *Echinometra mathaei* (Blainville) on Okinawan reef flats. Univ. of the Ryukyus.

C M. Pearce and R E. Scheibling: Settlement and metamorphosis in *E. parma*

1990,

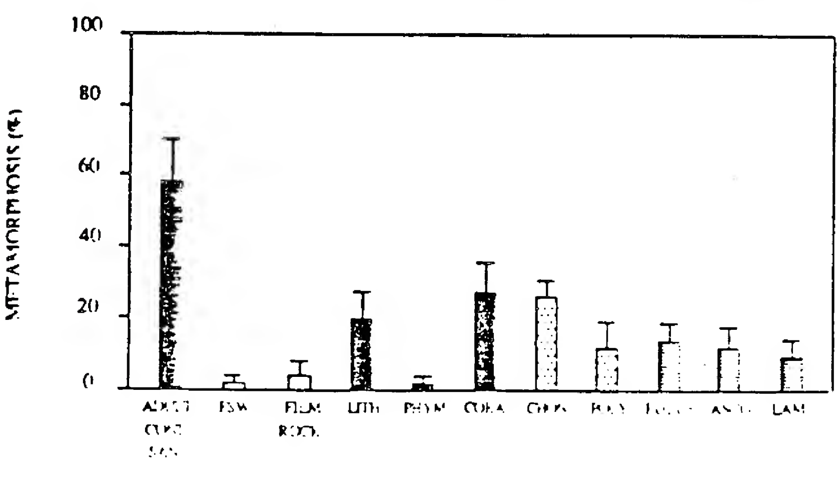


Fig. 4. *Echinarachnius parma*. Mean percent metamorphosis of larvae in response to various macroalgae: *Lithothamnion glaciale* (LITH), *Phymatholithon laevigatum* and or *P. rugulosum* (PHYM), *Corallina officinalis* (CORA), *Chondrus crispus* (CHON), *Polysiphonia lanosa* (POLY), *Fucus vesiculosus* (FUCUS), *Ascophyllum nodosum* (ASCO), *Laminaria longicruris* (LAMI), and bare rocks with a 9-mo-old microbial film (FILM ROCK). Controls are filtered sea water (FSW) and sand taken from a bed and maintained with adults (ADULT COND SAND). Each treatment consists of five replicates with ten larvae per replicate. Filled bars indicate red coralline algae, stippled bars red foliose algae, and lined bars brown algae. Error bars indicate standard error. Horizontal bar below graph underscores treatments which do not significantly d[illegible] proportion of larvae metamorphosed [illegible]

<u>Brasil</u>

Albuquerque, Maria da Nativadade. 1978. Amphiur Forbes, 1843 et Amphioplus Verrill, 1899 das regioes Antarticae Subantartica (Echinodermata-Ophiuroidea-Amphiuridae). Universidade Federal do Rio de Janeiro.

DOCTORAL DISSERTATIONS

<u>Australia</u>

Keesing, John K. 1990. Feeding biology of the crown of thorns starfish *Acanthaster planci* (Linnaeus). James Cook University of North Queensland.

Andrew, N.L. 1988. Population dynamics and herbivory in the common sea urchin *Centrostephanus rodgersii*. Univ. of Sydney.

Constable, A.J. 1989. An investigation of resource allocation in the sea urchin, *Heliocidaris erythrogramma* (Valenciennes). Univ. of Melbourne.

<u>New Zealand</u>

Pawson, D.L. 1963. Studies on echinoderms of the southern Pacific Ocean. Victoria University of New Zealand.

Crump, R.G. 1969. Aspects of the biology of some New Zealand echinoderms: feeding, growth and reproduction in the asteroids, *Patiriella regularis* (Verrill, 1867) and *Coscinasterias calamaria* (Gray, 1840). Univ. of Otago.

Clark, H.E.S. 1969. Revision of the Southern Hemisphere asteroid order Paxillosida. Victoria University of Wellington.

Dix, T.G. 1969. The biology of the echinoid *Evechinus chloroticus* (Val.) in different habitats. Univ. Canterbury.

Pentreath, R.J. 1968.The comparative form, function and ecology of some New Zealand brittle-stars (Ophiuroidea). Univ. Auckland.

Rainer, S.F. 1969. Marine benthic ecology in Otago: the macrofauna of deposit substrata in the Otago Harbour and Blueskin Bay. Univ. of Otago. (holothuroids, ophiuroids)

Barker, M.F. 1977. Studies on the life cycle of two forcipulate starfish (Echinodermata, Asteroidea) from New Zealand. Univ. Auckland.

Town, J.C. 1979. Aspects of the biology of Astrostole scabra (Hutton, 1872). Univ. Canterbury. uipXu, R. A. 1989. Studies on the reproductive biology of the forcipulate starfish *Scleasterias mollis* (Echinodermata: Asteroidea). Univ. of Otago.

<u>Puerto Rico</u>

Morales Velez, Mildred. 1990. The catch mechanism of the sea-urchin spine ligament. I. Cholinergic sensitivity. II. Influence of calcium. III. Structural factors. University of Puerto Rico.

Scotland

Bedford, A.D. 1986. Metazoan detritovores and underwater decomposition processes of detached sublittoral macrophytes. Univ. of Glasgow.

Turton, G.-C. 1987. Antifungal defense mechanisms of the sea urchin *Echinus esculentus* L. Univ. of Glasgow.

Russia

Levin, V.S. 1990. Trophoecology of holothurians in the coastal zone of the sea.

Ireland

Bowmer, T. 1982. Aspects of the biology and ecology of *Amphiural filiformis* (O.F. Muller) (Echinodermata: Ophiuroidea). University College, Galway.

Austria

Schinner, Gottfried. 1990. Functional morphology and ecology of *Schizaster ausliferus* (Echinoidea: Spatangoida) in the northern Adriatic Sea. Univ. of Vienna.

The Netherlands

den Besten, P.J. 1991. Effects of cadmium and PCBs on reproduction of the seastar *Asterias rubens*. Rijksuniversiteit Utrecht.

Pieter J. den Besten

Keats, D.W. 1986. The effects of the experimental removal of green sea urchins, and of ice-scour on sublittoral benthic macro-algal communities in eastern Newfoundland. Memorial Univ. of Newfoundland.

Gibson, A.W. 1987. Morphogenesis and differentiation of pigment cells in embryos of the sea urchin *Strongylocentrotus purpuratus*. Univ. of Victoria.

Cameron, L. 1981. Reproduction, development, processes of feeding and notes on the early life history of the sea cucumber Parastichopus californicus (Stimpson). Simon Fraser University.

Mooi, R.J. 1987. A cladistic analysis of the sand dollars (Clypeasteroida: Scutellina) and the interpretation of heterochronic phenomena. Univ. Toronto.

Rumrill, S.S. 1987. Differential predation upon embryos and larvae of temperate Pacific echinoderms. Univ. of Alberta.

Gibson, A.W. 1987. Morphogenesis and differentiation in the pigment cells in embryos of the sea urchin Strongylocentrotus purpuratus. Univ. of Victoria.

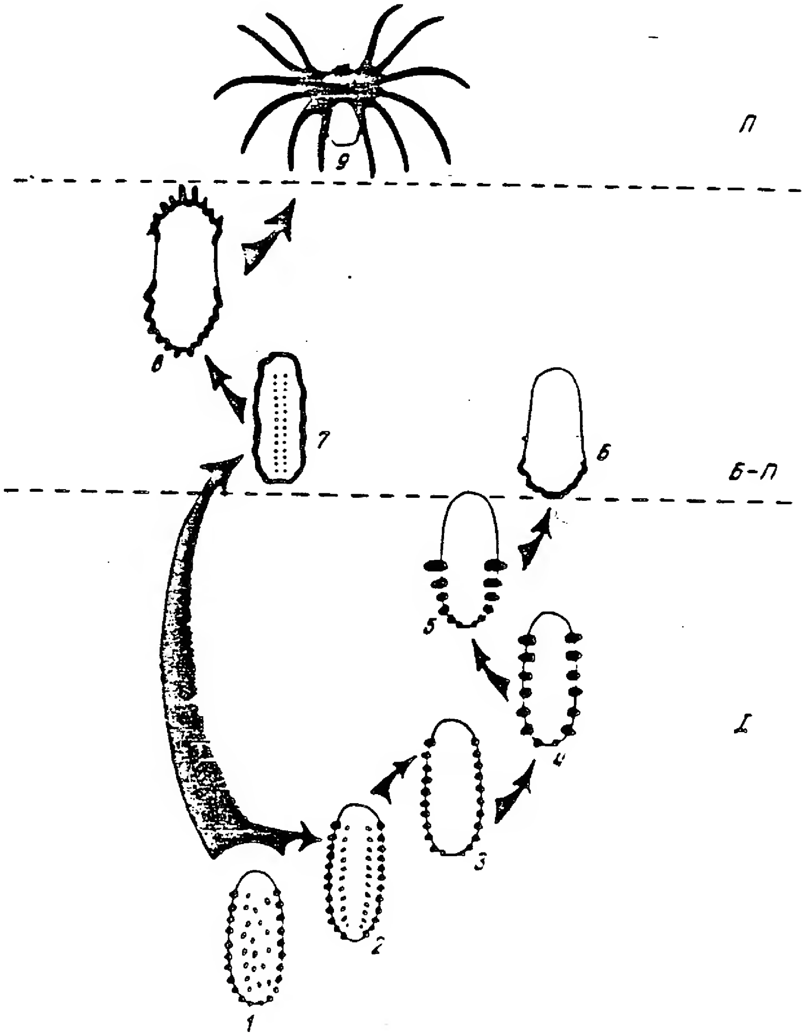


Рис. 1. Основные направления специализации выростов амбулакральной системы (ножек) у элазипод (1–9) (пояснения в тексте). Д, Б–П, П – жизненные формы: донная, [illegible]

Zool. J.

GEBRUK. 1990.

France

Sibuet, M. 1987. Structure des peuplements benthiques en relation avec les conditions trophiques en milieu abyssal dans l'ccean Atlantique. Univ. de Pierre et Marie Curie, Paris VI. (all extant classes)

Davoult, D. 1988. Etude du peuplement des cailloutis a epibiose sessile et de la populatic̄n d'*Ophiothrix fragilis* (Abilgaard) du detroit du Pas-de-Calais (France). Univ. de Lille.

Perin, J.P. 1976. Le lysozyme chez les invertebres: etude des lysozymes de Nephthys hombergii et d'Asterias rubens. Univ. Paris. VII.

Pomel, M.A. 1883. Classification methodiques et genera des echinides vivants et fossiles. Univ. Paris.

Francour, P. 1990. Dynamique de l'ecosystem a Posidonia oceanica dans le Parc national di Port Cros. Analyze des compartements matte, litier, faune vagile, echinodermes et possons. Univ. P. & M. Curie (Paris VI). (Psammechinus, Holothuria).

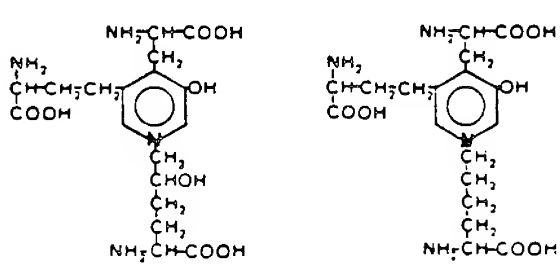
George, S. 1990. Reponses reproductive de trois Echinodermes et les consequences sur le developpement larvaire. Univ. P. & M. Curie (Paris VI). (Arbacia lixula, Paracentrotus lividus, Luidia clathrata)

Breton, G. 1990. Les Goniasteridae (Asteroidea, Echinodermata) jurassiques et cretaces de France: taphonomie, systematique, biostratigrqphie, paleobiologie, evolution. Univ. Caen.

Pedrotti, M.L. 1990. Etüde des processus biologiques et des facteurs physiques responsables de la dispersion et du recrutement des larves meroplankktoniques. Modele: les larves d'echinodermes. Univ. P. & M. Curie (Paris VI).

Neraudeau, D. 1990. Ontogenese, paleoecologie et histoire des *Hemiaster*, echinides irreguliers du Cretace. Univ. Bourgogne.

David, B. 1985. La variation chez les Echinides Irreguliers: dimensions ontogenetiques, ecologiques, evolutives. Univ. Dijon.



HP LP

Van Ness et al. 1988.

Fig. 1. Chemical structures of hydroxylysyl pyridinoline (HP) and lysyl pyridinoline (LP)

United Kingdom

Gorzula, S.J.F. 1976. The ecology of *Ophiocomina nigra* (Abildgaard) in the Firth of Clyde. Univ. of London.

Donovan, S.K. 1983. Evolution and biostrtigraphy of pelmatozoan colulmnals from the Cambrian and Ordovician of Britain. Univ. of Liverpool.

Gowland, S. 1987. Facies analysis of three members of the Scarborough Formation (Middle Jurassic: Lower Bajocian) in the Cleveland Basin, northeast England: Blea Wyke, Byland Limestone, and Crinoid Grit members. Univ. of Hull.

Morrison, G.W. 1979. Studies on the ecology of the sub-Antaractic ophiuroid, *Ophionotus hexactis* (E.A. Smith). Univ. of London.

Billett, D.S.M. 1988. The ecology of deep-sea holothurians. Univ. of Southampton.

Sloan, N. 1977. An experimental study of the predatory and social behaviour of *Crossaster papposus* (L.). Queen Mary College.

Vost, L. M. 1985. The influence of grazing by the sea urchin *Echinus esculentus* L. on subtidal algal communities. Univ. of Liverpool.

Johnson, J. 1972. The biology of *Amphipholis squamata* Delle Chiaje (Echinodermata: Ophiuroidea). Univ. Newcastlel-upon-Tyne.

Clerk, C. 1981. The animal world of the Mangalans. Univ. London (holothuroids)

Papua-New Guinea

Shelley, C. 1981. Aspects of the distribution, growth, and "fisher" potential of holothurians (beche-de-mer) in the Papuan coastal lagoon. Univ. Papua-New Guinea.

Singapore

Su-Yeong, G.L. 1986. Singapore reef echinoderms and their associates with emphasis on crinoids. National Univ. of Singapore. (includes checklist of echinoderms in the Singapore ZRC collection, information on all classes)

U.S.A.

Strumski, M.A. 1985. Purification and characterization of an endogenous carbohyrate-binding protein from the sea urchin *Lytechinus variegatus*. Univ. of Miami.

Venuti, J.M. 1985. Calmodulin and calmodulin-binding proteins of sea urchin coelomocytes. State Univ. of New York, Buffalo.

Morrison, D.E. 1986. Algal-herbivore interactions on a Jamaican coral reef. Univ. of Georgia. (Diadema)

Smith, F.F. 1985. Changes in the biochemical composition of the testis during spernmatogenesis in *Asterias vulgaris*, with emphasis on the role of polyamines in regulating proliferation. Univ. of New Hampshire.

Zmarzly, D.L. 1985. Distribution and ecology of shallow-water crinoids (Echinodermata) in the Marshall Islands, with emphasis on their symbiotic organisms. Univ. of California,San Diego.

Eschenberg, K.M. 1956. Studies on the sedimentability and biochemical characteristics of pentose nucleic acid complexes in the embryonic and adult sea urchins. Univ. of Washington.

Black, R.E.L. 1957. Proteolipid protein antigen in the gametes and embryos of the sea urchin, *Strongylocentrotus purpuratus*. Univ. of Washington.

Emlet, R.B. 1985. Functional morphology and ecology of larvae of clypeasteroid echinoderms and other ciliated larvae. Univ. of Washington.

Reidenauer, J.. 1986. A field investigation of a sand dollar (*Mellita quinquiesperforata*) population and its effects on the benthic community. Florida State University.

Terceiro, M. 1986. Changes in the epibenthic macro-invertebrate and demersal fish assemblages in Narragansett Bay and Rhode Island Sound. Univ. Rhode Island (Asterias)

Langelan, R.E. 1985. Unequal division, cell cycle and micromere determination in echinoid early embryogenesis: an experimental study. Univ. of Washington.

Boyle, J. A. 1989. Changes in the cortical cytoskeleton during oogenesis in the sea urchin, *Strongylocentrotus droebachiensis*. Tufts Univ.

Kelso,L. C. 1989. Regulation of protein synthesis during sea urchin early development. Univ. of Texas, Austin.

Stebbins, T. D. 1988. Ecology of a commensal isopod *Colidothea rostrata* (Benedict, 1898) in southern California. Univ. Southern California, Los Angeles. (on echinoids)

Donachy, J.E. 1988. Enzymatic activities associated with arm regeneration and calcification in *Asterias forbesi*. Univ. of South Carolina, Columbia.

Sucov, H.M. 1989. Characterization and developmental regulation of a gene expressed specifically in the skeletogenic lineage of the sea urchin embryo. Calif. Inst. of Technology, Pasadena.

Ojeda, F.P.1987. Rocky subtidal community structure in the Gulf of Maine: the role of mobile predators. Univ. of Maine, Orono. (*Strongylocentrotus*)

Hursh, D. A. 1988. Cell lineage-restricted transcripts in the development of the sea urchin *Strongylocentrotus purpuratus*. Univ. of Indiana.

Yabkowitz, R. 1987. Regulation of sea urchin myosin by 53K, a myosin-binding protein. Univ. of Miami.

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図10. *Ophiopholis* sp.

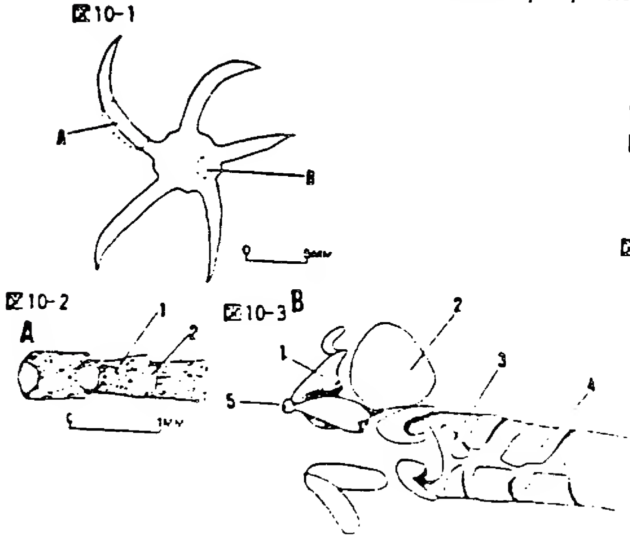


図10-1 腹面側

図10-2 腹面側の腕の一部（図10-1のAの部分）

1. 側腕板 (lateral arm plate)
2. 腹腕板 (ventral arm plate)

図10-3 [illegible]
(jaw apparatus) (図10-1のBの部分)

1. 口 板 (oral plate)
2. 間腕部 (interbrachial disk)
3. 腹腕板 (ventral arm plate)
4. 側腕板 (lateral arm plate)
5. 歯 (teeth)

Ishida 1988

REQUESTS AND INFORMATION

Request for reprints by institutional libraries

Extensive reprints collections are maintained by the following libraries. Investigators are urged to send reprints of their past publications to them and to place them on their mailing lists for future publications.

A.N. Solovjev
Paleontological Institute
USSR Academy of Sciences
117868 GSP-7
Moscow V-321
USSR

Library
Bamfield Marine Station
Bamfield, British Columbia VOR 1BO
Canada

Notice of newsletters

Beche-de-mer Information Bulletin. Group coordinator: Chantal Conand, Universite de Bretagne Occidentale, Laboratoire. Oceanogrphie Biologique, 29287 Brest, France. Number 1, January 1990. Published by the Fisheries Information Project, South Pacific Commission, Post Box D5, Noumea CEDEX, New Caledonia.

This bullein is the first to be produced by the SPC Fisheries Information It is intended for circulation to registered members of the SPC Special Interest Group (SIG) on beche-de-mer. 60 individuals are members of the group. All who have an interest in beche-de-mer are invited to join the group and to submit information on research activities in biology and ecology, fishing and marketing activities, information on books, conferences and publications.

FISHERIES INFORMATION PROJECT
SOUTH PACIFIC COMMISSION
PO BOX D5 - NOUMEA
NEW CALEDONIA

BECHE-DE-MER

INFORMATION BULLETIN Number 2 - November 1990

Group Co-ordinator: Chantal Conand, Université de Bretagne Occidentale, Labo Océanographie Biologique, 29287 Brest, France

NOTE FROM THE CO-ORDINATOR

Membership of the Special Interest Group on Bêche-de-mer has doubled since the first bulletin, showing not only the interest being taken in holothurians of commercial value and the bêche-de-mer market, but also the relevance of this newsletter. Our job is to act as a clearing-house for ideas, information and enquiries about the bêche-de-mer industry.

This fishery is often only given secondary importance, which explains the relative paucity of resources allocated for research. Increasing scientific interest may be noted, however in a number of countries and information is now available on the reproduction, distribution and abundance of various commercial species. Large gaps nevertheless still exist in the knowledge about recruitment, growth and mortality, which factors are essential to assess yield potential and commence rational management of stocks.

Scientific research on echinoderms is the theme for international meetings that have taken place every three years since 1972, bringing together specialists from various backgrounds. Following the 1987 Conference at Victoria in Canada, the 7th Conference recently took place in Atami, Japan, and was a great success. Echinoderm workshops are held regularly in Europe in the intervening periods. The papers tabled at these meetings are published and can be used to monitor developments in what is known about holothurian biology (cf. page 15).

Fisheries management will however require a better understanding of social and economic factors and research programmes should be developed in these areas and conducted in close conjunction with investigations into population biology.

Chantal Conand

Inside this issue

PIMRIS is a joint project of 4 international organisations concerned with fisheries and marine resource development in the Pacific Islands region. The project is executed by the South Pacific Commission (SPC), the South Pacific Forum Fisheries Agency (FFA), the University of the South Pacific's Pacific Information Centre (USP-PIC), and the South Pacific Applied Geoscience Commission (SOPAC). Funding is provided by the International Centre for Ocean Development (ICOD) and the Government of France. This bulletin is produced by SPC as part of its commitment to PIMRIS. The aim of PIMRIS is to improve the availability of information on marine resources to users in the region, so as to support their rational development and management. PIMRIS activities include: the active collection, cataloguing and archiving of technical documents, especially ephemera ("grey literature"); evaluation, repackaging and dissemination of information; provision of literature searches, question-and-answer service and bibliographic support; and assistance with the development of in-country reference collections and databases on marine resources.

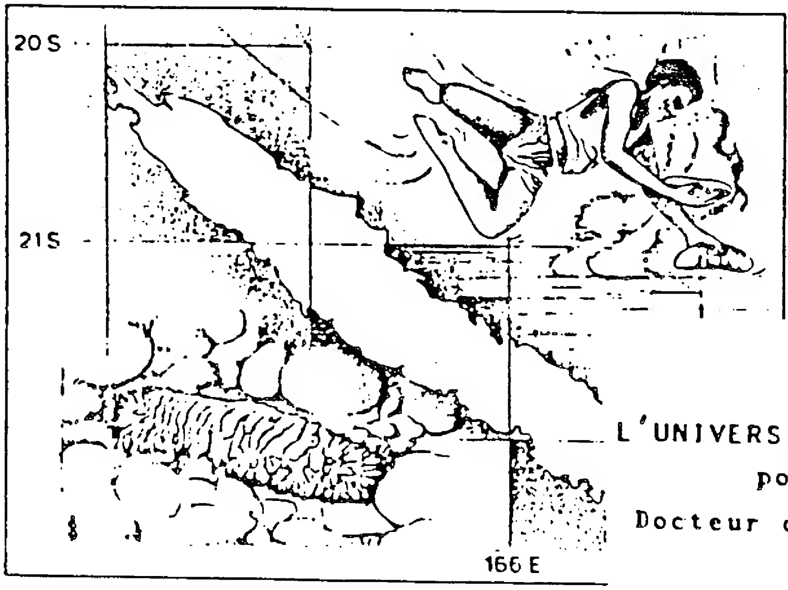
PIMRIS

Pacific Islands Marine Resources Information System

Table 2. Indicated changes in the value of beche-de-mer species between 1974-1990

Common Name	Scientific Name	Price US$/kg 1990 (1)	Value Rank 1979 (2)	Value Rank 1974 (3)
High value				
Teatfish white	*Holothuria fuscogilva*	14 - 24	1	1
Teatfish black	*Holothuria nobilis*	11 - 12	2	2
Prickly redfish	*Thelenota ananas*	12	3	3
Medium value				
Sandfish	*Holothuria scabra*	5 - 15	M	M
Chalkfish (1)	*Bohadschia marmorata*	10	no	M
Greenfish	*Stichopus chloronotus*	8	L	no
Surf redfish	*Actinopyga mauritiana*	7 - 8	M	M
Curryfish	*Stichopus variegatus*	6 - 7	L	M
Blackfish	*Actinopyga miliaris*	6	4	4
Stonefish	*Actinopyga lecanora*	4 - 6	M	M
Low value				
Deep-red surffish	*Actinopyga echinites*	4	M	M
Leopardfish	*Bohadschia argus*	4	L	L
Amberfish (2)	*Thelenota anax*	4	M	ni
Elephant's trunkfish (2)	*Holothuria fuscopunctata*	3	L	ni
Lollyfish	*Holothuria atra*	2 - 4	L	L
Brown sandfish	*Bohadschia vitiensis*	2 - 3	L	L
Pinkfish (1)	*Holothuria edulis*	2	no	no

Beche-de-mer Newsletter. No. 2. Nov. 1990.



THESE

présentée à

L'UNIVERSITÉ DE BRETAGNE OCCIDENTALE

pour obtenir le grade de

Docteur d'Etat ès Sciences Naturelles

par

CHANTAL CONAND

LES HOLOTHURIES ASPIDOCHIROTES
DU LAGON DE NOUVELLE-CALEDONIE :
BIOLOGIE, ECOLOGIE ET EXPLOITATION

COTS COMM. Editor: Brian Lassig, Great Barrier Reef Marine Park Authority, P.O. Box 1379. Townsville, QLD 4810, Australia. (COTS COMM: Crown-of-thorns commission). Now into No. 6 (July 1990).

Johannes Durbaum has observed commenslism between *Culcita novaeguineae* and *Carapus mourlani*.

Richard Stump has found growth rings in the aboral arm spines of *Acanthaster planci*

Mary Sewell is studying brooding in holothuroids.

Myriam Sibuet is studying the role of deep-sea holothuroids in the recycling of organic material.

Hertha Sieverts-Doreck is studying Miocidaridae (Echinoidea) and the calcareous ring of holothuroids.

Michael J. Simms is studying Triassic crinoids and the origin of articulates. He would like to know of any early Triassic material however fragmentary.

Albert Smith is studying the pathology of echinoderms.

James Sprinkle is studying Early Ordovician echinoderms from the Rocky Mountains. He would like to know of collections that should be included in this study. He is particularly interested in the extinct rhombiferans, eocrinoids, parablastoids, paracrinoids, homoiosteleans, and ctenocystoids.

Stephen Stancyk is particularly interested in knowing about invertebrates and vertebrates that feed on the discs or arms of burrowing amphiurid ophiuroids.

David Stephenson is interested in using echinoderms (particularly echinoids) to test punctuated equilibria.

Jacques Thierry is particularly interested in the ontogeny of the test of echinoids. He is also studying the irregular echinoids of the Jurassic.

Ronald Velarde would like to receive reports of symbiotic polychaetes and amphipods from eastern Pacific echinoderms.

Anders Waren is studying the molluscs parasitic on echinoderms.

Gary Webster would like to know the repository for crinoid specimens identified from the Journals in "Geology of the Confusion Range, West-centrl Utah" by C.S. Bacon, Jr. (2948, GSA Bulletin).

Yuri Yakolev is interested in the economic aspects, mariculture of holothuroids.

Clifford Barron would like to receive dried tests of assymetrical or non-pentaradial regular echinoids, especially *Lytechinus anamensis*, other toxopneustids, any temnopleurids, or cidaroids.

Joe Beamon is seeking locality information on spiraculate blastoids.

Peter Castro would like to receive records (published or not) of eumedonid crabs (genera *Harrovia*, *Ceratocarcinus*, *Echinoecus*, *Zeberida*, *Eumedonus*, etc.) associated with crinoids or echinoids throughout the Indo-west Pacific region.

Robert Endean is studying the outbreaks of *Acanthaster planci*.

Leonid Endelman is studying the Order Holectypoida and Mesozoic-Kainozoic regular echinoids.

A. Farmanfarmaian is studying the toxicology of echinoids and holothuroids.

Edgar Frankel is studying the previous distribution of *Acanthaster planci*.

Edward Gluchowski is interested in corresponding with individuals regarding the possible role of free-swimimng crinoid larva on population development. What is the survival time of the larvae? what distance can they be dispersed?

Carla Gordon is comparing fossil echinoids from the Late Pleistocene Jamaican reef-habitats and Recent echinoids to test the use of fossil corals as environmental indicators.

Sata Hidemi is studying the cell biology of asteroids, echinoids, and holothuroids.

Thomas Hopkins is studying the biology of Echiniasteridae, Astropectinidae, Luidiidae, Clypeasteridae.

Joanne Jellett is studying the immunology of echinoids.

Haris Lessios is trying to locate populations of *Lytechinus panamensis*. He would like to receive copies of collection data of museum specimens of this species. He would like to know where *Astropyga magnifica* can be found in the Caribbean.

Ronald Lewis is interested in the taphonomy of echinoderms.

Yulin Liao is interested in the mariculture of holothuroids.

Laurent Meijer would like information about the spawning season of starfish species with small (less than 200 um) oocytes.

Mauro de Moura-Britto is studying Stelleroidea from the continental shelf, coastal and estuarine regions, the patterns of the distribution of Stelleroidea.

James Nebelsick is studying the Miocene echinoids of Austria.

Bruce Neill would like unpublished records of *Echinometra* from the Pacific and Indian Oceans.

Patricia Orler is studying the biology of echinoids (Camarodonta, Echinidae, Strongylocentrotidae) in the southern part of Argentina.

Ronald Parsley is studying rhombiferans, diploprites, eocrinoids, homostelids, ctenocystids.

Michel Philippe is comparing Miocene and present echinoids.

Rudolf Prokop is studying cystoids,ophiocistioids, paracrinoids.

Richard Robison and G. Ubaghs have studied the homalozoans of the Wheeler formation of the Middle Cambrian in western Utah.

Steven D. Sroka is studying the early evolution of holothurians, paeozoic holothurian systematics and paleoecology, would like to receive reprints on fossil and Recent holothurians.

Alexey V. Smirnov would be much obliged to received material on the world fauna of Apodia for examination and identification, and also for reprints and other information on apodids. He would be thankful to receive material on all groups of echinoderms from the Arctic Ocean for examination and identification, and for reprints and information on systematics, distribution, and zoogeography of aractic echinoderms.

Cheng-Hai Wang is studying the relation between marine plants and sea urchins in the kelp-culture areas off the coasts of China, requests reprints on the subject.

B.K. Baskar is studying the biology, ecology, and fisheries of the sea cucumber *Holothuria atra*. He is attempting to breed and rear the species. .

Marine caddis-fly oviposition in Australian sea stars

Caddis fly embryos were found in the ovaries of *Asterina scobinata* collected from shallow water at Cape Otway, Victoria. The insect eggs were in the ovary and the larvae appeared to destroy the ovary. This phenomena has also been reported by Prof. D.T. Anderson who reported that the caddis fly deposits its eggs through the body wall of *Patiriella exigua*. Maria Byrne, Univ. of Sydney.

The Price Report

Vaguely FaRPs: way out at the fuzzy edge of a peptide family

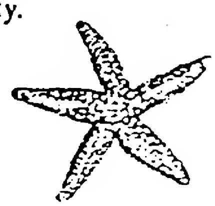
Old S253 was a great performer (and still has its place); but times change, and now we have begun using a new antiserum (Q2) to hunt FMRFamide-Related-Peptides (FaRPs).

Though we raised Q2 to be selective for the pulmonate heptapeptide FaRPs, we got (as any experienced parent might have predicted) both more and less than we expected. On the one hand, a radioimmunoassay (RIA) with Q2 is very good at distinguishing between FLRFamide and FMRFamide analogs, so long as that narrow choice is presented. On the other hand, when Q2 is confronted with a wider choice (like an extract), its "perception" of a FaRPish peptide is revealed to be very catholic. In this regard it is quite unlike our highly orthodox antiserum S253, and therefore a welcome new tool for hunting exotic FaRPs.

Consider, for example, the echinoderms. We had previously used S253 to hunt for FaRPs in sea cucumbers, and found absolutely nothing. So we had low expectations when Maurice Elphick, a visiting graduate student from England, expressed an interest in hunting for FaRPs in starfish. As we feared, Elphick's search with S253 turned up no immunoreactive peptides. Yet Q2 revealed plenty of immunoreactivity in starfish, and Elphick was able to fractionate it into two peptides. Within a couple of months, he had characterized:

SALMFamide
and SGPYSFNSGLTFamide.

Both of these peptides lack the penultimate arginyl residue which we have always regarded as essential for FMRFamide-like immunoreactivity.



The Whitney News 4(3), 1989.
The Whitney Laboratory, University of Florida, St. Augustine

Hemolytic activity in *Marthasterias*

Table 2. Effect of divalent cations on the hemolytic activity of *Marthasterias glacialis* coelomic fluid against rabbit erythrocytes

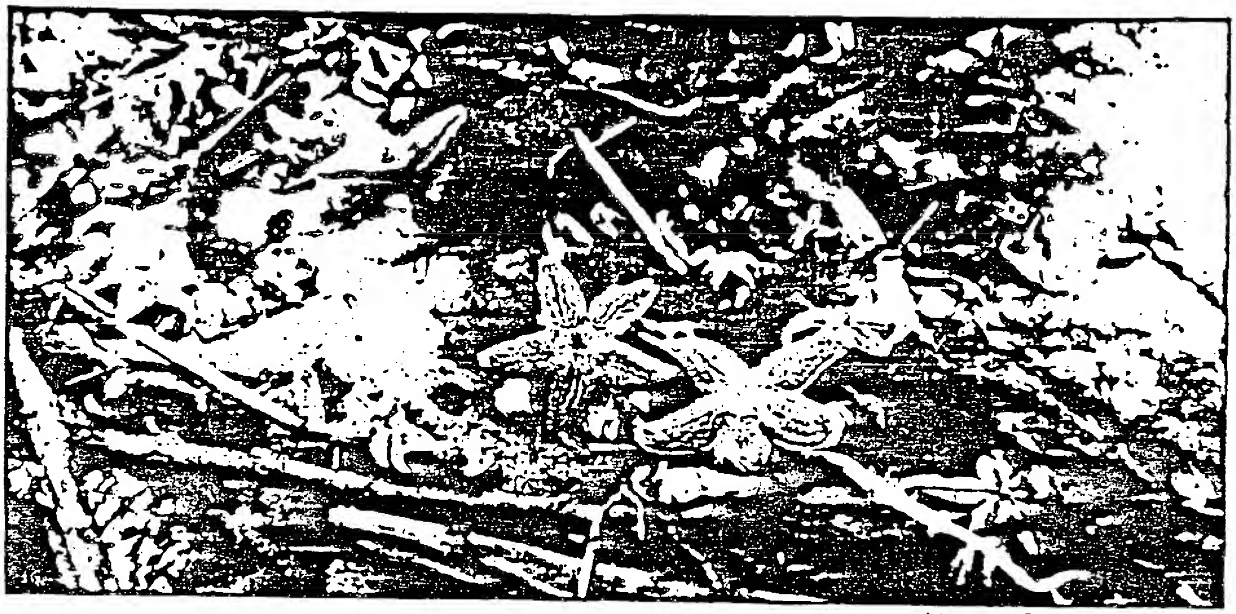
$CaCl_2$-$MgCl_2$ concentrations	Degree of hemolysis of undiluted CF*	Hemolytic titer
None	86.6 ± 2.3	8
10 mM $CaCl_2$	87.4 ± 2.3	8
20 mM $CaCl_2$	87.1 ± 2.1	8
10 mM $MgCl_2$	83.0 ± 2.4	8
20 mM $MgCl_2$	83.1 ± 1.7	8
10 mM EDTA	87.9 ± 1.4	8

*Mean values ± SE

Canicatti: 1989.
Comp. Biochem. Physiol.

Mass mortality of starfish in the north Pacific Ocean in 1990

Starfish deaths distress Soviets



Arkhangelsk Environmental Committee

Dead starfish litter the beach at Dvina Bay in the northwestern part of the Soviet Union.

☐ **Editor's Note: Articles from the Northern News Service are taken from newspapers from nations around the north, translated and distributed by the Novosti Press Agency in Moscow. The Daily News publishes them to give readers a view of issues peculiar to northern areas and as a view of how the news is reported in other nations.**

Fairbanks.

By BORIS POPOV
Northern News Service

There is one more inexplicable occurence added to the misery of mass suicide of whales — the mass death of starfish. This ecological tragedy took place in the northwestern part of the U.S.S.R. In May 1990, during the few days about 6 million starfish were cast ashore of the Dvina Bay (the White Sea) by the surf. The lifeless starfish were scattered along the seacoast with different degree of density for a distance of 60 kilometers.

Investigations of the ecological catastrophe have been held by special committees from local and state levels. Various versions of the catastrophe's causes have been developed: for example, an upset of the balance of salt-content of the sea waters by spring high water from the Severnaya Dvina River or a pollution of the shore by municipal and industrial waste-waters. But the strongest suspicions have fallen upon the military. In December 1989 some tons of rocket oxidizer were drained at the distance of about 100 kilometers from the shore from a submarine in a break-down situation. In April 1990 a missile accidentally fell into the bay. It also contained some propellant. These disquieting cases have become publicly known but there exist cases people learn about only from rumors. In one, for example, the military supposedly threw containers with yperite, a poison substance, into the sea.

Inhabitants of Arkhangelsk region were downright warried when the thing happened. Those people who lived in the coastal settlements were advised not to eat fish caught in the zone of starfish death. A competent study of the tragedy with finding out circumstances of the animals' death could only calm the people. But the anxiety still exists, though the prohibition on eating fish was eliminated in due course.

Recently, the joint Committee of Council of Ministers and of Academy of Sciences has published its conclusion. It was the most authorized of all the committees that worked with that case. The aboriginal population is not satisfied with this conclusion, for it gives no definite answer. It reads that the death of starfish has been a result of a strong, though short in time, influence of toxic substances. But the committee has failed to find out the nature and the source of those substances. But the committee has failed to find out the nature and the source of those substances.

Many scientific and research institutes of the country have got interested in the mystery of the White Sea and have sent their specialists to Arkhangelsk. The analysis of samples of seabed, water, seaweeds, starfish and other species of fish, mussels made by the scientists doesn't yet prove the conclusion of the state committee about an influence of toxic substances. A theory of so-called natural process, which can have a great number of variants, has been put in the forefront now. For example, an explicable growth of biocenosis (a complex of animals, microorganisms, plants) including mussels has been marked by local biologists lately. Mussels constitute the main feed by starfish. The scientists say that in those conditions a sharp growth of starfish could lead to such a biological disbalance, that the further life of starfish became impossible in that place. But all this is just a supposition.

In case something of this kind has ever happened in any other part of the world ocean, and on shores of northern seas in particular, scientists from Arkangelsk are ready to share further and more detailed information concerning the problem with foreign colleagues. Those scientists who are interested in this please contact with the Soviet scientists through the Regional Committee on Environmental Conservation on the address: U.S.S.R; 163061, Arkhangelsk, Vinogradov Prospect, 49.

see also: "Mysterious starfish mortality near Powell River, British Columbia" (Marine Pollution Bulletin, 21. no. 10). comm. by Tom Shirley, Univ. of Alaska.

☐ Boris Popov is a journalist in Murmansk.

Report of bacteria and starfish:

Sutton, D.C. 1988. Identification of bacterial populations associated with crown of thorns starfish and assessment of their role in the ecology of the starfish, and, A preliminary investigation into factors affecting the mortality of A. planci larvae raised under field and laboratory conditions. Reports to the Great Barrier Reef Marine Park Authority, Townsville.

Sutton, D.C., L. Trott, J.L. Reichelt, J.S. Lucas. 1988. Assessment of bacterial pathogenesis in crown-of-thorns starfish, *Acanthaster planci* (L.). Proc. 6th Internat. Coral Reef Symp., 2, 171.

Roberts. S. Isolation of bacteria from necrotic tissue of juvenile crown of thorns starfish *Acanthaster planci*. South Pac. J. Nat. Sci. 9. 21-30.

MASS MORTALITY OF ASTEROIDS IN THE WHITE SEA

Communicated by Vladimir Kasyanov, Institute of Marine Biology, Vladivostock

Extracts from the article *The case is stopped: no one to blame*. J. Tekhnika molodezhi (1990). 12: 1-5

...On May 10 the Letny beach on the southern coast of Dvinskaya Guba inlet was densely covered by dead invertebrates washed ashore: starfish, crabs, and mussels. The first investigation of the disaster was conducted on May 18 between the Solza and Syuzma Rivers. Two common starfish species were identified. The total number of dead starfish was about 4 million individuals. Dead crabs occurred in masses of algae washed ashore.

Storms in late May-early June twice again washed ashore dead animals: approximately 2 million starfish, crabs and mussels (10 thousands of each). Thus, the total number of dead animals over the 65-km shoreline reached 6 million individuals.

Workers of two biological stations situated on the White Sea coast have reported that no signs of mass mortality of marine animals has been observed since June 8. Not even single dead individuals have been seen on the shore.

At the end of June, researches of the Zoological Institute (Leningrad) informed us that the sea bottom joining the Letny beach already had been populated by young starfish, with a density of up to 50 individuals per sq m (100 and more individuals per sq m are normal). We suggest that this is a new population or that primarily adults had perished.

When the special joint commission started to consider possible causes of the disaster, it seemed that only several were worth serious attention:

1. Spring freshening of the waters in Dvinskaya Guba inlet

In May, storms might bring many starfish into Dvinskaya Guba inlet where they perished. Then the river flow could carry them again into the sea and tides could wash them ashore, onto Letny beach. These things do occur, but the number of dead starfishes would never reach more than several thousand individuals.

As to freshening of Dvinskaya Guba waters because of spring rains, the surface water salinity near Unsky lighthouse (the point of observation nerest the area of disaster) was not critical according to SOVHYDROMET data. In April the salinity was about 20-27 o/oo. Only in some sites of the area, adjoing Krasnaya Gorka, the settlement of Nenox, and the town of Severodvinsk, the records were 10.7, 10.9-12.3, and 5.8-10.7 o/oo salinity, respectively. In the open sea of the Letny beach area, the salinity did not fall below 13 o/oo, the survival limit.

The Joint Commission concluded that no natural phenomenon was the cause of the disaster.

2. Effect of industrial runoff

To begin the consideration of this version, we should note that the White Sea is characterized by a stable stratification of the water column: heavy cold-water layers of a high salinity from the Barents Sea do not mix with brackish wateres of the White Sea proper. Fresh waters entering Dvinskaya Guba inlet are already contaminated with industrial runoffs of Severodvinsk and Arkhangelsk. However, an analysis of the silts along the runoff course has not shown significant poisoning.

The Azov Research Institute of Fisheries reported that concentrations of polychlordiphenyl present in all the samples submitted to analysis were harmless to starfish (polychlordiphenyl is a side produce of cellulose). Still, dioxin, a very poisonous long-lived compound, can be synthesized from a polychlordiphenyl medium. It can cause a mass mortality of marine animals over a long period of time. However, the May disaster demonstrated a short-term impact of the toxins. It has been concluded the polychlorodiphenyl or dioxin are not likely to be the cause of the starfish mortality.

3. High radiation

This investigation was the shortest. The records of the Polar Institute of Fisheries has shown that the radiation background at all the disaster sites was not above the norm (4-11 uR/h).

4. Effect of components of rocket fuel lost in an emergency

On December 7, 1989, some 100 km north-west of Severodvinsk, a Soviet submarine in emergency jettisoned a component of rocket fuel with the permission of the High Command. It was suggested that the nitric acid could have produced some organic nitrous compounds in the sea. However, the Zoological Institute of Applied Chemistry did not find these compounds in the seawater and bottom sediment samples. No other rocket compoents were detected.

5. Contamination with war poisons, probably yperite and other toxic compounds

The first alarmists were the workers of the Arkhangelsk fish-farm: the animals were poisoned with war poisons! By chance, at the moment of the disaster, the fish farm conducted a civilian defense training exercise. And occasionally, for the sake of exercise, fish and starfish fished at Letny beach were analyzed for yperite. The workers were shocked: nearly all the samples showed the presence of sulfurous yperite. Without any verification, this version became popular and appeared in the press.

Within nearly a month, at the request of the fish farm, four common fish species (smelt, herring, polar cod, and flat-fish), starfish, mussels, and the alga *Laminaria* were sampled in the area from May 23 until June 8 and were analysed by specialists for yperite. The reaction for yperite was positive in 8 of the 15 fish sampled, in 3 of the 4 sea stars, and in a single sample each of laminarians and mussels. However, the second analysis of the same species sampled on June 28 in the area and also in fresh-water fish species did not detect any trace of yperite! Had it been lost somehow? Was it found at all? And even more interesting, where did it come from? Examination of suspicious military units has not given any result.

6. Contamination with some toxic materials lost by foreign ships

The port of Arkhangelsk was visited in May 1990 by six foreign transport vessels. It is tactless to suspect them *post factum*.

As to our vessels, all information on transport is saved no longer than a year. Hence, the commission failed to obtain documents on transportion of toxic and other dangerous chemicals over the White Sea in earlier years, or for incidences of burying.

Thus we can summarize our investigation.

According to preliminary estimations, about 4 million individuals of *Asterias rubens* dwell in the White Sea. No more than 1% perished. If the disaster is not repeated, the bottom biocoenoses will not suffer greatly.

The Joint Commission concluded: Starfish, some invertebrates and seals in the area of Letny beach perished under the short-term impact of some strong toxicant which might contain sulphurous componds. Yperite is not excluded. Even rumors on yperite seeping from tanks which, as it is said, were buried in the White Sea in the late 50s, are no help to us as the supposed burial site is far from the area of the disaster. The second conclusion of the commission is that there is no reason to believe that the entire area of Dvinskaya Guba (even less the entire White Sea) is involved in this poisoning.

MASS MORTALITIES OF STARFISH IN ALASKAN AND NORTH PACIFIC WATERS

communicated by Thomas C. Shirley, Juneau Center for Fisheries and Ocean Sciences, University of Alaska, Juneau, Alaska

"Mysterious starfish mortality near Powell River, British Columbia", Marine Pollution Bulletin, 21(10).

No observations of mass mortalities have been made at Kodiac, SE Alaska and the Gulf of Alaska, Prince William Sound.

Marine stations are requested to send lists of species of echinoderms available for use by visiting investigators.

List of Echinodermata available in the coast near Marine Biological Station in Japan Communicated by Prof. Norio Suzuki, Noto Marine Lab.

Akkeshi Marine Biological Station (Hokkaido University)
Akkeshi, Hokkaido 088-11, Japan

Asterina pectinifera
Henricia nipponica
Henricia tumida
Asterias amurensis
Leptasterias ochotensis similispinis
Aphelasterias japonica
Strongylocentrotus intermedius
Scaphechinus mirabilis
Cucumaria frondosa japonica
Cucumaria chronhjelmi
Stichopus japonicus
Leptosynapta inhaerens

Asamushi Marine Biological Station (Tohoku University)
Sakamoto 9, Asamushi, Aomori 039-34, Japan

Comanthus japonica
Ophiopholis mirabilis
Ophiura kinbergi
Astropecten scoparius
Luidia quinaria
Asterina pectinifera
Solaster paxillatus
Crossaster papposus
Plazaster borealis
Distolasterias nippon
Aphelasterias japonica
Asterias amurensis
Glyptocidaris crenularis
Temnopleurus hardwickii
Strongylocentrotus intermedius
Strongylocentrotus nudus
Scaphechinus mirabilis
Echinocardium cordatum
Brissus agassizi
Stichopus japonicus
Cucumaria frondosa japonica
Cucumaria chronhjelmi
Pentacta australis
Paracaudina chilensis ransonneti
Patinapta ooplax
Labidoplax dubia

Sado Marine Biological Station (Niigata University)
Tassha, Aikawa-machi, Sado Island, Niigata 952-21, Japan

Ophioplocus japonicus
Pectinura anchista
Certonardoa semiregularis
Lethasterias fusca
Asterina pectinifera
Stereocidaris japonica
Pseudocentrotus depressus
Anthocidaris crassispina
Scaphechinus brevis
Strongylocentrotus nudus
Hemicentrotus pulcherrimus
Holothuria pervicax
Stichopus japonicus
Paracaudina chilensis ransonneti
Patinapta ooplax

Noto Marine Laboratory (Kanazawa University)
Ogi, Uchiura, Ishikawa 927-05, Japan

Comanthus japonica
Comanthus parvicirra
Ophioplocus japonicus
Astropecten scoparius
Astropecten polyacanthus
Astropecten latespinosus
Certonardoa semiregularis
Asterina batheri
Asterina pectinifera
Asterias amurensis
Coscinasterias acutispina
Luidia maculata
Luidia quinaria
Stereocidaris japonica
Temnopleurus toreumaticus
Temnopleurus reevesi
Mespilia globulus
Temnotrema rubrum
Anthocidaris crassispina
Pseudocentrotus depressus
Strongylocentrotus nudus
Strongylocentrotus sachalinicus
Hemicentrotus pulcherrimus
Clypeaster japonicus
Peronella japonica
Peronella rubra
Scaphechinus brevis
Astriclypeus manni

Lovenia elongata
Echinocardium cordatum
Schizaster lacunosus
Brissus agassizi
Stichopus japonicus
Stichopus variegatus

Misaki Marine Biological Station (University of Tokyo)
Koajiro, Miura, Kanagawa 238-02, Japan

Metacrinus rotundus
Comanthus japonica
Comanthus solaster
Comanthus parvicirra
Lamprometra palmata palmata
Tropiometra afra macrodiscus
Luidia quinaria
Luidia maculata
Dipsacaster pretiosus
Astropecten scoparius
Astropecten latespinosus
Astropecten polyacanthus
Ctenopleura fisheri
Certonardoa semiregularis
Asterina pectinifera
Asterina batheri
Asterina coronata
Henricia pachyderma
Coscinasterias acutispina
Asterias amurensis
Ophioplocus japonicus
Ophiactis savignyi
Ophiomastix mixta
Ophiothrix koreana
Ophiothrix marenzelleri
Hemilepis euopla
Ophionereis dubia
Ophiopholis mirabilis
Stegophiura vivipara
Stegophiura sterea
Stegophiura sladeni
Ophiura kinbergi
Ophiurodon acanthophora
Prionocidaris baculosa annulifera
Astenosoma ijimai
Araeosoma owstoni
Diadema setosum
Diadema savignyi
Temnopleurus reevesii
Temnopleurus hardwickii

Temnopleurus toreumaticus
Mespilia globulus
Toxopneustes pileolus
Tripneustes gratilla
Pseudocentrotus depressus
Hemicentrotus pulcherrimus
Strongylocentrotus nudus
Echinostrephus aciculatus
Anthocidaris crassispina
Clypeaster japonicus
Clypeaster virescens
Laganum fudsiyama
Peronella japonica
Astriclypeus manni
Pseudomaretia alta
Maretia planulata
Brissus agassizi
Echinocardium cordatum
Lovenia elongata
Stichopus japonicus
Parastichopus nigripunctatus
Holothuria hilla
Holothuria pervicax
Holothuria moebi
Cucumaria echinata
Ankyroderma roretzi
Polycheira rufescens
Leptosynapta inhaerensis

Tateyama Marine Laboratory (Ochnomizu University)
Ko-yatsu 11, Tateyama-shi, Chiba 294-03, Japan

Comanthus japonica
Ophioplocus japonicus
Astropecten latespinosus
Astropecten scoparius
Asterina pectinifera
Asterias amurensis
Astenosoma ijimai
Diadema setosum
Diadema savignyi
Temnopleurus toreumaticus
Mespilia globulus
Toxopneustes pileolus
Tripneustes gratilla
Pseudocentrotus depressus
Hemicentrotus pulcherrimus
Strongylocentrotus nudus
Echinostrephus aciculatus
Anthocidaris crassispina

Echinometra mathaei
Clypeaster japonicus
Astriclypeus manni
Holothuria moebi

Shimoda Marine Research Center (Tsukuba University)
Shimoda-shi 5-10-1, Shizuoka 415, Japan

Comanthus japonica
Comanthus parvicirra
Tropiometra afra macrodiscus
Ophiopeltis vadicola
Ophioplocus japonicus
Astropecten scoparius
Astropecten polyacanthus
Certonardoa semiregularis
Leiaster leachii
Asterina pectinifera
Coscinasterias acutispina
Diadema setosum
Temnopleurus toreumaticus
Mespilia globulus
Toxopneustes pileolus
Pseudocentrotus depressus
Hemicentrotus pulcherrimus
Echinostrephus aciculatus
Anthocidaris crassispina
Echinometra mathaei
Clypeaster japonicus
Holothuria pervicax
Holothuria moebi
Stichopus japonicus
Stichopus oshimae

Sugashima Marine Biological Laboratory (Nagoya University)
429-63 Sugashima-cho, Toba-shi, Mie 517, Japan

Comanthus japonica
Comanthus parvicirra
Gorgonocephalus caryi
Ophiothrix koreana
Ophioplocus japonicus
Ophiarachnella gorgonia
Astropecten scoparius
Astropecten polyacanthus
Luidia quinaria
Certonardoa semiregularis
Asterina batheri
Asterina pectinifera
Henricia nipponica

Coscinasterias acutispina
Prionocidaris baculosa var. annulifera
Temnopleurus toreumaticus
Temnopleurus reevesi
Mespilia globulus
Temnotrema sculptum
Toxopneustes pileolus
Pseudocentrotus depressus
Hemicentrotus pulcherrimus
Anthocidaris crassispina
Clypeaster japonicus
Holothuria pervicax
Stichopus japonicus
Cucumaria chronhjelmi
Cucumaria echinata
Pentacta australis
Leptosynapta inhaerens

Seto Marine Biological Station (Kyoto University)
Shirahama 459, Nishimuro, Wakayama 649-22, Japan

Comanthina schlegeli
Comanthus japonica
Comanthus solaster
Comanthus parvicirra
Lamprometra parmata parmata
Iconometra japonica
Tropiometra afra macrodiscus
Trichaster elegans
Gorgonocephalus caryi
Astrocladus dofleini
Astrocladus coniferus
Astroboa arctos
Ophiactis savignyi
Amphiopholis japonica
Ophiothrix koreana
Ophiotrichoides nereidina
Macrophiothrix longipeda
Ophiomaza kanekoi
Ophiothela danae
Ophionereis dubia
Ophiocoma brevispes
Ophiomastrix mixta
Ophiogymna elegans
Ophioplocus japonicus
Ophiarachnella gorgonia
Ophiarachnella differens
Astropecten latespinosus
Astropecten scoparius
Astropecten polyacanthus

Ctenopleura ludwigi
Luidia quinaria
Luidia macunata
Protoreaster nodosus
Nardoa frianti
Fromia monilis
Stellaster equestris
Certonardoa semiregularis
Linkia laevigata
Linkia guildingi
Leiaster leachii
Ophidiaster cribrarius
Asterina batheri
Asterina coronata japonica
Asterina pectinifera
Henricia nipponica
Henricia ohshimai
Acanthaster planci
Mitthrodia clavigera
Pteraster tesselatus
Coscinasterias acutispina
Asterias amurensis
Goniocidaris biserialis
Plococidaris verticillata
Prionocidaris baculosa var. annulifera
Astenosoma ijimai
Stomopneustes variolaris
Coelopleurus maculatus
Caenopedina mirabilis
Astropyga radiata
Diadema setosum
Diadema savignyi
Echinothrix diadema
Echinothrix calamaris
Temnopleurus toreumaticus
Temnopleurus reevesi
Salmacis sphaeroides
Mespilia globulus
Temnotrema sculptum
Toxopneustes gratilla
Pseudoboletia maculata
Pseudocentrotus depressus
Hemicentrotus pulcherrimus
Parasalenia gratiosa var. boninensis
Anthocidaris crassispina
Echinostrephus aciculatus
Echinometra mathaei
Heterocentrotus mamillatus
Colobocentrotus mertensi
Echinoneus cyclostomus

Clypeaster japonicus
Peronella japonica
Scaphechinus mirabilis tenuis
Astriclypeus manni
Lovenia elongata
Echinocardium cordatum
Schizaster lacunosus
Brissus agassizi
Metalia spatagus
Holothuria edulis
Holothuria hilla
Holothuria pervicax
Holothuria leucospilota
Holothuria moebi
Stichopus japonicus
Stichopus oshimae
Stichopus variegatus
Parastichopus nigripunctatus
Pentacta australis
Afrocucumis africana
Polycheira rufescens

Iwaya Marine Biological Station (Kobe University)
Iwaya, Awaji-cho, Tsuna-gun, Hyogo 656-24, Japan

Astropecten polyacanthus
Asterina pectinifera
Henricia ohshimai
Asterias amurensis
Temnopleurus toreumaticus
Pseudocentrotus depressus
Hemicentrotus pulcherrimus
Anthocidaris crassispina
Brissus agassizi
Pentacta australis
Stichopus japonica
Patinapta ooplax

Ushimado Marine Laboratory (Okayama University)
130-17 Kashino, Ushimado, Okayama 701-43, Japan

Ophiactis savignyi
Ophiothrix koreana
Ophiura kinbergi
Ophioplocus japonicus
Ophiarachnella gorgonia
Astropecten latespinosus
Astropecten scoparius
Astropecten polyacanthus
Luidia quinaria

Certonardoa semiregularis
Asterina betheri
Asterina pectinifera
Asterias amurensis
Temnopleurus toreumaticus
Temnopleurus reevesi
Mespilia globulus
Pseudocentrotus depressus
Hemicentrotus pulcherrimus
Anthocidaris crassispina
Peronella japonica
Scaphechinus mirabilis
Astriclypeus manni
Lovenia elongata
Echinocardium cordatum
Stichopus japonicus
Cucumaria chronhjelmi
Leptosynapta inhaerens
Patinapta ooplax
Protankyra bidentata
Protankyra autospista

Oki Marine Biological Station (Shimane University)
194 Sasuka, Kamo, Saigo-cho, Oki-gun, Shimane 685, Japan

Comanthus japonica
Tropiometra afra macrodiscus
Euryalae aspera
Gorgonocephalus caryi
Ophioplocus japonicus
Astropecten latespinosus
Luidia maculata
Certonardoa semiregularis
Asterina pectinifera
Goniocidaris biserialis
Pseudocentrotus depressus
Hemicentrotus pulcherrimus
Anthocidaris crassispina
Echinoneus cyclostomus
Fibulariella acuta
Laganum depressum
Laganum fudsuyama
Clypeaster japonicus
Brissus agassizi
Echinocardium cordatum
Holothuria pervicax
Holothuria leucospilota
Stichopus japonicus
Polycheira rufescens

Mukaishima Marine Biological Station (Hiroshima University)
2448 Mukaishima-cho, Mitsugi-gun, Hiroshima 722, Japan

Temnopleurus toreumaticus
Anthocidaris crassispina

Usa Marine Biological Institute (Kochi University)
Usa-Inoshiri, Kochi 781-11, Japan

Comanthus japonica
Ophiactis savignyi
Ophiothrix koreana
Ophiocoma brevipes
Ophiomastrix mixta
Ophioplocus japonicus
Astropecten scoparius
Astropecten polyacanthus
Asterina batheri
Asterina coronata japonica
Asterina pectinifera
Coscinasterias acutispina
Diadema setosum
Diadema savignyi
Temnopleurus toreumaticus
Temnopleurus reevesi
Mespilia globulus
Toxopneustes pileolus
Pseudocentrotus depressus
Hemicentrotus pulcherrimus
Parasalenia gratiosa var. boninensis
Anthocidaris crassispina
Echinostrephus aciculatus
Echinometra mathaei
Holothuria pervicax
Holothuria leucospilota
Holothuria moebi
Cucumaria frondosa
Thyone sacellus
Polycheira rufescens

Nakajima Marine Biological Station (Ehime University)
Nakajima-cho, Onsen-gun, Ehime 791-45, Japan

Certonardoa semiregularis
Asterina pectinifera
Asterias amurensis
Coscinasterias acutispina
Pseudocentrotus depressus
Hemicentrotus pulcherrimus
Anthocidaris crassispina

Peronella japonica
Astriclypeus manni
Holothuria pervicax
Stichopus japonicus

Aitsu Marine Biological Station
Aitsu, Matsushima-machi, Amakusa-gun, Kumamoto 861-61, Japan

Astropecten latespinosus
Astropecten polyacanthus
Luidia quinaria
Luidia macunata
Asterina pectinifera
Coscinasterias acutispina
Asterias amurensis
Temnopleurus toreumaticus
Hemicentrotus pulcherrimus
Anthocidaris crassispina
Peronella japonica
Protankyra bidentata

Amakusa Marine Biological Laboratory (Kyushu University)
Tomioka, Reihoku-cho, Amakusa, Kumamoto 863-25, Japan

Ophiactis savignyi
Ophiura kinbergi
Monamphiura iridoides
Ophiothrix koreana
Ophiothrix marenzelleri
Ophionereis dubia
Astropecten latespinosus
Luidia quinaria
Luidia macunata
Certonardoa semiregularis
Asterina pectinifera
Temnopleurus reevesi
Salmaciella dussunieri
Temnotrema sculptum
Mespilia globulus
Toxopneustes pileolus
Pseudocentrotus depressus
Hemicentrotus pulcherrimus
Anthocidaris crassispina
Echinoneus cyclostomus
Fibulariella acuta
Clypeaster japonicus
Peronella japonica
Lovenia elongata
Brissus agassizi

Sesoko Marine Science Center University of the Ryukyus)
Sesoko, Motonobu-cho, Okinawa 903-01, Japan

Comanthus sp.
Ophiactis savignyi
Macrophiothrix longipeda
Ophiarachna incrassata
Ophiolepis annulosa
Ophioplocus imbricatus
Ophiocoma brevipes
Ophiocoma scoloperdrina
Ophiocoma erinaceus
Ophiomastrix mixta
Protoreaster nodosus
Culcita novaeguineae
Nardoa tuberculata
Linkia laevigata
Ophidiaster cribrarius
Asterope carinifera
Echinaster luzonicus
Acanthaster planci
Phyllacanthus dubius
Diadema setosum
Diadema savignyi
Echinothrix calamaris
Echinothrix diadema
Stomopneustes variolaris
Mespilia globulus
Toxopneustes gratilla
Pseudoboletia maculata
Echinometra mathaei
Echinostrephus molaris
Heterocentrotus mammillatus
Peronella lesueri
Holothuria argus
Holothuria arta
Holothuria leucospilota
Holothuria scabra
Afrocucumis africana
Polycheira rufescens
Stichopus chloronotus
Thelenota ananas
Synapta maculata

ECHINODERMES VIVANT A BANYULS

communicated by Alain Guille, Professor and Director of the Laboratoire Arago, Banyuls-sur-mer France

CRINOIDES

Antedon mediterranea (Lamarck)
Leptometra phalangium (O.F. Müller)

ASTERIDES

Astropecten johnstoni (Delle Chiaje)
Astropecten spinulosus (Philippi)
Astropecten aranciacus (Linné)
Astropecten bispinosus (Otto)
Astropecten irregularis pentacanthus (Delle Chiaje)
Tethyaster subinermis (Philippi)
Luidia sarsi (Düben et Koren)
Luidia ciliaris (Philippi)
Ceremaster placenta (Müller et Troschel)
Ophidiaster ophidianus (Lamarck)
Hacelia attenuata (Gray)
Asterina gibbosa (Pennant)
Anseropoda placenta (Pennant)
Anseropoda lobiancei Ludwig
Echinaster sepositus (Retzius)
Choetaster longipes (Retzius)
Brisingella coronata (O. Sars)
Marthasterias glacialis (Linné)
Scleriasterias richardi (Perrier)

OPHIURIDES

Astropartus mediterraneus (Risso)
Ophiomyxa pentagona Müller et Troschel
Ophiothrix fragilis Abildgaard
Ophiothrix quinquemaculata (Delle Chiaje)
Ophiopsila aranea Forbes
Ophiancantha setosa Müller et Troschel
Ophiocomina nigra (O.F. Müller)
Amphiura chiajei Forbes
Amphiura filiformis (O.F.Müller)
Amphiura mediterranea Lyman
Amphiura apicula Cherbonnier
Amphiura delamarei Cherbonnier
Amphiura cherbonnieri Guille
Amphiura securigera (Düben et Koren)
Amphiura lacazei Guille
Amphipholis squamata (Delle Chiaje)
Acrocnida brachiata (Montagu)

Ophioderma longicauda (Retzius)
Ophiura africana (Koehler)
Ophiura albida Forbes
Ophiura texturata Lamarck
Ophiocten abyssicolum Marenzeller
Amphilepis norvegica (Ljungman)

ECHINIDES

Cidaris cidaris (Linné)
Arbacia lixula (Linné)
Genocidaris maculata A. Agassiz
Psammechinus microtuberculatus (Blainville)
Echinus melo Lamarck
Echinus acutus Lamarck
Paracentrotus lividus (Lamarck)
Sphaerechinus granularis (Lamarck)
Echinocyamus pusillus (O.F. Müller)
Ova canalifera (Lamarck)
Spatangus purpureus (O.F. Müller)
Spatangus inermis Mortensen
Echinocardium mediterraneum (Forbes)
Echinocardium flavescens (O.F. Müller)
Echinocardium mortenseni Thiéry
Echinocardium cordatum (Pennant)
Brissopsis lyrifera (Forbes)
Brissus brissus (Leske)

HOLOTHURIDES

Holothuria impatiens (Forskaal)
Holothuria sanctori Delle Chiaje
Holothuria polii Delle Chiaje
Holothuria tubulosa Gmelin
Holothuria stellati Delle Chiaje
Holothuria forskali Delle Chiaje
Holothuria helleri Marenzeller
Holothuria mammata Grube
Mesothuria intestinalis (Ascanius)
Stichopus regalis (Cuvier)
Cucumaria saxicola Brady et Robertson
Paracucumaria hyndmanni Thomson
Stereoderma kirschbergi (Heller)
Pseudocnus köllikeri (Semper)
Trachythyone tergestina (M. Sars)
Trachythyone elongata (Düben et Koren)
Ludwigia planci (Brandt)

Ludwigia petiti Cherbonnier
Pseudothyone raphanus (Düben et Koren)
Pseudothyone sculponea Cherbonnier
Havelockia inermis (Heller)
Thyone cherbonnieri Reys
Thyone fusus (O.F. Müller)
Thyone gadeana R. Perrier
Molpadia musculus Risso
Neocucumis marioni (Marenzeller)
Phyllophorus urna Grube
Leptosynapta inhaerens (O.F. Müller)
Leptosynapta minuta (Becher)
Oestergrenia digitata (Montagu)
Labidoplax buski (M'Intosh)
Labidoplax media Ostergren
Phyllophorus drachi Cherbonnier et Guille
Phyllophorus granulosus (Grube)
Myriotrochus vitreus meridionalis Salvini-Plawen

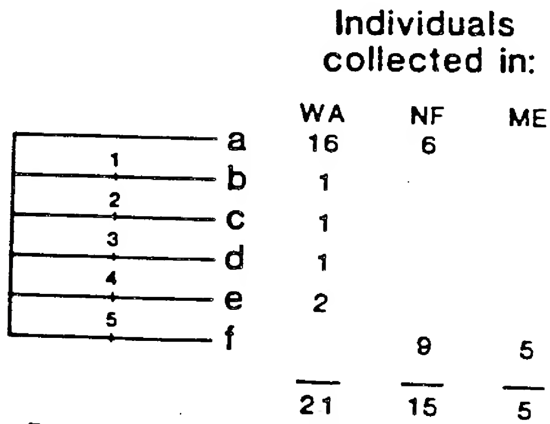


FIG. 2. Mitochondrial-DNA genealogies among 41 individual *S. droebachiensis* collected in Washington (WA), Newfoundland (NF), and Maine (ME). Construction of this cladogram is similar to that in Figure 1. Of the six genotypes observed, none was more than a single restriction site different than the reference genotype (a). All individuals from Maine differed by a single restriction-site gain from all Washington individuals. Nevertheless, individuals from both coasts of North America shared at least 64 of 65 restriction sites

Palumbi & Wilson. 1990. Evolution.

Echinoderms available at Portobello Marine Station, P.O.Box 8, Portobello, New Zealand (communicated by Keith Probert)

Asteroidea
Allostichaster insignis (Farquhar)
Astropecten primigenius Mortensen
Coscinasterias calamaria (Gray)
Odontaster benhami (Mortensen)
Patiriella regularis (Verrilll)
Pentagonaster pulchellus Gray
Sclerasterias mollis (Hutton)
Asterodon miliaris (Gray)
Astrostole scabra (Hutton)
Ophiuroidea
Ophiocoma bollonsi Farquhar
Ophiomyxa brevirima H.L. Clark
Ophionereis fasciata Hutton
Ophiopteris antipodum E.A. Smith
Pectinuracylindrica (Hutton)
Pectinura maculata (Verrill)
Echinoidea
Goniocidaris umbraculum (Hutton)
Pseudechinus huttoni Benham
Pseudechinus albocinctus (Hutton)
Pseudechinus novaezealandicae (Mortensen)
Evechinus chloroticus (Valenciennes)
Holothuroidea
Stichopus mollis (Hutton)
Trochodota dendyi Mortensen
Trochodota dunedinensis Mortensen

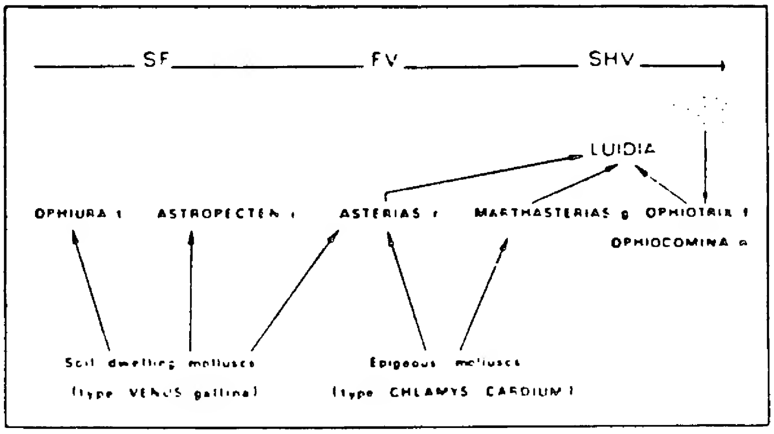


Fig 3.—Generalised food web (adapted from Menge, 1982) of the epigeous echinoderms of the sedimentary areas of the Bay of Douarnenez (arrows point to the predator) Guillou. 1990

in Barnes + Gibson (eds.)

LACM AWARDED NSF GRANT FOR ECHINODERM COLLECTION UPGRADE

Dr. Gordon Hendler, Invertebrate Zoology Section Head at the Los Angeles County Museum of Natural History, announced an award made in September, 1990. The National Science Foundation, Biological Resources Research Program, has provided $209,950 for the improvement of the museum's echinoderm collection.

During the last decade the collection has grown rapidly, chiefly through the incorporation of the Allan Hancock Foundation holdings and other "orphaned" collections. LACM now houses the largest echinoderm collection in the western United States and the third largest in the country; it is cosmopolitan, with outstanding coverage of the Eastern Pacific and Caribbean faunas. The upgrade will make these collections more accessible than previously; the collections are now available to the scientific community for study, and loans of specimens are being expedited; some NSF funds are available to support visits to the museum by specialists who will assist in working up portions of the collection.

As Principal Investigator, Hendler has implemented an 18 month program designed to re-organize and transfer specimens to two environmentally controlled areas within the museum. He is being assisted by Sherman Suter (NSF - funded collections manager) and by Cathy Groves (LACM curatorial assistant). New compactor carriages are being installed to hold alcoholic collections, and new steel museum cabinets have been purchased to store dried specimens. Wet material will be transferred from inadequate glassware to new bottles, re-alcoholed, and moved to compactors; dry specimens will be transferred from substandard containers to polystyrene boxes. In addition, a collection inventory will be prepared to serve as the basis for further upgrading storage equipment, and processing and cataloguing the existing holdings.

AILSA'S SECTION

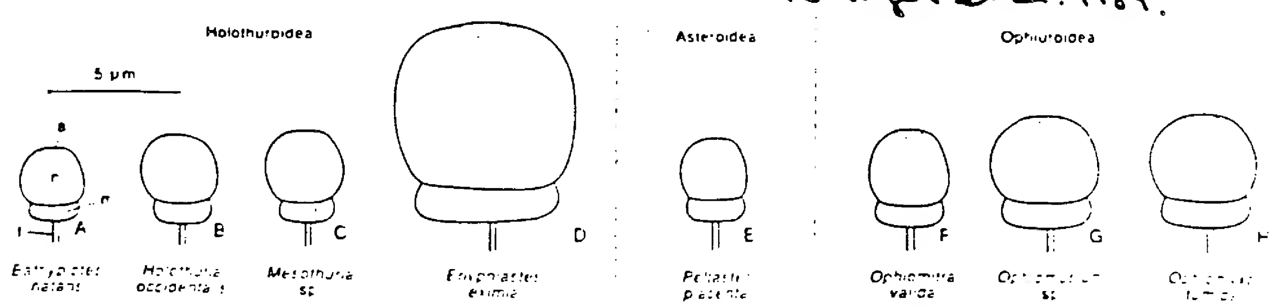
Wyville Thomson *The depths of the sea*

"Among echinoderms, *Ophiacantha spinulosa* was one of the prevailing forms, and we were greatly struck with the brilliancy of its phosphoresence. Some of these hauls were taken in the evening, and the tangles were sprinkled over with stars of the most brilliant uranium green; little stars, for the phosphorescent light was much more vivid in the younger and smaller individuals. The light was not constant, nor continuous all over the star, but sometimes it struck out a line of fire all round the disk, flashing, or one might rather say glowing, up to the centre; then that woyuld fade, and a defined pat●ch, a centimetre or so long, break out in the middle of an arm and travel slowly out to the point, or the whole five rays would light up at the ends and spread the fire inwards.

Coming down the Sound of Skye from Loch Torridon, on our return, we dredged in about 100 fathoms, and the dredge came up tangled with the long pink stems of the singular sea-pen *Pavonaria qudrangularis*. Every one of these was embraced and strangled by the twining arms of *Asteronyx loveni*, and the round soft bodies of the star-fishes hung from them like plump ripe fruit.

As the dredge was coming in we got a glimpse from time to time of a large scarlet urchin in the bag. We thought it was one of the highly-coloured forms of *Echinus flemingii* of unusual size, and as it was blowing fresh and there was some little difficulty in getting the dredge capsized, we gave little heed to what seemed to be an inevitable necessity--that it should be crushed to pieces. We were somewhat surprised, therefore, when it rolled out of the bag uninjured; and our surprise increased, and was certainly in my case mingled with a certain amount of nervousness, when it settled down quietly in the form of a round red cake, and began to pant--a line of conduct, to say the least of it very unusual in its rigid undemonstrative order. Yet there it was with all the ordinary characters of a sea-urchin, its interambulacral areas, and its ambulacral areas with their rows of tube feet, its spines, and five sharp blue teeth; and curious undulations were passing through its perfectly flexible leather-like test. I had to summon up some resolution before taking the wierd little monster in my hand, and congratulating myself on the most interesting addition to my favourite family which has been made for many a day."

Eckelbarger et al. 1989.



in Ryland & Tyler (eds.)

Figure 1
Diagrammatic drawings of [illegible]

HOW ECHINODERM BIOLOGISTS BECAME ECHINODERM BIOLOGISTS

In the past few years, a number of young echinoderm biologists have asked me how I and other (presumably older) echinoderm biologists became echinoderm biologists. I became curious myself as to how my friends and colleagues began their studies. I have found the accounts very interesting. Those I have are given below. One of these written accounts is not nearly as interesting as the oral account I received first hand. When I asked the author why the written account did not contain all of the details I had heard, the reply was: "My first effort, on rereading, might have led me into a law suit or worse, so I scrapped it." Oh, lost history! The rest of you will have to wonder who this individual is.

Alain Guille, Laboratoire Arago, Banyuls-sur-mer, France
I finished graduate school in zoology at a time when France became involved in biological oceanography. I was living as an assistant at the Mediterranean marine laboratory of the University of Paris at Banyuls. My original plan was to study phytoplankton communities under the guidance of Prof. Margaleff (Barcelona University) that nobody studied in France. However, the director of the Banyuls station, Prof. Petit, had to discuss the project. At that time (1961) he was urgently looking for a teaching zoologist able to identify the faunal elements of the marine biotopes close to the station. In late summer of that year, when I was trying to define a subject for my doctoral dissertation, I happened to meet a "still young" researcher in the hallway of the lab. He was from the Museum of Paris and in Banyuls partly to work and partly for vacation. He said, "You should work on echinoderms. I have a thesis subject for you. It's the study of the Ophiothrix populations in the Banyuls area." That was G. Cherbonnier. I accepted. I discovered quickly that there were already nearly 200 publications on the subject. There would be many more by the time I finished this first thesis, which was a contribution to the systematics and the ecology of Ophiothrix quinquemaculata. Ever since, my scientific life has shifted back and forth, osscilating between the echinoderms and the study of benthic communities, between the Paris Museum and Banyuls. I have absolutely not regrets, because a good ecologist has to start as a good zoologist, and the echinoderms are a truly rewarding group for the study of biology, ecology, and evolution!

Alan Baker (New Zealand National Museum)
While scuba diving off the Bay of Islands, northern New Zealand, in 1959, I discovered a broken test of Brissus gigas Fell. As a student, I had studied an occasional echinoderm in practical classes, but I had never seen anything like this! As heart-urchins go, it's a whopper! I collected the specimen, and for several years it sat among my collection of fish skulls,dried swim bladders, quartz crystals, and beer bottles (no cans then!). I took old gigas with me to the University of Auckland, where unfortunately, there were no echinoderm people to identify and rave over my find. In 1963 I moved to the hub of New Zealand marine science, Victoria University of Wellington, where I cam across Prof. Barry Fell and one of his students, D.L. Pawson. Real live echinoderm people! When Fell discovered I had dived in the mysterious northern subtropical region of the country (34oS), he questioned me thoroughly about echinoderms I might have seen. Brissus gigas opened his eyes, as it was previously known from only one specimen. He immediately

encouraged me, a lowly undergraduate, to search for more, and to write a paper redescribing the species. This I did with help from DLP and it was duly published in the Transactions of the Royal Society of N.Z. (1965) - my first paper of any kind. Fell's enthusiasm was catching and his lectures superb. He was a master of the blackboard illustration, crammed with information. So it came about that I was captivated by the pentagonal and spiny.

John Gage (Dunstaffnage Marine Laboratory)
I have always been fascinated by the spiny appearance of echinoderms which appeals to my prickly character. More practically, we have found from our deep-sea smples that the echinoderms were the obvious group to start with as their taxonomy seemed much more respectable than that of some others; also their spines mean that they are not so easily washed out or damaged as some other animals are in the trawl. Also, I have a peculiar fascination for a group that has fine rather than just two of everything.

G. Ubaghs (University of Liege)
Originally I intended to study the stratigraphy of the Belgian Famennian, but I frankly was not interested in this prospect. One day, while looking through the geological collections of the University of Liege for fossils of that age, I discovered some fine remains of ophiuroids. This awoke my curiosity and immediately began working on them. This was my first, fortunate encounter withthe Paleozoic echinoderms. My interest in crinoids was subsequently inducted by Victor Van Straelen, at that time Direct of the Musee d'Histoire Naturelle de Belgique. After the war, I was greatly encouraged by R.C. Moore, whom I met at the Geological Congress (1948) in London. A little later (1950), he invited me to spend several months in Lawrence, Kansas, in order to work with him and Mrs. Doreck on crinoids. Since then, and until 1978, I was involved in studies of various echinoderm groups, many of which for use in the Treatise. The third and last turn in the course of my life as an echinoderm researcher resulted from a vist (1958) to the University of Montpellier, where I went to examine the famous somasteroids described by W.K. Spencer (1951). As I did not find them there (later on, I learned they were in Lyon), I spent my time making latex casts of the beautifully preserved carpoids and eocrinoids that I found in the collections of the University. I was really amazed and, apparently, I have not yet overcome this infatuation.

John Lawrence (University of South Florida, Tampa). I was born and raised in the state of Missouri, in the center of the US. I planned to be a high school teacher in the state. During my studies for the master's degree at the University of Missouri on the physiological responses of a fresh-water killifish to high concentrations of salt, I became aware that there was much more to the world than Missouri. My older brother, Addison, was also a biology graduate student at Mizzou and had just returned from a summer at Hopkins Marine Station of Stanford University where he had taken a course in physiological ecology with Prof. Arthur Giese. I was very impressed with the accounts he gave of the ocean, the sea shore, and Prof. Giese. I had never seen the sea, and it seemed a wonderful thing to do. At this time, Prof. Giese and his laboratory had initiated studies on the reproductive biology and physiology of echinoderms. I had never seen an echinoderm, not even a preserved one. But Prof. Giese accepted me into his laboratory. And I well remember a specific afternoon in September 1960 when I first saw the Pacific

Ocean while crossing the pass at Los Gatos in the Coastal Range and later that afternoon when I first saw Strongylocentrotus purpuratus, Pisaster ochraceus, and Asterina (then Patiria) miniata in the intertidal at Pacific Grove.

Helen Clark/Rotman (National Museum of New Zealand)
My association with echinoderms began many years ago when I was looking for a M.Sc. topic. There were then only two zoology professors at Victoria University in Wellington and Professor H. B. Fell, with his wide and very practical knowledge of echinoderms, seemed a good choice. Barry Fell is a great enthuisast and a perfectionist; he is also a superb teacher. From him I learnt a great deal and I will always be grateful to him. It was he who encouraged me to work on Southern Ocean asteroids and my first publication, Anareaster, a new genus of asteroid from Antarctica was a joint venture with Barry as senior author. Later I worked at the Smithsonian in Washington, D.C. and I renewed my association with Dave Pawson, a fellow countryman. I really enjoyed my time there and a sourthern trip in the research vessel Eltanin was most rewarding and enjoyable. It was very exciting to see fresh and almost living material rising from the ocean depths!

Katsuma Dan (Tokyo Metropolitan University)
I was about twenty years old and a student at Misake Marine Laboratory of the University of Tokyo. When I saw the echinoderms I was impressed with their regularity, and I thought how wonderful it would be to spend my life trying to understand why this was so.

Paul Tyler (University of Southampton, U.K.) I left school at 16 and worked as a medical laboratory technician for 5 years. Did A levels degree. Graduate at 26 in oceanography and zoology. Awarded a University of Wales postgrad scholarship to study estuarine hydrography as my undergrad project had been on estuarine amphipods. After 3 months, I realized that the project was impossible. Started looking for a new zoological project and saw Lucienne Fenaux's 1968 paper. Decided to work on ophiuroids. Completed PhD and met John Gage at a EMBS meeting. Went to sea to work on deep-sea ophiuroids, and then to all the other deep-sea echinoiderm groups.

David Nichols (University of Exeter). Rather few people visited the South Coast of England towards the end of the Second World War, because of the coastal defences. Certainly, it would have been too difficult to take geological field-trips to the area. To a 14 year-old, the challenge of worming one's way to the beach in Dorset was irresistible, and it was then that I first tasted the delights of the Chalk cliffs and foreshore, and first came face-to-face with an echinoderm.

Five years of inaccessibility had left a legacy to an inquisitive youngster: the *Micraster* fossils of the Middle Chalk, which outcrops there, had been gently weathered to perfection and protruded from the cliff-face, attached by a mere stalk of matrix and ripe for collection by simply breaking them off. What on earth were they? Were they really "Shepherd's Hearts", as the locals said of the flint casts lying in the fields above? My biology teacher had no clue, but the local museum told me enough to fire the imagination, explaining the function of the radiating pores on the dorsal surface and the tubercles covering the body.

Six years later, an Assistant Demonstrator taking a practical class during my undergraduate course put on display the dried test of a Recent heart-urchin (*Echinocardium*), also from the South Coast of Englnd, separated in time from my fossils by 75 million years. There were the radiating pores on the top and the covering of tubercles, with some of the spines still attached. The division of labour of the spines was described, and the fact that nobody really knew how they lived. Could a study of the living animals from the sandy beaches of South-West England help in interpreting the way of life of those Cretaceous fossils from the cliffs just along the coast? That was it: here was a ready-made undergraduate project, later submitted for a graduate research scholarship. Hooked.

It is intriguing that so many researchers stay with the group. Presumably others find, as I do, that no other group has the mystery and the sheer provocation of the echinoderms. So often one feels on top of a problem, only to have a challenging excpetion thrown under one's nose, defying you to let your guard drop for an instqnt. But in addition to the fascination of the group itself, what a joy it is to work in a field in which, clearly, other scientists feel the same inspiration.

Iain Wilkie (Glasgow College). My curiosity about echinoderms in general was first aroused by a short lecture course on the phylum given by the late Professor Norman Millott at the University of Glasgow in 1970. I then became one of his research students and started to investigate the ecology of the brittlestar Amphipholis squamata at the Milllport Marine Station. One day my fellow research student S.J.F. Gorzula happened to notice on my bench the autotomised arms of a large specimen of the brittlestar Ophiura ophiura. Although working on the ecology of Ophiocomina nigra, Steve Gorzula was a keen herpetologist, and he commented on the superficial similarity between the Ophiura arm and the tail of a lizard. We realized that this extended to their both having the capacity for autotomy, and he directed me to a paper by

Sheppard and Bellairs on the functional morphology of the lizard-tail autotomy plane. Having found almost nothing on ophiuroid arm-shedding in the literature, I started to investigate with Professor Millott's approval, firstly the functional morphology and then the mechanism of ophiuroid autotomy. I soon realised that arm detachment depends not on violent muscular activity, as had been previously assumed, but on the rapid disintegration of collagenous ligaments and tendons at the autotomy plane. Inspired by the early papers of Professor K. Takahashi on the sea-urchin catch apparatus, I began to look at the physiology of the phenomenon. My devotion to mutable collagenous tissues had begun!

R.P.S. Jefferies (British Museum, Natural History). I am not primarily interested in echinoderms but in primitive fossil chordates and the phylogenetic relationship between chordates, echinoderms, and hemichordates. For this reason I have devoted almost 26 years to the study of the curious fossils called calcichordates. I first heard of these animals when I was a student at Cambridge in the summer of 1952. They formed part of a stimulating course on echinoderm palaeontology given by Bertie Brighton, who for many long years was curator of the fossil collections in the Sedgwick Museum. Bertie's audience consisted of three people only - Martin Rudwick, Martin Brunt, and myself. We were specialising in palaeontology. Bertie was immensely knowledgeable and a godd lecturer to a small audience, although he did have the strange habit of usually talking with his eyes closed. He mentioned Cothurnocystis and gave us, for the most part, the straight Bather interpretation, by which the gill slits were multiple mouths. He mentioned Gislen's view, however, that the gill slits were gill slits and that Cothurnocystis, or its close relatives, was ancestral to the vertebrates. I remember Martin Rudwick saying to me that perhaps this was not as daft as it sounded, seeing that echinoderms were supposed to be closely related to chordates. I joined the staff of the British Museum (Natural History) on April Fool's Day 1960. On that same day, Errol White, the Keeper of Palaeontology, set me to complete a small exhibit on echinoderms for the public galleries. In preparing this exhibit I read Gislen's1930 paper for the first time and decided that he had a considerable case for his chordate interpretation. The next important event took place in the first week of February 1964 (beginning about Monday, 3rd February). I was looking at that time for a project to do with echinoderms when my colleague Bill Dean brought in a couple of mitrates which he had found in the Upper Ordovician of Shropshire. Thier fish-like appearance reminded forcibly of Gislen's work which I immmediately re-read. There followed about three weeks of intense activity in which I examined all the cornutes and mitrates in the B.M.(N.H.) collections. I discovered the gonopore-anus (which I then called the anus) just left of the tail of Cothurnocystis, worked out the essential correspondence in internal anatomy between the mitrate and cornute head (which I then called the theca), and decided that the rectum of the mitrates must have opened into the left atrium. I was delighted to discover, in referring to my undergraduate text-book of zoology (Borradaile, Eastham, Potts, and Saunders, 2nd. Edition, 1948, p. 676), that the same was true of a tunicate tadpole. Since that moment, I have never doubted the chordate interpretation of the calcichordates. Some notable changes have happened since then. Sometime in late 1973 and early 1974, I decided that I had been wrong to identify the calcichordate tail with the crinoid stem. Sometime in early 1975 I resolved to speak of the two parts as head and tail, as a result of reading the works of the great German nineteenth century anatomist August

Froriep. In the early 1970s, I came under the influence of Henning's phylogenetic systematics, largely by the persuasion of my colleague Colin Patterson. In 1975 I worked out how the classical vertebrate head segments were disposed in a mitrate. I have two great regrets. The first is that I did not begin supervise research students until late in my career, though in the last few years I have had the pleasure of working with several clever young people who have now started to publish on calcichordates (Tony Cripps, Paul Daley, Fritz Friedrich, Ian Woods, Adam Craske). The second is that I have never been able to establish strong links with the United States. Perhaps there is still time, though I retire from the B.M.(N.H.), at the age of 60, in January 1992. I fully intend to continue working on calcichordates after my retirement.

J. Wyatt Durham (University of California). On the 1940 E.W. Scripps cruise to the Gulf of California I collected numerous fossil echinoids, with 27 species being recorded in the expedition report (Geol. Soc. Am. Mem. 43). While at the California Institute of Technology, one of my students found a number of good fossil asteroids that we described (Durham & Roberts 1948). In 1948 I described a new fossil Dendraster, which had been confused with the living species and also showed that in terms of structural construction, the externally morphologically similar sand dollars Anorthoscutum (Scutellaster), Dendraster, Echinarachnius, and Merriamaster could be easily differentiated. This paper attracted the attention of R.C. Moore, who at that time was searching for contributors to the echinoid volume of the Treatise on Invertebrate Paleontology. He asked me to do the clypeasteroid section of the Treatise. Inasmuch as the clypeasteroid volume of Mortensen's Monograph of the Echinoidea had just appeared, I thought that this would be an easy task! My classification of the clypeasteroids appeared in 1955 and involved numerous changes in the detailed classification and much new data on the construction of the test. This task gradually was enlarged by Moore to a general supervision of all parts of the echinoid volume of the Treatise. This was done with the help of Carol D. Wagner and included the completion of several other sections of the echinoid volume that no other echinologist had been willing to undertake. Meanwhile I had been fortunate in recognizing the echinodermal nature of the bizarre Lower Cambrian fossil that Ken Caster and I described and named Helicoplacus, and for which we proposed the class Heliocoplacoidea in 1963. I had not previously investigated echinodierms other than echinoids and stelleroids. Caster was teaching a summer school class at Berkeley at that time and had studied various other Paleozoic echinoderms. Because I was hesitant to propose a new class by myself I asked him to cooperate with me in describing and naming the new class (Durham & Caster, 1963, Science, 140, 820-822). From this time on I examined and studied various other poorly known Cambrian echinoderms. My interest in echinoderms has resulted in various publications over the years and continues on. Currently I have a major paper on the helicoplacoids, showing that Paul and Smith's 1984 interpretations of helicoplacoid morphology is incorrect, submitted to Palaeontology and tentatively accepted. I have near completion a paper on the occurrence of the Paleozoic "cidaroid" Pholidocidaris in Mid-Devonian strata northwest of Fairbanks, Alaska. It is somewhat older and around 4000 km from the nearest record of that genus. In 1984 I had a monograph of the fossil and Recent keyhold sand dollars of the genus Mellitella nearly completed, but put it temporarily "on the shelf" while I improved and corrected Paul and Smith's inadequate treatment of the helicoplacoids. My immediate plans include completion of these temporarily delayed studies.

Ailsa M. Clark (British Museum, Natural History). I was lucky enough as a child to live only five minutes away from marvellous cornish rock platforms rich in marine life and spent a lot of time prodding around in rock pools. So, when I got my degree in 1948, a career in marine biology seemed infinitely preferable to messing about with bugs or biochemistry. Unfortunately in those post-war days sea-going females were discouraged, though a few very determined ones fought their way in. Not being in the Brunnhilda class (excepts perhaps physically) I was extremely lucky that a vacancy to work on echinoderms - the only all-marine major group curatorially - occurred just then at the British Museum (Natural History) and there I stayed for 38 years gainfully employed, interpreting my role as mainly a back-up to research biologists in universities and marine stations doing more practical jobs. Fortunately, this period was mostly a time of financial expansion with improving facilities, at least until the eighties, when economic stringencies prompted cutbacks to basic science, so retirement perhaps saved me from redundancy! One day maybe a curator of echinoderms will again be something that the nation can afford but for the present it's difficult to be optimistic. So good luck to all you D.I.Y. systematists!

William I. Ausich (Dept. of Geology, Ohio State University). My maternal grandfather polished rocks, in retirement. As a teenager, I was fascinated by these attractive stones, which included specimens called "pudding stone", "petosky stone", and "alphabet rock". Alphabet rock was a crinoidal limestone, white crinoid columnals in a dark-colored matrix. Crinoid columnals were cut at all angles yielding the O, C, U, D, B, I, etc. shapes, hence the alphabet rock. This alphabet rock was most intriguing. My grandfather and I did conclude that the "letters" in the alphabet rock were crinoids by consultation with Fenton and Fenton The Fossil Book. Although I did not pursue rock or fossil collection or rock polishing as a teenager, I did enter the university of Illinois as an undergraduate major in Geology. At Illinois, Dan Blake was studying fossil asteroids, and two of his graduate students, Dennis Kolata and Frank Ettensohn, were studying fossil crinoids and other crinoids. The seed of interest planted unknowingly by my grandfather took firm root. By the beginning of my junior year, I had decided to study crinoids. I entered graduate school at Indiana University specifically to study fossil crinoids under the direction of Gary Lane.

Aage Moller Christensen (Helsingor Marine Laboratory). It was Gunnar Thorson who suggested that I study the feeding biology of Astropecten irregularis for my master's degree. Later I felt it natural to add new data and do considerable experimental work on the species in order to get my Dr. scient. degree. Already while working for my master's, I became concerned with the question as to how seastars of the Asterias type gained entrance of their stomach into their molluscan prey, but it was the late Dr. Thurlow Nelson, then professor at Rutgers, who took an interest in "my problem" and saw to it that I could go to Seattle and Friday Harbor to try to solve it. Only condition - I had to work at the New Jersey Oyster Research Laboratory for 18 months afterwards. In all it was probably the best two years of my life as a scientist. Now I have not worked with seastars for many years. In fact I have only published two papers on them in my whole career, in addition to a review paper published by Feder and myself. I am much more at home amongst people working on turbellarians.

Edward P. F. Rose (Royal Holloway and Bedford New College). My commitment to echinoderm palaeobiology stems from a series of misfortunes and mistakes! Between the ages of 7 and 10, I was annually struck down by childhood diseases (scarlet fever, measles, chicken pox, Asian flu, etc.) which confined me to bed for many weeks of the winter months, where I could do little but listen to the radio, most importantly to a fascinating programme series intended for schools entitled, I believe, "Life on Earth" or something like that. Thus fired with an enthusiasm for fossils, from the age of 10 I had the health, maturity (and necessary pocket-money) to regularly make the hour-long bus journey to the Natural History and the Geological Museums in London, where one could then (if no longer) gaze enviously at vast fossil collections displayed for public viewing. By 13 I had acquired a bicycle and the friendship of fellow schoolboy enthusiasts, so determined pedalling took us to the nearest rock outcrops south of London - to the Chalk, and therefore to Micraster and its companion Late Cretaceous echinoids in all their relative abundance and curious diversity. Tolerant staff at the British Museum (Natural History) at first identified our discoveries, and then saw the potentially labour-saving wisdom of directing our energies into the literature of the Museum's library, to work things out for ourselves. I was hooked! On admission to Oxford to read geology, I made determined efforts to broaden my horizons, but in the very first term a guest lecture to the Oxford University Geological Society by David Nichols from the Zoology Department next door so clarified my understanding of schoolboy observations on Micraster that the old enthusiasm was rekindled. I tried to dampen it by participating, at the end of my first year of undergraduate studies, as a geologist on the Oxford Expedition to Cyrenaican Libya in 1961 - only to find the wadis strewn with the most beautiful Tertiary echinoids. On graduation, I therefore resolved to transfer to the Zoology Department and work there on these fossil faunas under David Nichols' stimulating sueppervision. On my way back from my next (solo) trip to Libya, with a Landrover already full of fossil echinoids, the boat from Benghazi to Syracuse stopped at Malta. I decided to get off and catch the next boat. Ten days and many specimens of some 42 Tertiary echinoid species later, I realized what my first postdoctoral study would ultimately involve! And so life goes on: travel as I will, there always seem to be echinoids waiting for me, in the rocks, the sea, and the local museums and collections. And there are such fascinating problems still to be solved. And from fossil echinoids, one can demonstrate just about every palaeontological principle of significance - as my students will affirm, perhaps with somewhat brittle smiles on their faces.

James Cobb (Gatty Marine Laboratory). My first introduction to echinoderms was a requirement to dissect a sea-urchin in my second year at St. Andrews University. I remember trying to crack it like an egg on a galvanised bucket before discarding it with the hope that no-one would give us this extra-ordinary thing in a practical exam. I started a research project on bivalve shell opening in my final undergraduate year under the supervision of Prof. Mike Laverack (I was his first student since he and I both started at St. Andrews at the same time, albeit at rather different levels). The bivalve project did not work and Mike suggested I carry on with something he had done on gut rhythmicity in sea-urchins. This did not work either, but I became fascinated by the workings of Aristotle's lantern (or Archimedes' pump as one of my undergraduates recently wrote!) I still am fascinated by it and only wish echinoid nerves were not so small. At this time J.E. Smith was king of the echinoderm nervous system but I was lucky enough to be able to use the electron microscope and it quickly became obvious that Smith's methylene blue techniques presented a false picture. It gave me something to cut my teeth on. I met Eric Smith once or twice. The first time he came to the Gatty Marine Laboratory when Adrian Horridge was director. Eric Smith was a Fellow of the Royal Society at that time and I think Adrian was hoping to join those illustrious ranks and he took me on one side on the morning of the visit and told me to behave myself! He became an FRS two years later so I obviously did. Having completed my Ph.D. I went to Geoff Burnstock's lab in Melbourne for two years to learn to do intra-cellular nerophysiology on the small cells of echinoderms. By chance I returned to the staff at St. Andrews but it was another twelve years before I finally succeeded in recording intra-celluarly from echinoderm neurones and I still spend many hours achieving useful impalements. I have never for a moment regretted working on echinoderms though very isolated from mainstream neurobiology. I become more and more convinced that there is something very peculiar about the evolution of this wierd and wonderful phylum.

Norio Suzuki (Noto Marine Laboratory). When I first saw sea-urchin fertilization under a microscope in an undergraduate marine course, I was so surprised because until then I had never seen such quick biological phenomenon. Most biological phenomena are so slow, like the growth of plants and animals. Then I decided to be an echinoderm biologist who dealt with the biochemical mechanisms of sea-urchin fertilization.

Konrad Märkel (Ruhr University, Bochum). On the whole I became a zoologist in order to escape as far as possible ideological pressures. At least the animals themselves (not the biology!) did not take care of human ideologies. I was 40 years old when I started with echinoderm research. Having survived World War II as a soldier, I lived in Dresden in East Germany. In 1960 I left East Germany as a refugee and got a position at a West Germany university. I was fascinated to have the freedom to travel in foreign countries. A trip (with students) led to the Mediterranean Sea, and for a few days we visited the Laboratoire Arago in France. This was my very first occasion to observe live marine animals. Up to this time they were known to me only in the preserved condition. I felt like a paleontologist who had stepped back into the Jurassic. I looked for opportunities to stay for a longer time on the Mediterranean coast. For this purpose I needed grants, and the prerequiste to get a grant was a well-defined research program. For health reasons I was not allowed to dive, but the shore was full of sea urchins and prosobranch gastropods. Both groups are provided with fascinating teeth. My doctoral thesis was on the pulmonate radula. Then I applied for a grant to study the teeth of gastropods and sea urchins, but more and more my interest turned to the sea urchins and their structural anatomy.

Chia, F.-S. (Dept. of Zoology, Univ. of Alberta). My relationship with echinoderms began as an arranged marriage which worked out well: this is, I fell in love after the wedding. I came to the University of Washington in 1958 as a graduate student, but spent the first two years taking a large number of courses to make up for my deficiencies. However I knew all along my research would be centered around embryology of marine invertebrates, because my supervisor, Dr. R.L. Fernald, was an invertebrate embryologist and had just beeen appointed as the Director of the Friday Harbor Laboratories. At the beginning of my third year Dr. Fernald called me into his office and told me that I should begin my research on the development of either a worm, a snail, or a starfish. I chose the starfish. In 1960 on Thanksgiving evening I collected my first starfish, *Leptasterias hexactis*, off Edward's Reef, San Juan Island. That was the beginning of my inquiry into various aspects the biology of echinoderms, and that was over than 30 years ago.

Robert D. Burke (Dept. of Biology, University of Victoria). I recall being very interested in development as an undergraduate. I am not sure if it was the subject matter, or my instructors, or both. In the summer of my last year I took a summer course at Bamfield Marine Station. In this environment, where marine invertebrates and developing embryos can be scooped up by the handfull, I delighted in seeing many of the things I had heard of in lectures. I remember specifically being fascinated at seeing fertilized eggs divide. Although I knew more about mitosis than is healthy, I had never seen it in the flesh. My interest in echinoid development stems from seeing the famous fourth cleavage and the formation of micromeres. It is almost insignificant in description, but to me, seeing first hand the micromeres, which have a very specific fate in making the larval skeleton, provded inspirational. It was almost an ultimate proof of what was in the textbooks - I could believe all that I had been told about animal development after that. Although equally interesting phenomena occur in ascidians, vertebrates, spiralians, and a host of other animals, the unsurpassed simplicity and clarity of sea urchin eggs made a lasting impression on me. When graduate studies were suggested to me, there was no question in my mind about the subject of my research.

Arthur Charles Giese (Dept. of Biology, Stanford University). I was to assist C.V. Taylor the summer of 1929 at Hopkins Marine Station and he asked me to become acquainted with marine eggs, especially echinoderm eggs, before he got to HMS from Stanford. I had been at Berkeley and we were finished there in early May. I had dissected the dreary, smelly urchins at the University of Chicago when I was an undergraduate, but became fascinated by the beauty and colors of the live ones aty HMS. I collected *Patiria* and *Pisaster* too and tested the eggs of all of them, fertilizing and watching development. When he came I had learned about the early embryology of all the echinoderms that were breeding in June. I was fascinated by the synchrony of division in batches of eggs. However, his interest was in stripping off the membranes and fertilizing the pieces. The project was not well conceived and produced little useful data. But I got to use the eggs later in my experiments on effects of UV on cells -- the sperm proved to be 1000 times as sensitive as the eggs to a given dose. It was quite a few years later that I had trouble getting eggs that I decided to study the breeding cycle and found it to be periodic and then we were off to a different set of experiments. I also taught invertebrate biology so the knowledge came in handy. I wanted to show the students live things, not the smelly brown goop that I had had at the University of Chicago. I projected movements of small stars and urchins and got them as fascinated as I was. p.s.: I never got paid by Taylor. His grant did not materilize, but it did not concern him that I was at the point of starvation.

David Meyer (Dept.of Geology, University of Cincinnati). My echinoderm interests go back to my boyhood experiences collecting fossils in western New York State. Devonian microcinoids from the classic Hamilton shales were my first serious interest and became a science fair project in high school. It was contact with active echinoderm paleontologists during my undergrad days at Michigqn that really developed my echinoderm tendencies: first Bob Kesling, then Brad Macurda, who joined the UM faculty when I was a sophomore. I spent a summer on a trip to Britain and Europe with Brad, seeing major fossil echinoderm collections at the British Museum and elsewhere, visitng classic Carboniferous localities. During two subsequent years I served as Brad's lab and field assistant, working the echinoderm-rich carbonates of the U.S. mid-continent and southwest. By the time I graduated I was determined to study echinoderms in graduate school. A major influence at this point was my marine invertebrates course at Friday Harbor, the summer before starting grad work at Yale. At Friday Harbor, I had my first exposure to living marine animals as well as my first living crinoids, and I guess this triggered a desire to explore living crinoids to gain insight to their fossil ancestors. At this time I received a lot of encouragement from Porter Kier, who was studying Recent echinoid living habits in the West Indies, and it was through Porter that I first learned of crinoids accessible by diving on Caribbean reefs. It took a pilot study during my first summer of grad work to show me how abundant crinoids were around different areas in the Caribbean, and I was set for my dissertation work. It was then vital that my advisors at Yale (Karl Waage, Lee McAlester, Don Rhoads) were supportive of a project dealing strictly with living animals from a paleobiological viewpoint. The study of fossils from a biological approach was nuturued at Yale at that time, and I think this healthy interdisciplinary climate was essential in enabling me to develop an interest in both living and fossil echinoderms that cointinues to this day.

Roland Emson (Biosphere Sciences Division, King's College, London). The blame falls princpally on the shoulders of Ailsa M. Clark and Norman Millott. In 1968 I was interested in echinoderms but was not an echinoderm worker. I attended the Zoological Society of London meeting on echinoderm biology, and listened among others to Norman Millott, David Nichols, Ailsa Clark, and Jim Cobb. Ailsa's paper in particular intrigued me and caused me to take up the study of fission in echinoderms when I went to New Zealand later that year. There I also met Robin Crump with hom I subsequently collaborated on Asterinid biology and discovered for myself the joys of working with pentamerous creatures. My fate was decided.

Gary Lane (Dept. Geological Sciences, Indiana University). I didn't get interested in paleontology until my senior year as an undergraduate when I took paleo from Harold Brooks. He influenced me, Al Fagerstrom, and Bert Driscoll all to go into paleo that year. I went to Kansas because they were strong in paleo especially with R.C. Moore there and because they offered me a full assistantship, which other schools had not done -- my grades weren't all that great at Oberlin. At any rate, I did a general stratigraphy, sedimentology, paleo master's thesis with Moore on a Lower Permian cyclothem in south-central Kansas. I had planned to get a masters and then work in industry, and had a couple of good offers. But Moore asked me to stay on and the department provided fellowship support, so I decided to do a Ph.D. I talked with Luke Thompson about doing a microfossil facies study, but Moore was against it. At first he tried to interest me in working on snails, but I wasn't too interested. Then he said, "What about crinoids?" I replied that I didn't know anything about crinoids. His rejoinder was, "Is there any group of fossils that you know much about?" I had to admit that there wasn't. So, that is how I got started. He had made a large collection of plaster casts of type crinoid specimens mainly from the USM. With copy of Moore and Laudon and Moore, Lalicker, and Fischer in hand, I pored over those casts trying to figure out the morphology and classification. He soon decideed that I should do a taxonomic revision of the camerate family Batocrinidae, which I what I did for my dissertation.

<u>Daniel Blake</u> (Dept. of Geology, University of Illinois). I have liked both biology and geology from my childhood days on my grandmother's farm -- I'm one of the few people I know of that actually likes chickens on the claw as well as in the pot. Paleontology seemed a good way to combine both geology and biology, and so I was a geology major as an undergraduate. Although I grew up in the midwest and went to midwestern schools, I found I liked post-Paleozoic fossils better than Paleozoic ones. I migrated to the Unviersity of California and J. Wyatt Durham's laboratory probably more with the intent to work on gastropods or pelecypods than echinoderms (true confessions!). Wyatt at the time was working on *Helicoplacus* and starting to work on other Paleozoic echinoderms, as well as continuing his work on echinoids (the Treatise was underway), and I got caught up in it all. Asteroids? On my first field trip from Cal, one of the student's picked up a fossil "blob". Wyatt looked at it and said, "It is a starfish", and something as fleeting as that decided how I would spend a good part of my life (a warning to students?). (The fossil proved to be a *Luidia*).

<u>Ronald Parsley</u> (Dept. of Geology, Tulane University). I went to grad school interested in early Paleozoic paleontology. (Early Paleozoic was the time when all of the more advanced animal taxa were evolving hard parts and diversifying). A look, early in my grad career, into my mentor's (Ken Caster, University of Cincinnati) "goodie cabinet", full of early Peleozoic primitive echinoderms, was one of the most seductive experiences of my life. "What a plastic phylum, these echinoderms!" There were "carpoids" which are more or less bilaterally symmetrical, "cystoids" and paracrinoids with bilateral and triradial symmetry: all of these strange critters, many without a trace of run-of-the-mill bipentaradial symmetry? There were forms recumbent, forms stemmed, forms sessile, forms "wriggle-motive", forms burrowing, and forms vagile. What a potpourri! Most of these critters supposedly had some sort of "internal plumbing (water vascular) system". And, all of these weird fossils were constructed by the echinoderm "universal constant" -- high magnesium calcite stereom. This several hours' adventure. through half a dozen drawers of fossils, was enough to snare me into a lifelong career. Along these lines, I am frequently reminded of the last sentence in the preface to Libbie Hyman's book on the Echinodermata -- "!

also here salute the echinoderms as a noble group especially designed to puzzle the zoologist.

Malcolm Telford (Dept. of Zoology, University of Toronto). Every student of biology is guided and, worse, influenced, by an older, more experienced, and "wiser" mentor. As a student, I was guided into the experimental world of biochemical physiology, although my interests had always been in whole animal biology. But what is "whole animal biology", and how do you make a career in it when the whole community is united in irrevocable wedlock with chemical biology? Of course, you struggle to unite biochemistry/physiology with your vision of the whole organism. But for me, as time passed, I found myself doing more and more intricate biochemical work, the biology of slurries and homogenates. Eventually I had to take stock, and didn't like what I found: work, life, science wasn't fun anymore. So one sabbatical leave, I set out to change my world: I resolved that in everything in which I had the choice, I would not do anything that was not entertaining and amusing. Having resolved that, how would I get away from crustacean tissue homogenates into the world of whole animal mechanics and evolution, the realm that I now regard as modern day natural history? The trick was not finding a new research slant, but making the switch without forfeiting research funds. My aim was to work with physical and mechanical principles, and echinoids looked like the ideal group. I had already started wondering about the lunules and other structural problems in sand dollars. So I designed a bridging project. Since I was funded for some work on decapod crustaceans, In included a little study of behavior of pinnotherid crabs symbiotic on irregular urchins (genus *Dissodactylus*). In subsequent grant applications, I quietly dropped the crustaceans and based the research on the "hosts". Since that time, about ten or eleven years ago, I have played with problems in fluid mechanics (hydrodynamic functions of lunnules), skeletal architecture (the test as an engineered dome), biomechanics of Aristotle's lantern (modeled as a thick-walled cylinder and as a set of wedges), the possibility that urchins are inflated pneus (measuring internal pressures), the feeding mechanism of clypeateroids (leading to a computer simulation of the process), and also some interesting problems in systematics and evolution. Since making the change in research direction, every day has been *fun*. I have found some outstanding students, met a wonderful bunch of people, and even maintained my research funding! If there is a moral to my tale, it is, Do what you want, listen to advice but don't be unduly influenced, and *never, ever* let yourself be talked into a line of research which is not your own first choice! Oh, yes: And have some fun!

David L. Pawson (National Museum of Natural History, Smithsonian Institution). In 1958, during my last year of a B.Sc. degree at Victoria University in Wellington, New Zealand, three things led me in the direction of the echinoderms. Firstly, for the invertebrates course I was taking, we were required to put together a collection of representative invertebrates from the local rocky shore. On numerous weekend field trips we collected many echinoderms - ubiquitous *Patiriella regularis*, marauding *Pectinura maculata*, and squashy *Stichopus mollis*. They seemed more interesting and exciting than most other animals (with the excpetion of the beautiful abalone *Haliotis iris*, which we collected and ate in vast quantities). Secondly, I participated in some of our Zoology Department's ventures into deep-sea research - we would steam out into Cook Strait in a rented fishing trawler and fish in deep water using long lines, ring nets, try nets, and bottom traps. Bathyal echinoderms, such as *Gorgonocephalus* or *Molpadia*, would be collected, and would momentarily distract me from losing my lunch over the side of the vessel. Thirdly, I assisted our echinoderm specialist Prof. H. Barraclough Fell in first-year Zoology laboratories, and we talked frequently about his favorite subject - echinoderms. As the year wore on, I became very interested in these animals. Barry Fell steered my interest in the direction of the holothurians at that time, probably because he had the other echinoderm groups of the New Zealand region pretty much at his fingertips, and he knew very little about sea cucumbers. So, for an M.Sc. degree I studied New Zealand holothuroians, then for a Ph.D. I became involved with echinoids as well, from the southern Pacific Ocean and elsewhere. During those years, from 1959 to the end of 1963, I learned much about living and fossil echinoderms from Barry Fell, and collaboratored with him on a study of fossil regular echinoids for the *Treatise on Invertebrate Paleontology*. We exchanged what seemed like a million letters with *Treatise* editor Ray Moore on a bewildering variety of topics and issues; some of these, for example the Holothuroidea/Holothuriodea spelling debate, are unresolved to this day. At that time, 1961-63, Fell was immersed in his controversial studies on fossil sea stars, and the interrelationships of echinoderm classes, living and fossil. He would meet with Helen Clark Rotman and I, behind closed doors, to reveal his various new ideas. Helen and I seemed to be stunned by it all. Early in 1964 came the Curator of Echinoderms job at the U.S. National Museum, and life has been pentagonal for me ever since.

<u>Thomas Ebert</u> (Dept. of Biology, San Diego State University). Why I started to work on sea urchins is easily answered. I grew up in northern Wisconsin and when I finished my undergraduate work at the University of Wisconsin I had not yet seen an ocean. I applied to a number of schools in coastal states and picked the University of Oregon because I thought that it was on the coast (it isn't). I entered graduate school in the fall of 1961 and my intentions were to see an ocean and mountains and red wood trees (I thought that Oregon was covered with redwoods -- it isn't), and then go back to the Midwest and work with fish. During my first year at Oregon, I was a teaching assistant in introductory biology, and when echinoderms were presented in the laboratory I noticed that a broken sea urchin spine had rings like a tree or like a fish scale. That summer (1962), in addition to being a teaching assistant in a fruit fly genetics lab, I registered for researach and began work with minnow migration in a small stream. I trapped and tagged and would have been perfectly content to pursue work in fish ecology. I hadn't checked faculty interests before arriving at the University of Oregon and, as it turned out, the only persons interested in fish were physiologists. This wasn't a major problem because I had no intention of staying at the university. I was in a course-work master's program, and so did not have to do resear write a thesis. In the fall of 1962, I needed 2 credits to fill my course program and so decided to see whether I could get them by taking "directed research" with some faculty member. I didn't think that measuring oxygen uptake by catfish sounded like much fun and so I tried to think of possible work with an invertebrate. Another student told me that Peter Frank had some interest in sea urchins and so I asked him whether I could get 2 credits by examining growth lines in the spines. He agreed and so I started grinding spines and counting lines with a goal of getting an age-frequency distribution for sea urchins in a tide pool at Sunset Bay. My intentions still were to finish my MS degree in spring 1963 and to return to the

Midwest, but growth lines in spines actually turned out to be interesting (!). In spring 1963, I had to decide whether to leave Oregon to pursue work with fish elsewhere or to remain and try to develop something with invertebrates for a Ph.D. dissertation. I figured that probably I could get my Ph.D. in a shorter time by staying and working with urchins. I suspect that I was right. So why did I begin to work with sea urchins? Random wall is a reasonable answer that summarizes events.

Gordon Hendler (Natural History Museum of Los Angeles County). As a kid growing up in the Bronx (a borough of New York City) my favorite pastimes were self-preservation and an annual trip to the American Museum of Natural History. I do not know if there was an echinoderm on exhibit in the museum, "echinoderms" was not in my lexicon; I wanted to be an entomologist. Later, a science fair prize for home grown tissue cultures of mouse kidney paved the way for my fist jobs, in cell biology labs at Collumbia University. In college, a career in echinology was still unanticipated, but summer employment at the New Jersey Oyster Research Laboratory stoked my passion for marine invertebrates. During those years, my chief scientific interest was the gastropods, and my first proposal for doctoral research was a study of *Bittium*. After measuring countless numbers of snails under the microscope, I started to imagine that they looked like ugly little cows with red eyes and black shells. At the point that I was ready to change my dissertation research to anything else, my advisor,, David Franz, asked me whether I recognized some extraordinary looking creatures: amphiurid brittlestars. I could identify them to class, and decided on the spot that they would replace red-eyed cows as my thesis topic. In retrospect, that moment seems an important turning point in my life. I set out to learn "everything about brittlestars", beginning with the sphagetti-armed dweller of sulfurous mud, *Amphioplus abditus*. Luckily, I was able to endulge an obsession with echinoderms because of the generosity of my parents and the kindness of teachers and scientists who encouraged me as a youngster. The decision to study echinology resulted in years of uncertain employment, but it also initiated the most exciting adventure of my life and opened a path that has led me to many of my best friends and most satisfying accomplishments.

Stephen E. Stancyk (Baruch Institute, University of South Carolina). My introduction into the study of echinoderms seems to me to be rather prosaic, although my major professor, Frank Maturo, may have been more disingenuous than I thought at the time. Prior to entering graduate school at the University of Florida, my total experience with echinoderms was the dissection of *Asterias* in Invertebrate Zoology at the University of Colorado. At Florida, I was overwhelmed with the diversity of fascinating animals and environments, and spent my first year playing with fresh waters, amphibians, sea turtles and a variety of marine critters. I knew I wanted to do something with marine ecology, but simply couldn't settle on a subject. Finally, in frustration, Dr. Maturo suggested that we just go out to Cedar Key and look around. The day was one of those blustery gray Florida days when it looks cold but isn't, occasionally spits rain, and the waters around Cedar Key are opaquely brown. We arrived in Cedar Key around low tide, and drove out the airport road to Goose Cove (which I now recognize as the type locality of *Ophiophragmus filograneus*; surely Maturo didn't know that, did he?). We waded out into Goose Cove until we were about knee deep on an unvegetated bottom of muddy sand. Frank told me to reach down and feel around in the mud with my fingers. A little nervously, I did so, and felt something like roots. I pulled it up, and it was an amphiurid ophiuroid. "What's that?", he said. "Looks like a brittlestar with long skinny arms", I said. "What do you know about brittlestars?", he asked. "They're echinoderms", I said, "and they don't have an anus." (Have you noticed, people who've studied inverts always seem to remember that about brittlestars?) "What else do you know about them?" "That's about it", I said. "Well, then, why don't you study them?" And so it was. I did a general study of the common brittlestars in Cedar Key for my thesis, and became increasingly interested in their life histories and reproduction in three of the common species. Since then, my students and I have investigated ecological and life history questions with a variety of organisms from sea turtles to zooplankton, but my most exciting and rewarding work has been with those burrowing brittlestars. I still don't understand whey such a fascinating and abundant group of organisms has received so little study, but it's a fortunate circumstance for me.

John Dearborn (Dept. of Zoology, University of Maine). Echinoderms crept up on me over the years - sometimes literally. My first serious encounters were as a teenager exploring the delights of theintertidal of Narragansett Bay in Rhode Island and during undergraduate field trips led by Emery F. Swan to the New Hampshire coast. Later, as a summer employee at the Marine Biological Laboratory at Woods Hole, I had the extreme good fortune to work with Milton "Sam" Gray, a man with an extraordinary knowledge of natural history and a pioneer collector of marine invertebrates for scientific research. I began to appreciate the esthetic diversity and functional anatomy of echinoderms. It was not until a few years later, however, as a doctoral student at Stanford University working under the direction of Donald P. Abbott and as an Antaractic field assistant for Donald E. "Curly" Wohlschlag that I realized that for me the echinoderms, especially crinoids, asteroids, and ophiuroids, were truly wondrous beasts which would keep me puzzled for a lifetime. On my first Antarctic trip in 1958 I passed through New Zealand and met Professor H. Barraclough "Barry" Fell of Victoria University in Wellington and several of his graduate students, especially David L. Pawson and Helen E.S. Clark. Contacts with these dynamic biologists and my own rummaging through tons of Antarctic benthos over the next few years convinced me of the wisdom of setting in for a career of picking over spiny critters.

Richard Strathmann (Friday Harbor Laboratories, University of Washington). I remember two steps in beginning to work on echinoderms. Echinoderms became especially interesting to me when they were omitted for the course in biology that I took in high school. They were present at the shore and in our textbook, and they made me doubt the course's organization, which followed a scale of nature from unicellular organisms at the bottom to highly cephalized organisms (especially us) at the top. Echinoderms seemed to me to break the rules more than other animals and that appealed to me. I first began to work on them after trying and rejecting a number of topics for dissertaiton research. I took Bob Fernald's course in comparative embryology because Megumi had enjoyed it so much. The echinoderm larvae were among the most beautiful forms that I had seen in nature. I asked Bob why they have the shapes they have, and he said that no one knew. I did not have a clear idea of how to explain their shapes but thought functional morphology would be the best approach to an explanation. I knew that I did not have a well defined problem, that few people were interested in that sort of question, and that I lacked special skills and equipment for studies of small ciliated animals, but I felt that even if I failed to get a Ph.D., staring at echinoderm larvae would be a rewearding and entertaining experience.

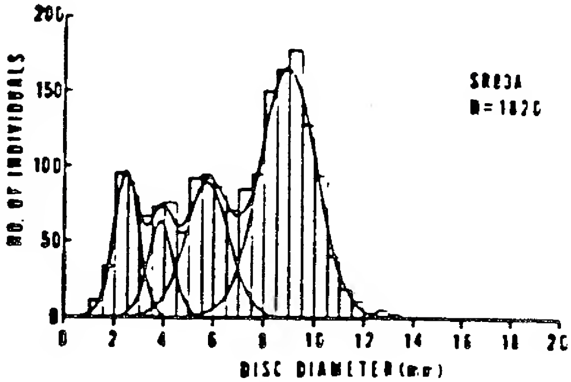


Fig 2 *Ophiura sarsii* Size-frequency distribution at depth about 250 m off Ōtsuchi on 10 March 1989 (Stn SR63A) Histogram denotes observed frequency. Curves represent 4 Gaussian component distributions and their summed frequency fitted by numerical analysis The population was dominated by large individuals

Fujita & Ohta. 1990.
Mar. Ecol. Prog. Ser.

Population densities and population sizes of six dominant species and their contributions in oxygen consumption and ammonium excretion to Loloata seagrass bed community

	Population density ($n \cdot m^{-2}$) ± SD	Population size (n)	Population biomass (kg AFDW)	Oxygen consumption ($l\ O_2 \cdot day^{-1}$)	Ammonium excretion ($g\ N \cdot day^{-1}$)
Tripneustes gratilla	0.098 ± 0.232	6430	43.2	418.2	27.6
Axius acanthus	0.281 ± 0.622	80600	25.3	820.1	57.4
Conomurex luchuanus	1.11 ± 2.14	72800	78.3	833.2	59.8
Malleus malleus	0.281 ± 0.622	18400	14.0	233.1	19.3
Holothuria atra	0.163 ± 0.236	10700	53.9	196.5	13.4
Holothuria scabra	0.0089 ± 0.057	584	16.1	26.8	2.02

Mukai et al. 1989.

Vladimir Kasyanov (Institute of Marine Biology, Vladivostok). Before I came to Vladivostock I worked in Leningrad University and was engaged in the study of biophysical characteristics of development in Amphibia. In those days, I saw living echinoderms just once: during my student practice in 1960 on the Barents Sea. The animals seemed to be strangers from another world. Upon my removal to Vladivostok, professor A.V. Zhirmunsky, Director of the Institute of Marine Biology, asked me to determine the period of reproduction of echinoderms in Peter the Great Bay (Sea of Japan). The animals were widely used in the Institute as research objects and many specialists of various fields were eager to know the reproduction stages of sea urchins and starfishes to obtain their embryos at the optimal time. Hence my interest in echinoderms was "stimulated from above". Soon I was also filled with deep sympathy for these strange creatures when, diving with a snorkel in the Bay, I saw congestions of spawning sea urchins and especially when I found "nurseries" of juvenile starfishes in a shallow, well-warmed inlet.

Yulin Liao (Institute of Oceanology, Qingdao). I was enrolled to study marine zoology in the Department of Biology at Amoy University, Fujian Province in 1951 and was graduated in 1955. After grduation I was assigned by the government to work at the Institute of Oceanology, Academia Sinica, and assigned by the director to assist an echinoderm specialist, Prof. Feng-Ying Chang. There seemed to me no more interesting thing to do than become an echinoderm biologist. At first I was guided by my teacher as to how to work on the taxonomy of echinoderms. As the work continued, I became very interested in these animals. During 1958-1960, a large-scale, comprehensive oceanographic survey was made along the whole coast of China by the People's Republic of China. I had been fortunate to participate in this survey and undertook the work of identification of the echinoderm specimens collected by the vessels. At that time I did all of the work on identification as my teacher was in poor health. At time passed, I found myself doing more and more taxonomic work involving the entire echinoderm phylum, and learned much about the echinoderm fauna of China.

TABLE 3. GENETIC VARIATION IN SEVEN POPULATIONS OF FOUR SPECIES OF THE FAMILY DIADEMATIDAE

	D. setosum			*D. savignyi*	*E. calamaris*		*E. diadema*
	SH	KU	OK	SH	OK	TA	TA
No. of alleles per locus	1.07	1.11	1.07	1.08	1.07	1.11	1.08
Proportion of polymorphic loci (%)	7.4	11.1	7.4	7.7	7.4	11.1	8.0
Expected average heterozygosity per locus (%)	3.1	4.3	3.1	3.5	2.7	5.6	3.5

SH = Shirahama, KU = Kushimoto, TA = Tanegashima, OK = Okinawa.

TABLE 4. GENETIC IDENTITIES (ABOVE DIAGONAL) AND GENETIC DISTANCES (BELOW DIAGONAL) BETWEEN SEVEN POPULATIONS OF FOUR SPECIES OF THE FAMILY DIADEMATIDAE

Species	1	2	3	4	5	6	7
1. *Diadema setosum* (SH)	—	0.996	0.999	0.776	0.642	0.627	0.598
2. *Diadema setosum* (KU)	0.004	—	0.993	0.798	0.657	0.642	0.594
3. *Diadema setosum* (OK)	0.001	0.007	—	0.773	0.634	0.624	0.595
4. *Diadema savignyi* (SH)	0.254	0.226	0.257	—	0.699	0.698	0.456
5. *Echinothrix calamaris* (OK)	0.443	0.420	0.456	0.358	—	0.985	0.665
6. *Echinothrix calamaris* (TA)	0.467	0.443	0.472	0.360	0.015	—	0.678
7. *Echinothrix diadema* (TA)	0.517	0.521	0.519	0.785	0.408	0.389	—

Genetic identities and genetic distances were calculated by the method of Nei [18]. SH = Shirahama, KU = Kushimoto, TA = Tanegashima, OK = Okinawa.

Matsuoka. 1989. Biochem. Syst. Ecol.

IN THE PAST

"One day when the whole family had gone to a circus to see some extraordinary performing apes, I remained along with my microscope, observing the life in the mobile cells of a transparent starfish larva, when a new thought suddenly flashed across my brain. It struck me that similar cells might serve in the defence of the organism against intruders. Feeling that there was in this something of surpassing interest, I felt so excited that I began striding up and down the roonm and even went down to the seashore in order to collect my thoughts.

I said to myself that, if my supposition was true, a splinter introduced into the body of a starfish larva, devoid of blood-vessels or of a nervous system, should soon be surrounded by mobile cells as is to be observed in a man who runs a splinter into his finger. This was no soon said than done.

There was a small garden to our dwelling, in which we had a few days previously organized a Christmas tree for the children on a little tangerine tree; I fetched from it a few rose thorns and introduced them at once under skin of some beautiful starfish as transparent as water.

I was too excited to sleep that night in the expectation of the result of my experiment, and very early the next morning I ascertained that it had fully succeeded."

From O. Metchnikoff. 1921. *Life of Elie Metchnikoff*. This observation in 1882 led Metchnikoff to develop the phagocyte theory.

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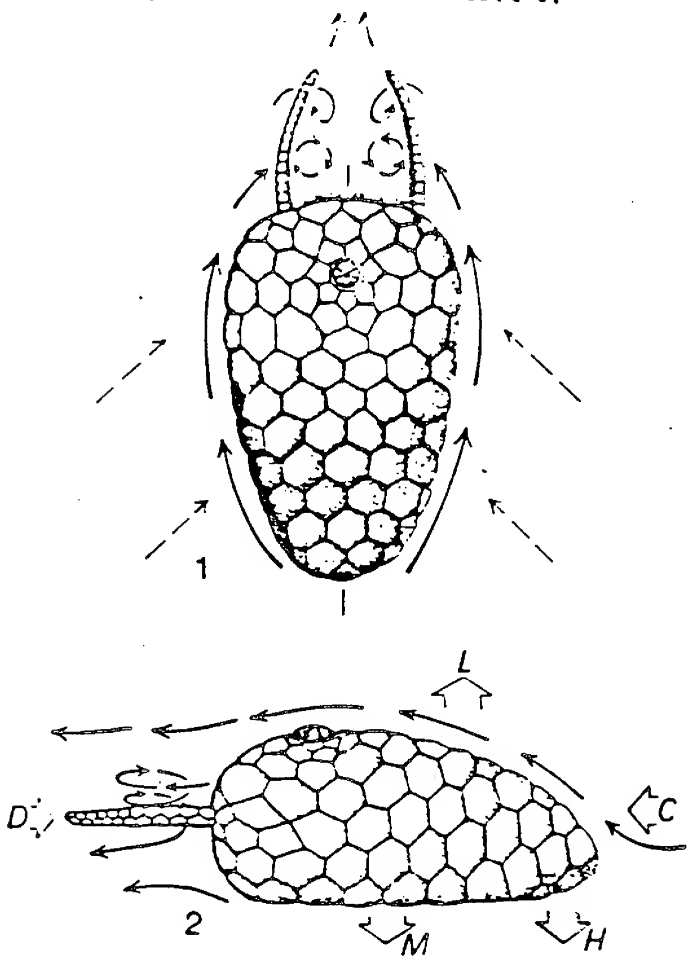

FIGURE 2—Dynamics and orientation of *Aristocystites bohemicus*. *1*, posterior face, solid arrows show currents sweeping around lateral faces of the theca and swirling into eddies and vortices on the lee (ambulacral) face, showering the brachioles with nutritive particles; dashed arrows at 45° to the sagittal axis indicate the maximum inclination of the theca to the prevailing current in order to maintain eddies adjacent to the ambulacral face. *2*, lateral face, solid arrows show currents passing over the posterior (upper) face, open arrows indicate forces acting on the recumbent theca resting on its anterior face. C, current, L, lift, D, drag, M, mass of the theca, H, anchoring holdfast at aboral end of the anterior face.

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PROCESSING BECHE-DE-MER IN THE ANDAMAN AND NICOBAR ISLANDS

From: D.B. James. Prospects and problems of Beche-de-mer industry in Andaman and Nicobar Islands. 1987. Proc. Symp. Management of coastal ecosystems and oceanic resources of the Adamans, pp 110-113

Processing the sea bucumbers for *beche-de mer* is very simple. There are three methods of processing depending on the species used. Suitable sea cucumbers are collected either by hand picking during the low tide or by diving in shallow waters. After collection they are kept in a heap (pl. I, A). Crowding them at one place will make them to throw out their internal organs. Those which fail to do so are cut at the cloaca on the dorsal side. On making a small slit of 30 mm length, the internal organs would flow out. The sea cucumbers are also squeezed to remove the internal organs. After the internal organs are removed, they are put in iron drums and boiled for one or two hours depending on the size of the sea cucumbers. While boiling, the material should be constantly stirred to make the product uniformly cylindrical. After a distinct cooked odour is emitted, they are removed and burried in a pit near the shore. After 12 hours they are removed from the pit and put in a basket to clean them. Some sand is put over them to facilitate good abrasion. This is trampled by one person while another pours water over the material to remove all chalky deposits sticki g to them. The quality of *beche-de-mer* is rated high if it is completely free from chalky deposits. If the processing is imperfect this is deposited as a white substance on the surface especially on the underside. After a thorough clearing, the material is once again put in clean sea water and boiled for a few minutes. The material is then removed and completely dried in sun for 3-4 days. The material could be smoke dried during rainy season, but the material does not command good price. The above method of processing is suitable for *H. scabra* which is by far the most important species in the Andamans. There are minor modifications in processing depending on the species of sea cucumber used. The processing thus does not call for any costly equipment. Fuel is not a problem due to good supply of coconut husk.

Looking much like a red sea urchin, the hairy exterior of the Rambutan hides a juicy, fleshy fruit that dribbles with sweetness. The name Rambutan has its origin in the Malay word 'rambut', which literally means 'hair'. Indigenous to Singapore, the Rambutan is a popular seasonal fruit widely grown and enjoyed in Southeast Asia

Menu. Singapore Airlines. September 1990.

"Perhaps there is no class of people more happy in the choice of names for natural objects than our quarrymen and pitmen. Every collector of fossils has heard of the ... "Files" (spines of *Cidaris*), ... "Screw-stones" (casts of Encrinite stems)..." H. Woodward. 1863. On the "Seraphim" and its allies. The Intellectual Observer. Vol. 4.

AGASSIZ AND VIGUIER

Agassiz, A. 1877. North American Starfishes. iii. "The plates which accompany this volume have now been drawn on stone for more than twelve years. It was the intention of the late Professor Agassiz to add to them the anatomy of several or more common species, but the duties connected with the care of the Museum prevented him from accomplishing this task. Although during the last twelve years several important papers have been published on the anatomy of Echinoderms which would necessitate a complete re-examination of the anatomy of starfishes, it has been thought best, since there was no probability of being able to finish within a reasonalble time the necessary anatomical investigations to complete this volume as originally planned, to publish the Plates as they were left by Professor Agassiz....As several European naturalists are at the present moment engaged upon the styudy of the Starfishes, it appeared judicious to issue these plates before they became antiquated."

C. Viguier. 1879. Anatomie comparee du squelette des Stellerides. Theses. Faculte des Sciences de Paris. p. 35. "...le present travail fut interrompu une annee entiere, de novembre 1876 a november 1877, et pendant ce temps M. Alexandre Agassiz fit paraitre un important memoire. L'auteur nous dit dans sa preface que les planches qu'il donne sont lithographiees depuis plus de douze ans, et que, le temps lui manquant pour finisr l'ouvrage suivant le plan initial, il se hate de les publier, de peur que les travaux des naturalistes europeens, qu'il sait maintenant a l'oeuvre sur ce sujet, ne leur fassent perdre de leur actualite."
C. Viguer. 1879. (Comparative anatomy of the skeleton of asteroids. Thesis, University of Paris. p. 35. "...the present work was interrupted for an entire year, from November 1876 to November 1877. During this time, Alexander Agassiz published an important memoir. The author stated in his preface that the plates he gave are lithographs produced over a period of more than twelve years, and that, as time for him to finish the work following the intial plan was lacking, he made haste to publish them from fear that the work of European naturalists, whom he knew now to work on the subject, would make them lose their present interest.")

A FABLE

Once upon a time, at least 500 million years ago, there lived a very grumpy and discontented creature on the bottom of the sea-bed. Other animals were beginning to evolve to do very interesting things and this only increased his dissatisfaction. One day Mother Nature came to hear of this discontented creature and sought him out to ask what was the matter. "I'm fed up with sitting on the sea-bed with all these heavy old plates being ignored, I want to be really different so that all the other animals will be impressed". "Humph", said Mother Nature, "I'm sure we could do something about that. How would you like to be a star?" "That's it!, said the creature. "I want to be a star." "Then I shall give you a special gift", said Mother Nature. "You shall have mutable connective tissue." "Is that a good thing?", asked the new starfish. "What's all this mutable stuff?" Mother Nature explained that muscles use energy and that locking and unlocking connective tissue was a great labour saving advantage and would be very valuable in the new highly competitive world. "Well, that's great!", said the starfish. "Give me mutability and I'll show these other phyla a thing or two." One moment", said Mother Nature, tidying her hair - she was like Margaret Thatcher in many ways - "You cannot have something for nothing. All rewards must be earned or penalties will be given as well. You will have to live the for the rest of the time with radial symmetry." "Is that bad?", asked the starfish apprehensively. "Well", said Mother Nature, "Bone Idle you may be but you shall also be brainless." And that is how the animal became a starfish.

James Cobb. Gatty Marine Laboratory, University of St. Andrews, Scotland. (Presented at the 2nd European Echinoderm Colloquium, Brussels, 1989) Cobb notes that the exact nature of the animal that became the starfish is uncertain, writing, "...this detail became smudged as the story was handed down over the years".

"INTERTIDAL GOLF TOURNAMENT. The Bamfield Volunteer Fire Department organises this prestigeous event in early August...Included in the course hazards are mud, *Pisaster*, gulls and incoming tides." from: How to survive at Bamfield Marine Station (a guide to visitors).

ECHINODERMS IN SONG

STARFISH AND COFFEE from Prince

"All of us were ordinary compared to Cynthia Rose.
She always stood at the back of the line.
A smile beneath her nose.
Her favorite number was 20 and every single day.
If U asked her what she had 4 breakfast.
This is what she'd say.

Starfish and coffee.
Maple syrup and jam.
Butterscotch clouds, a tangerine.
And a side order of ham."

contributed by Pieter den Besten (Utrecht) who asked, "Have you ever tried it? I hope not because I would expect some stomach problems."

Anecdote: "An interesting accident befell the cat of a friend and with whom I had left a few of the Sunstars (*Solaster papposa)* to look at. During the tea-hour, the feline member of the family managed to devour the half of one. In half an hour's time she could not walk straight, and groaned piteously...Next day, however, she was herself again, and I received emphatic orders never to bring Starfish there again." Patterson, A.H. 1904. Notes of an east coast naturalist.

ECHINODERMS IN POETRY

L'etoile de mer

L'etoile
quand on la rejette a la mer
disparait en dansant
c'est un petit rat d'Opera
Toujours une tete
duex jambes duex bras.
Prevert "Fatras".

communicated by Albert Lucas (Universite de Bretagne Occidentale)

ECHINODERMS IN LITERATURE

"The water was slimy with moonlight, the barge itself was slimy--all black and gold drippings--and Cowles, having flung his cigarette behind him and over the side, held the blade extended and moved down the slippery deck toward the boy and booted figure at the hatch with the slow embarsassed step of a man who at any moment expects to walk upon eel or starfish and trip, losing his footing, sprawl heavily on a deck as unknown to him as this.....He had tended to Sparrow in alleys, bathhouses with crabs and starfish dead on the floors, in doorways, in the Majesty, and the back of horsedrawn wagons on stormy hights." John Hawkes. 1961. The Lime Twig.

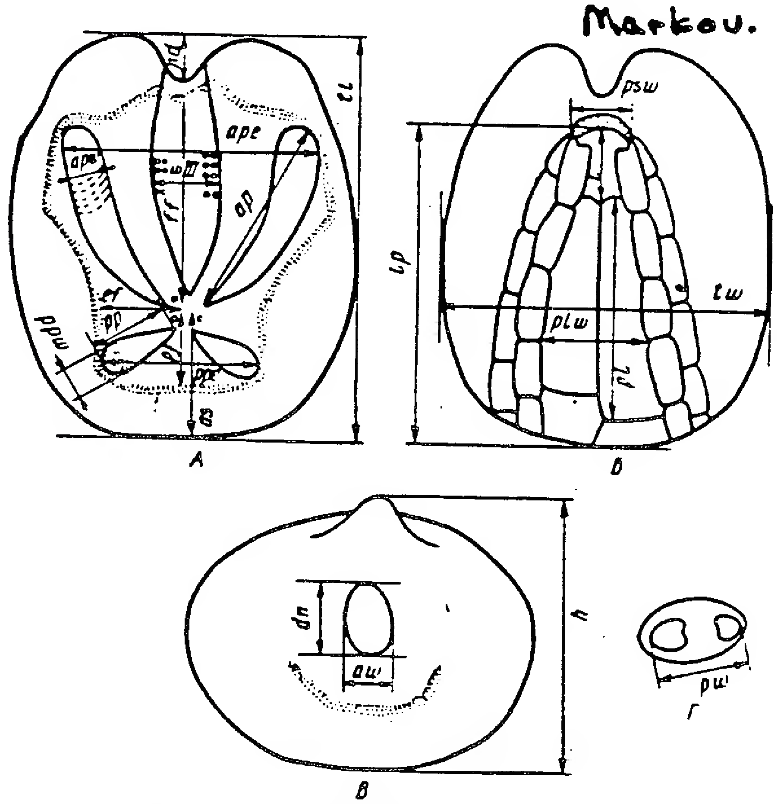
"Before everyone showed up, Maureen streched out on the grass to survey the backyard. She smiled with contentment: Maureen the mermaid. Her hair was in a braid, clipped with a barette in the shape of a blue starfish". A. Beattie. Love Always.

"But now, on this grim winter's night, while Walter lucubrated and Jessica turned her thoughts to Holothurians, Tom Crane was pulling on his pink suede lace-up boots (with the unfortunate smirches of motor oil he'd tried to remove by applying a solution of carbon tetrachloride and high-test gasoline) and slipping into the houndstooth bellbottoms that hugged his bony knees and made racing chocks of his feet." T. Coraghessan Boyle. World's End.

"'Looky that!' Iva Lee exclaimed, and they examined the odd assortment of specimens laid out on the shelves: piles of rare, especially colorful, and root beer bottle caps; an old chewing tobacco tin; cadmium-blue milk of magnesia bottles; a rattlesnake skin oiled with glycerin; two whelks and two sand dollars;...." P. Sharp. 1989. The woman who was not all there.

"She lay in the chair like a starfish and imagined the sound of his voice, the clink of the instruments and the squeak of chairs penetrating her body with thin rays of light, piercing through her bones and traveling gaily up and down her skeleton." M. Gaitskill. 1988. Bad Behavior.

Markov. 1989.



Условные обозначения морфометрических признаков морских ежей рода *Brisaster* (по Chesher, 1968, с изменениями): *А* – вид сверху, *Б* – вид снизу, *В* – вид сзади, *Г* – парная пóра третьего амбулакра

The origin of the term, ambulacra

Cuvier, G. 1798. Tableau elementaire de l'histoire naturelle des animaux. Baudouin. Paris. p. 647. "Les pieds sont tubuleux et termines en sucoirs, comme ceux des asterides; ils passent par des trous de la coquille disposes tres-regulierment, et qui y forment comme des allees de jardin, dont on leur a aussi donne le nom (ambulacra)." (The feet are tubes and end in suckers like those of asteroids. They pass by very regularly spaced holes from the shell, and look like the paths of a gardin, from which they have received the name (ambulacra). JML) (allee: alley, avenue, walk. JML)

Lamarck, J.B.P. 1840. Histoire naturelle des animaux sans vertebrae. Tome troisieme. Deuxieme edition. J.B. Bailliere Libraire, Paris. p. 265. "Ces series de petits trous forment sur le test de ces Radiaires, des bandelettes poreuse...On a donne le nom de Ambulacra, par comparison avec une allee de jardin, tantot a l'espace compris entre les due bandelettes d'une paire, et tantot a chacque bandelette elle-meme; variation dans la definition du terme employe-, qui muit a l'intelligence des descriptions.....p. 355. des bandelletes..constituent entre elles des compartimens allonges qu'on a nommes ambulacres, en les compararant a des allees de jardin." (These series of small holes form porous bands on the test of these Radiata. The name ambulacra, in comparison with a gardin path, has sometimes been given to the space between the bands of a pair and sometimes to each band itself....p. 355. the bands...produce elongated compartments between them that are called ambulacra in comparison with gardin paths. JML)

Koehler, R. 1921. Faune de France. 1. Echinodermes. Paul Lechevalier, Paris. p. 4. "Cet tubes (tubes ambulacraire)...en se contractant, les tubes tirent l'Echinoderme dans une certaine direction; is servent donc la locomotion, d'ou le nom de tubes ambulacraires" (These tubes (ambulacral tubes)...in contracting, the tubes pull the echinoderm in a certain direction. They thus serve for locomotion, from which the name, ambulacral tubes. JML)

The nature and role of starfish

"The starfishes, grossly considered, might be regarded as mere walking stomachs; and the office assigned to them in the economy of nature, that of devouring all sorts of garbage and offal which would otherwise accumulate on our shores." T.R. Jones. 1841. A general outline of the animal kingdom and manual of comparative anatomy. John Van Voorst, London.

COTS COMMS

Issue Number 6 July 1990

"Sea star or "Starfish"

(by John Lawrence, University of South Florida)

A generally accepted source for word usage is the Oxford English Dictionary (OED). The OED lists "star-fish, starfish", with only one definition: "Any echinoderm of the genus *Asterias* or of the class Asteroidea. The first usage recorded is "1538 ELVOT Dic., *Stella*, a sterre, also a sterrefyshe." More recently, this traditional usage appears in the title of the book by Mary Windsor (1976) that analyses the development of taxonomy in the 19th century, *Starfish, jellyfish, and the order of life.*

These usages correspond to the first definition given for "fish" in the OED: "In popular language, any animal living exclusively in the water". The definition goes on to state however, that it is "primarily denoting vertebrate animals ... In modern scientific language restricted to a class of vertebrate animals (with gills etc.)." This categorization of asteroids as "fish" must be similar to Linnaeus' (1758) placing all invertebrates including echinoderms but excluding insects into one class, Vermes (worms).

The first definition given in the OED for "sea-star" is a star which guides mariners at sea. The second definition for the term is a "starfish". This entry records the first usage in "1569 FENTON *Secret Wond. Nature*: A kind of fishe called *Stella*, or Sea starre, bycause it hath the figure of a painted starre." Similarly in "1594 NASHE *Unfort. Trav.*: The fishes called Sea-starres, that burne one another by excessive heat."

As far as I know, Latin and the romance languages always use the equivalent of "sea star". Thus the book by Iohannis Henrici Linckii, *De Stellis Marinis* published in 1733, and the familiar "etoile de mer". According to Libbie Hyman, in *The Invertebrates: Echinodermata* (1955), the Greeks called them *Aster*. She included a footnote to her first sentence in the section on general remarks on the class (p. 245): "The Asteroidea comprise the marine animals commonly known as starfish or sea stars ... It is suggested that zoologists [illegible]

Usage of "starfish" or "sea star" seems dependent upon an individual's history, and preference - a feeling about the "rightness of things". Whatever may be the degree of confusion to the public, no biologist seems likely to be confused by either usage (in contrast to the use of "urchin" without the prefix "sea-". A number of years ago I found a listing of "*oursin*" in the library of a French marine biological laboratory to deal with the terrestrial kind). However, Michel Jangoux and I decided at the outset that appellations used in *Echinoderm Studies* be derived from the appropriate taxonomic name, and thus "asteroid" is used and "starfish" and "sea-star" are not.

(*Asteroid may be technically correct, but it creates some new confusion - see following article from "The Australian" - Ed.*)

Scientists seek war on the asteroids

WASHINGTON - A leading group of space scientists, with the endorsement of US Vice President Dan Quayle, is calling for an international effort to hunt down and destroy - with nuclear weapons and modified "Star wars" gear - asteroids headed toward Earth.

"Earth orbit-crossing asteroids clearly present a danger to the earth and its inhabitants," the American Institute of Aeronautics and Astronautics said yesterday.

"Although no fatalities have yet been recorded as a consequence of such events, the impact of even a rather small object would have a devastating effect on humanity."

Mr Quayle, chairman of the National Space Council, supported their initiative.

"In 1965, a small asteroid exploded high over Canada with a force equivalent to an atomic bomb," he said.

The scientists said a 16 kilometre-wide asteroid would hit with a force 10,000 times that of the superpowers' combined nuclear arsenals, and could be expected once every [illegible] million to 100 million years.

Some scientists believe such a collision [illegible]

Sea stars

Clark, H.L. 1923. The echinoderm fauna of South Africa. Ann. South African Mus. 13. p. 235: "Sea-stars. Asteroidea).

Mortensen, T. 1927. Handbook of the Echinoderms of the British Isles. Oxfrod University Press.
p. 41: "It has been thought desirable to use the designation 'sea-stars' for this class of animals instead of the more popular but misleading 'star-fishes', 'sea-star' also is preferable as corresponding to the designation used in most other civilized languages -- 'Seestern', 'Etoile de mer', 'Sostjerne', etc."

Fell, H.B. 1962. Native sea-stars.
"There are two kinds of star-shaped animals generally known as sea-stars. Best known are the starfishes, or Asteroidea...The other kind of sea-stars comprise the long-armed forms known as brittlestars, or Ophiuroidea."

Fell, H.B., D.L. Pawson. 1966. General biology of echinoderms. in R.A. Boolootian (ed.). Physiology of Echinodermata. Interscience. p. 1-48:

Spencer, W.K., C.W. Wright. 1966. Asterozoans. In: R.C. Moore (ed.). Treatise on Invertebrate Paleontology. Part U. Echinodermata 3. The Geological Society. of Anerica, Inc., and the University of Kansas Press. p. U30. "....the major subdivision of sea stars..." (see entry below under starfish)

Lambert, P. 1981. The sea stars of British Columbia. British Columbia Provincial Museum, Vancouver.

Starfish

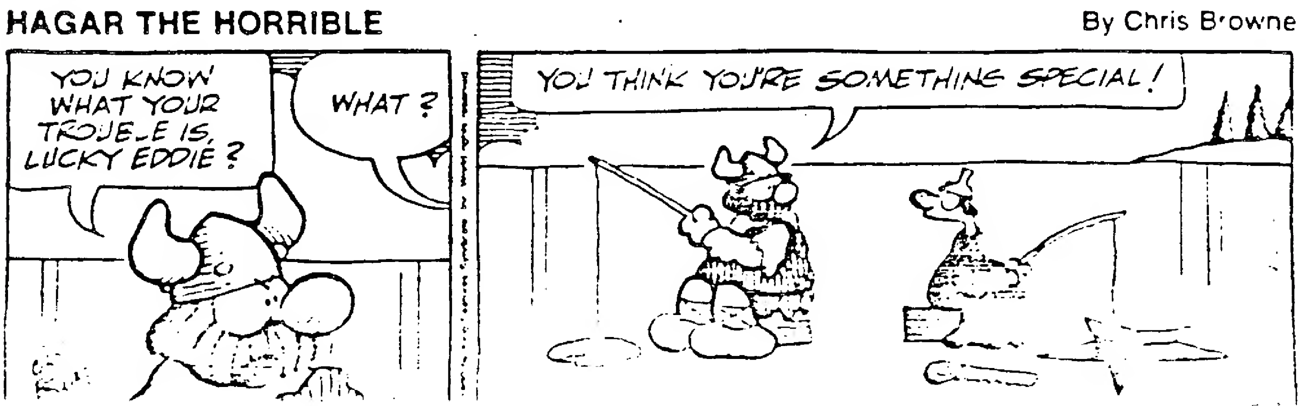
Todd, R.B. 1839. Cyclopaedia of anatomy and physiology. Longman, Brown, Green, Longmans, & Roberts, London. "Echinodermata...A class of invertebrate animals belonging to the division Radiata or the Cycloneurose sub-kingdom. The most familiar examples of them are the common sea-urchin and star-fish."

Forbes, E. 1841. A history of British starfishes, and other animals of the class Echinodermata. John Van Voorst, London.

Gray, J.E. 1876. Synopsis of the species of starfish in the British Museum. John Van Voorst, London.

Agassiz, A. 1877. North American Starfishes. Mem. Mus. Comp. Zool. 5(1).

Duncan, P.M., Sladen, W.P. 1881. A memoir on the Echinodermata of the Arctic Sea to the west of Greenland. John Van Voorst, London. p. 23. "A starfish..."



Romanes, G.J. 1885. Jelly-fish, star-fish and sea-urchins. Kegan Paul, Trench & Co., London.

Bell, F.J.1892. Catalogue of the British echinoderms in the British Museum (Natural History). Brit. Mus. (N.H.), London. p. 4. "The Starfish..."

Bather, F.A. 1900. The Echinoderma. in: E.R. Lankester (ed.) A treatise on zoology, part III. Adam & Charles Black, London. p. 237. "The class of the Stelleroidea includes the starfish, brittle stars, sand stars, basket-fish, and branching stars....."

Fisher, W.K. 1911. Asteroidea of the North Pacific and adjacent waters. Part 1. Phanerozonia and Spinulosa. U.S. Nat. Mus. Bull. 76. p. 1. "....the starfishes..."

Verrill, A.E. 1914. Monograph of the shallow-water starfishes of the north Pacific coast from the Arctilc Ocean to California. Harriman Alaska Series, Vol. 14. Smithsonian Institution, Washington, D.C.

Fell, H.B. 1962. Native sea-stars. "...starfishes, or Asteroidea." (see above under sea-stars)

Spencer, W.K., C.W. Wright. 1966. Asterozoans. In: Treatise on invertebrate paleontology. Part U. Echinodermata 3. The Geological Society of American, Inc., and the University of Kansas Press. p. 31U. "Many starfishes..." (see entry under sea stars above)

Nichols, D. 1967. Echinoderms. Hutchinson University Library, London. p. 15: "Who has not marvelled at the symetrical beauty of the starfish and brittlestar,..."

Cassell's New Compact French Dictionary. 1968. Dell Publishing Co. asterie, starfish.

Windsor, M.P. 1976. Starfish, jellyfish, and the order of life. Yale University Press, New Haven.

Harrap's Shorter French and English Dictionary. 1982. London, Paris, Stuttgart. "starfish - asterie, etoile de mer; etoile de mer - starfish".

Usage of "starfish" and "sea star" in titles of current publications

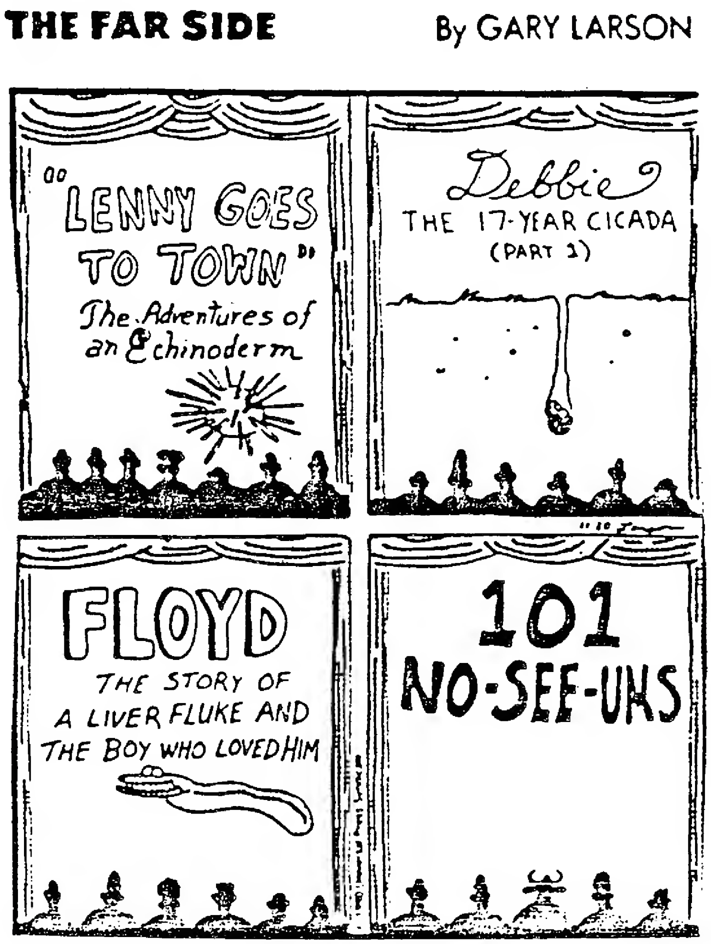
Citations in *Science Citation Index*, January-September 1990

	Asteroidea	starfish	sea star or seastar
number of citations	10	43	14
field			
molecular biology/ biochemistry		36 (78%)	10 (22%)
biology/natural history/ecology		9 (69%)	4 (31%)

COMMON NAMES FOR ECHINOIDS

Harvey, E.B. 1956. The American Arbacia and other sea urchins. Princton University Press.

English: sea urchin, urchin, sea hedgehogs, egg urchins, sea eggs, chalk eggs (fossils), egg fish, buttonfish, sea chestnuts, sea thistles, needle shells, porcupine stones, whore's eggs, zarts, porcupines, burrs, spikes, devil's hedgehog (Arbacia nigra).
French: oursin, Chataignes de mer.
German: Seeigel, Meerige.
Greek: achinos.
Italian: riccio di mare, riccio marina, zincini.
Spanish: erizo de mer.



Nature films that Disney test-marketed but never released.

British Columbia Provincial Museum
Special Publication No. 6

an engraving of a watercolour by John
CPM:PN 5075)

THE WEST COAST PEOPLE

The Nootka of Vancouver Island and Cape Flattery

E. Y. Arima

1983

Sea urchins, or "eggs", were collected in a number of ways. The green or brown ones, **nòschi**, could be picked by hand on a very low tide but more often were taken using a canoe and a long-handled, nettle-fibre dipnet, **ts'imiḥtama**, with a hoop of cedar withe about 18 inches wide and a straight, front edge. Giant red sea urchins, **t-ots'op**, were skewered from a canoe with the sea urchin spear, **t'otsḥtà**, a red cedar pole two or three fathoms long with two to four sharp prongs of yew lashed on. In winter when low tides were at night, the eggs of the red sea urchin could be speared by feel where they were abundant and the man knew the ocean bottom. Purple sea urchins, **ḥìx**, were extracted with the prying stick from their small holes in tide pools in the rock. Sea urchins were cracked open at the mouth, cleaned of weeds and guts, and the five gonads were scooped out and eaten.

Sea anemones, **k'intimts**, were gathered usually in spring with the prying stick. They were steamed and, if offered one, you had to eat it all or be a widower. Sea cucumbers, **tà?inwa**, could be picked by hand on flat beaches at low tide. On steeper shores, a long pole was used with a cross stick to drape the animals over. The head was usually bitten off and eaten raw. The body was scraped clean of its slime and eaten raw or boiled. Dungeness crab, **hasàmats**, was skewered with the sea urchin spear or a single-pointed spear. It was especially speared on the low spring tides. Often the crab hunter in his canoe wore a visor of red cedar bark to see better but still needed good eyes to spot his quarry 15 or 20 feet down. The starfish, **qasqìp**, was not eaten.

Province of British Columbia
Ministry of Provincial Secretary
and Government Services

Provincial Secretary

TEACHINGS OF THE TIDES

USES OF MARINE INVERTEBRATES BY THE MANHOUSAT PEOPLE

David W. Ellis
and
Luke Swan

THEYTUS BOOKS

1981

20) Any starfish or seastar, including common starfish or seastar, *Pisaster ochraceus* (Brandt) and sunflower starfish or seastar, *Pycnopodia helianthoides* (Brandt)

ḵasḵiip, 'crossed'

The common starfish was considered to be the "real" ḵasḵiip, although the other varieties were called by the same name. No starfish species were utilized in any way.

21) Sea cucumber, *Parastichopus californicus* (Stimpson)

taa7inwa

Sea cucumbers were often eaten by the Manhousat people. They were collected along the shoreline between Openit and Sharp Point, and at Hayden Passage or "Rocky Pass", Apswiẏalh, 'narrow passage', as well as at many other places.

Along beaches that were relatively flat at low tide, sea cucumbers were often picked up by hand. Along steeper shorelines, the sea cucumbers were often sub-tidal and beyond reach even on the lowest tides. At these places, sea cucumbers were brought to the surface with a special implement made by lashing a short stick at right angles to the end of a long pole. The animals were draped over the small stick and pulled to the surface. They had to be drawn up quickly, as they tended to swell and become wi7akshitl, 'rounded like a ball', or 'stubborn', and so firm that they would roll off the small stick. The Manhousat people have an expression for children that become particularly stubborn when they are scolded: "You are like Taa7inwam̓it (the name given to the sea cucumber in legends); you are wi7akshitl ('stubborn')".

The head of a freshly caught sea cucumber was usually bitten off and eaten raw. Then the viscera were squeezed out of the creature. If the body was to be eaten raw also, it first had to be scraped with a sharp stick. This removed much of the slime and caused the sea cucumber to stiffen. It could then be eaten raw. Many people cut the sea cucumber open and ate the strips of white meat inside, called hawaḵsti, 'filling food'.

Sea cucumbers were also prepared by boiling. Before this was done, however, they had to be scraped on the rocks and barnacles to stiffen them and to rid them of slime. First, they were skewered through their abdomen on a shaved cedar limb sharpened at the thick end. The two ends of this limb or withe were tied together with a reef knot, making a loop on which about a dozen sea cucumbers were skewered. These were dragged and scraped over the rocks and barnacles for about twenty minutes or until they stiffened and much of the slime had been removed. Then they were chopped from the withe which, with the tails of the sea cucumbers still skewered on it, was thrown away and boiled for about fifteen minutes. This caused them to shrink considerably, until they looked somewhat like sausages. Usually they were cut open and the inside strips of white meat were eaten first, followed by the skin. They could also be sliced and eaten like sausages.

"The old timers really liked it," said Mr. Swan. The "old timers" were said to like eating all the different kinds of low tide food because they were all kwisaap'alhshitl, 'food which because it is only occasionally eaten, tastes especially good.'

26) Green sea urchin, *Strongylocentrotus droebachiensis* (O.F. Müller)
"green or brown sea egg"

nuuschi

Green sea urchins were Mr. Swan's favourite kind of "sea egg". In the Hotsprings Cove area, they were usually collected at Saap7a (from sa7ak, 'crawling on one's hands and knees'), an intertidal passage and bay on the east side of Mate Island. Also, they were often collected in a small bay on the north-western side of Hayden Passage.

On a very low tide, green urchins could be gathered by hand. Often, however, they were collected from the shallow bottom by means of a long-handled dip-net, called ts'miiḫtama (see Chapter 2 for a description of this implement).

To extract the edible insides, green urchins were broken across their mouth, called 7imin, 'navel', with a few blows of a knife, stick or stone. After the loose intestines had been drained out, the five gonads were scooped out with the thumb and eaten. A certain number of those urchins that were broken open would have a "milky" substance around the gonads. These urchins were called tl'its'aḵtl, 'white inside'. Usually, however, a larger proportion of the urchins that were opened would have gonads that were a clear orange colour. Today, most people, including Mr. Swan, like these clear gonads best. However, Mr. Swan insisted that, in the past, most "old timers" liked the "milky" gonads best, as they believed that these enhanced their virility. The gonads of all sea urchins were always eaten raw. Mr. Swan would eat up to six green urchins at one time.

In the legend of "Raven and Green Sea Egg", Green Sea Egg was a small man with a tiny mouth and an even tinier appetite. Raven befriended him, and liked to take him along when he went from house to house begging for food from different "animal people". Raven never needed to worry about Green Sea Egg eating too much of the food that they were given, as the little man had such a small mouth.

27) Giant red sea urchin, *Strongylocentrotus franciscanus* (A. Agassiz)
"big red sea egg"

t'uts'up

Like all "sea eggs", giant red urchins were considered a great delicacy. They were most often procured with the help of a sea urchin spear, t'utsh̲taa (see Chapter 2 for a description of this implement). At half tide, giant red sea urchins could be taken with a long-handled spear. Generally, however, they were skewered at low tide from a canoe, when a spear of moderate length could be used. If it was windy, and the tidal current was strong, two people would go out in a canoe. One would turn the canoe into the wind or current, while the other person, usually working from the bow, would spear the "sea eggs". If it was calm and the current weak, a person could spear sea urchins alone.

It was important to twist the spear as soon as the three yew wood spikes were driven into the back of the urchin. This was to dislodge the animal from the rocks; if it was not done, the urchin would strengthen its hold and could not be easily freed. Once the urchin had been removed from the rocks, the three spikes held it firmly and there was little chance of it falling off the spear.

In winter, when there were no really low tides during daylight hours, experienced spearsmen would sometimes collect giant red sea urchins at night. The bottom was gently poked with the spear, and when an urchin was felt it was quickly stabbed. This was only attempted at a place where urchins were known to be particularly abundant, and where the spearsmen knew the lay of the sea bottom.

Giant red sea urchins were usually taken at certain specific locations. The urchins were said to be especially "full" at these places and to taste better than those collected at random along the coast. As well, they were said to be superior because their food supply—seaweed—was usually abundant. If one attempted to spear sea urchins at a place where the rocks were bare of weed, the sea urchins would always be found to have thin, poor tasting gonads.

Mr. Swan insisted that the urchins tasted better at these select locations because of the abundance of seaweed, and not because of the constant harvesting and consequent renewed growth, as was said to be the case with goose barnacles and California mussels. In other words, giant red sea urchins, although they were usually collected at select locations, were not a species believed to be in a state of "semi-cultivation".

Near Hotsprings Cove, giant red sea urchins were taken at three locations. The best spot was at Chaachaak, 'small islands', a group of rocks and reefs on the west side of Mate Island. Inside Hotsprings Cove, they were often speared around a small reef in front of Sumakawis. Kw'utsma7aktl'a, 'edible blue mussel bay', near Sharp Point, was another place that received enough protection from the ocean swells to enable people to spear the big urchins.

Up Sydney Inlet, they were speared at Adventure Point, Ts'itkaatmit (from ts'iitkaa, 'dripping or running water'), just outside the old 7alhma7a village site. People staying at Young Bay speared them at Ts'anaakw'a7a, 'rocky stream'. In Shelter Inlet, they were taken at Tl'itshuulh, 'white slime' (referring to cormorant excrement, because birds roosting there stained the rocks white with their excrement), and at Dixon Point, Ch'ituukwhapi, 'point on edge'. They were very numerous in Hayden Passage or "Rocky Pass", and were usually speared at the northwestern end of it.

Near Flores Island, big sea eggs were taken at 7u7umaktl'a7iik, 'calm bay', just south of Starling Point, and near a rock in the middle of a bay called Hats'uu, 'deep inside', just north of Ii7aak. Despite their abundance at Lhu7aa, they were never collected there, apparently because it was not a select location.

On the early morning low tides, especially in spring, spearsmen would often collect large quantities of giant red sea urchins. When approaching the village, they would shout "T'uts'a:p, t'uts'a:p!" ('Giant red sea urrrchins! giant red sea urrrchins!'), to call the people down to the beach to receive the sea eggs. Carrying a stick or some other implement to smash open the urchins, people would walk down to the beach to meet the canoe. They would help themselves to a few urchins and immediately break them open to eat the edible insides. Sometimes, women would take a few urchins home in a basket. In cool weather, these would keep for about two days.

Mr. Swan once observed a slightly different custom among the Kyuquot people, a West Coast tribe that lived far to the northwest. There, the spearman named the people with whom he wanted to share urchins. People not named, but who wanted some of his urchins, had to pay for them.

Giant red urchins were broken open across the mouth, 7imin, 'navel', and cracked in two. After the weeds and loose intestines had been drained out, the five edible gonads were individually scooped out and eaten. Mr. Swan preferred the clear gonads to the "milky" ones, although he insisted that in the past the "old timers" liked the "milky" gonads better. Even today, most people of the Kelsomat tribe, who live in the Tofino area, are said to prefer the "milky" gonads. The men believe that they enhance virility.

Generally, giant red sea urchins which were found in deeper water, below the intertidal zone, were said usually to have clear gonads. Those speared in shallower water, often within the intertidal zone, were said to have "milky" gonads.

Should five or six urchins be eaten at a sitting, especially during summer, "You get very sleepy. But the most I could eat was two or three," said Mr. Swan.

These gonads were sometimes used for bait for the kelp greenling. These fish were said to "smell" the urchin's gonads for some distance. Despite a rather fragile appearance, the gonads stayed on the hook quite well.

28) Purple sea urchin, *Strongylocentrotus purpuratus* (Stimpson)
"purple sea egg"

ḫiix

Purple sea urchins were especially common on the rough stretch of coast west of Hotsprings Cove. They could only be collected during relatively calm weather, due to the heavy surf in this area. They were almost always taken from tide pools, where they were usually deeply imbedded in small holes in the rock. A prying stick was used to extract them.

People who were living at Hisnit paddled to Hilhḫuu7a to collect purple sea urchins and several other varieties of low tide food. Near Hotsprings Cove, these urchins were collected at K̲aatsis (from k̲aatsw̓isa 'boiling' because bubbles rise from an underwater spring here) near the "blinker" (navigational aid) on the west side of the cove entrance. The Hesquiat people to the northwest collected large numbers of this species of sea urchin from the Estevan Point area.

Purple sea urchins were broken open in the same way as the giant red urchin. The clear gonads are apparently favoured today, although in the past the "old timers" were said to have preferred the "milky" gonads of this urchin; younger people were said to have preferred the clear gonads.

31) Sand dollar, *Dendraster exentricus* (Eschscholtz)

maa7its

Sand dollars were frequently observed along many sandy beaches, but were not used in any way. The word for pilot bread is mama7itskw'ukw, 'looks like a sand dollar'.

3) The three-pronged sea-urchin spear

t'utsh̲taa

This spear was of varying length, depending upon the depth at which the sea urchins were to be found. The shaft was usually between two and three "fathoms" in length. Red cedar was the preferred wood for this shaft, although thick, straight, relatively limbless young red cedars were hard to find. Lengths of red cedar that were split from a larger tree were not used, as they could easily break when shaved to the desired thickness. A whole young red cedar, after it had been limbed, de-barked and trimmed to a consistent thickness, was much stronger and had less tendency to break. In lieu of red cedar, a length of Douglas fir that had been split from a larger tree was sometimes used.

Three equidistant four inch grooves were made in one end of the shaft. Then, three sharpened pieces of tough, heart-wood yew, each about eight to ten inches long, were set into these

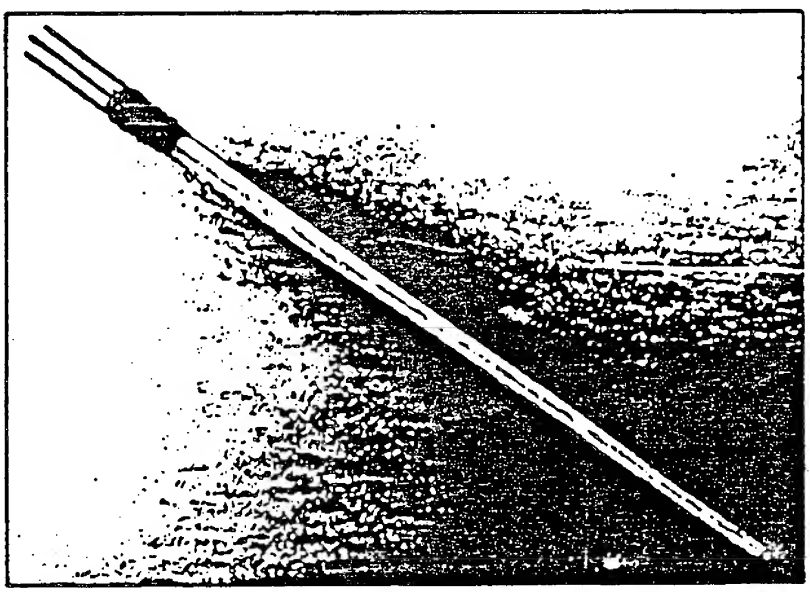


Fig. 23. The three-pronged sea-urchin spear

three grooves and lashed into place with split spruce root or wild cherry bark. These three pieces of yew wood were about as thick as a pencil and protruded about four inches past the end of the shaft.

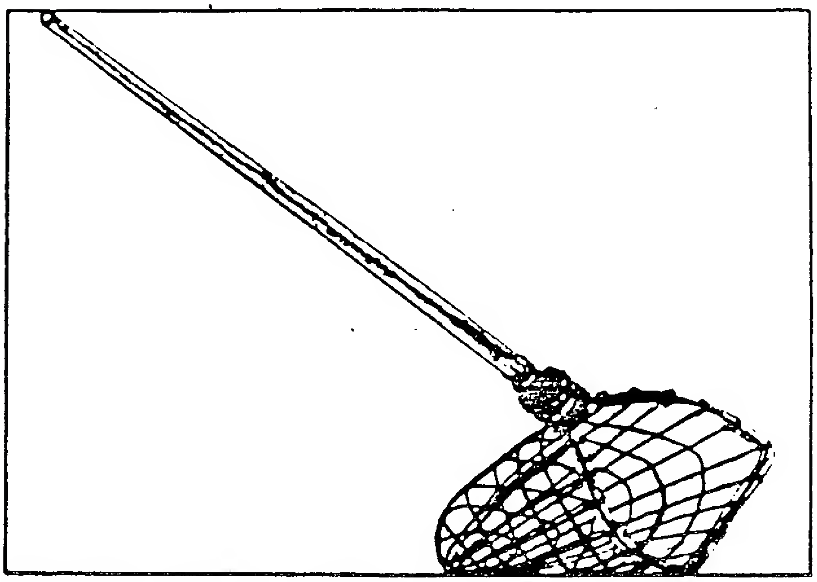
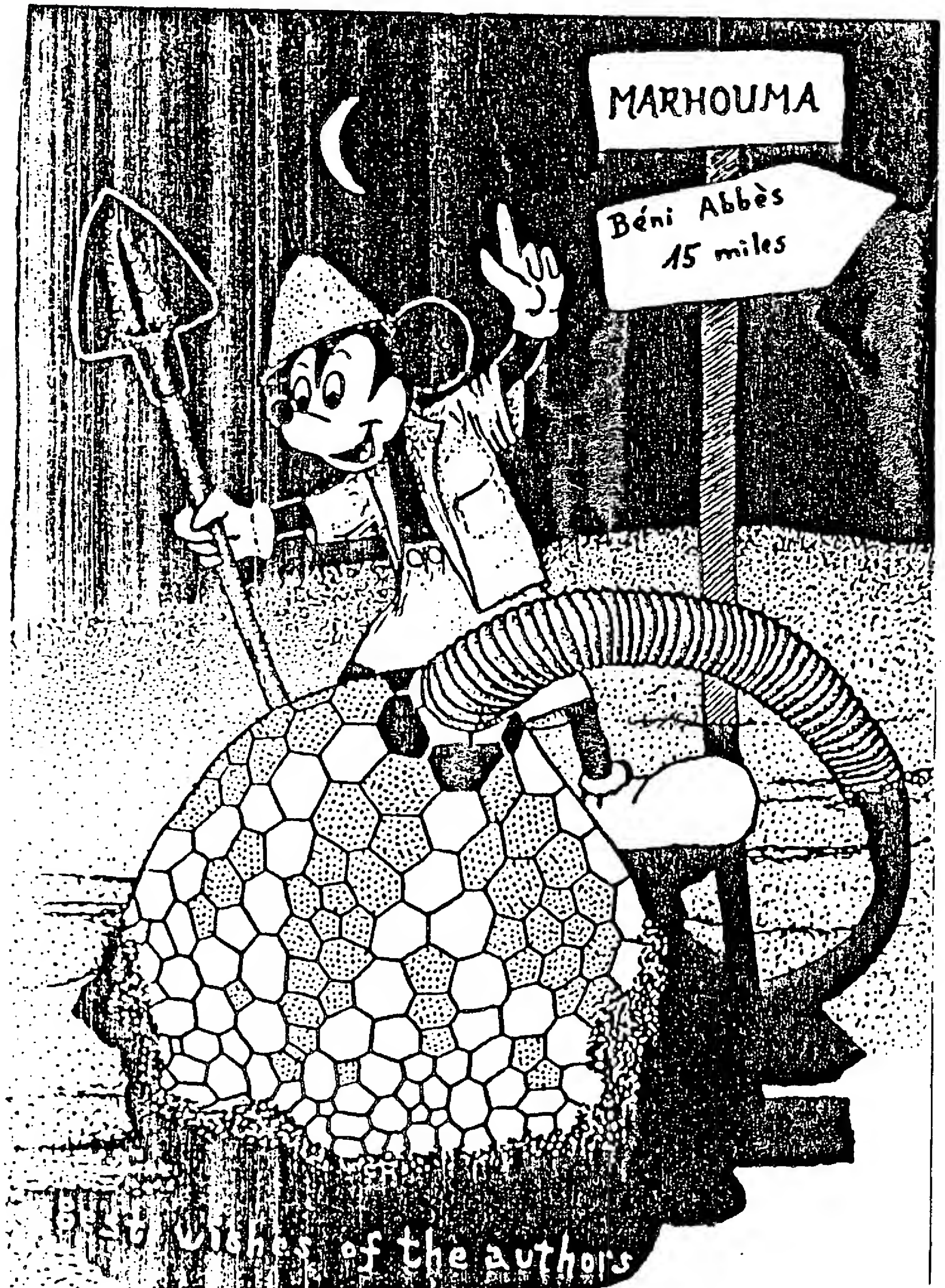


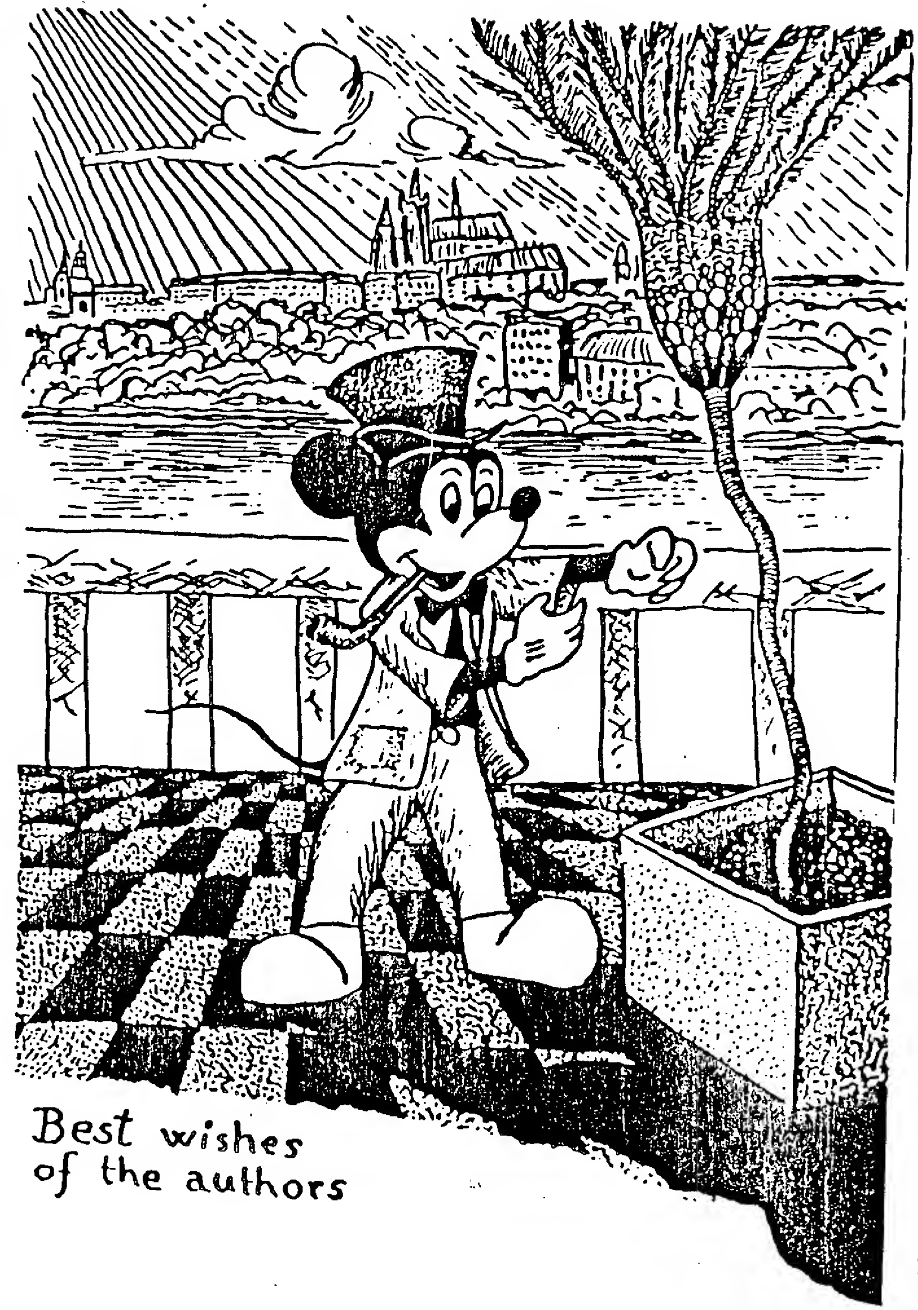
Fig. 24. The sea-urchin dip net

4) The sea urchin dip net

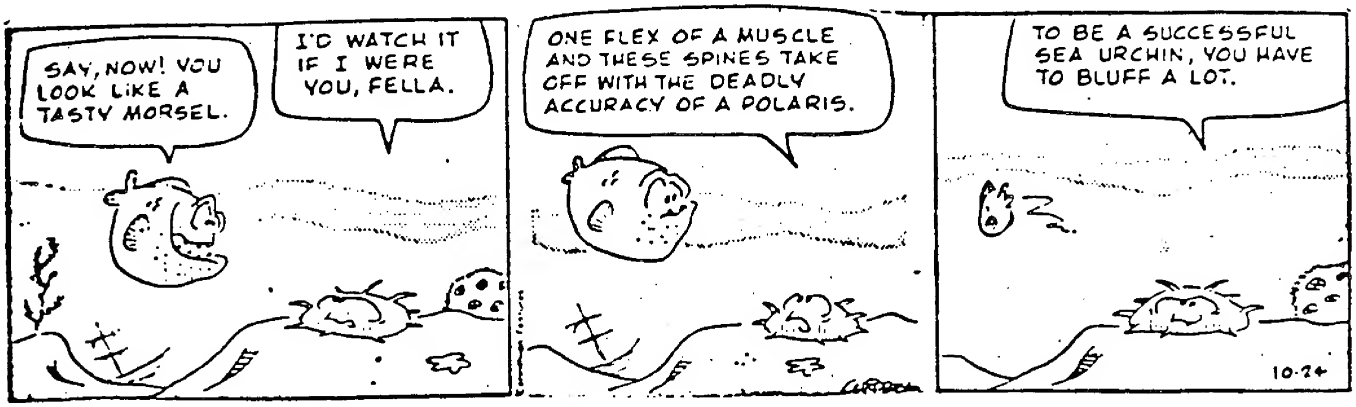
ts'miih̲tama (from ts'ima, 'any netting')

This dip net had a red cedar or Douglas fir handle between two or three "fathoms" long. The hoop of the net was made from a thick red cedar withe, and was about eighteen inches wide. This withe was bound tightly to the handle with wild cherry bark or split spruce root. The front edge of the hoop was straightened so more of the net rim would scrape the bottom, enabling a larger number of green sea urchins to roll in. The netting itself was made from stinging nettle fibre. It was said to be very durable, and to last for many years.

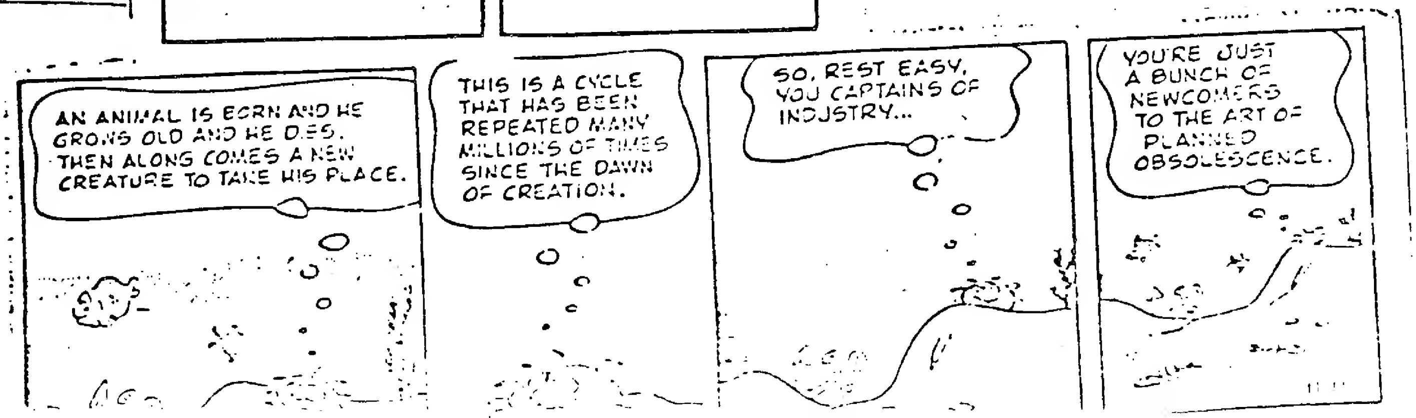


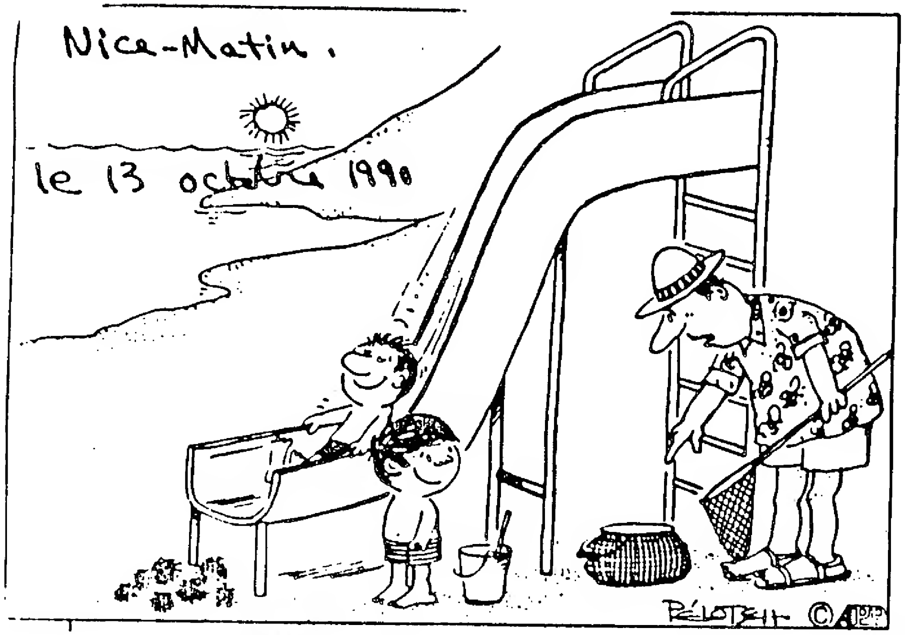


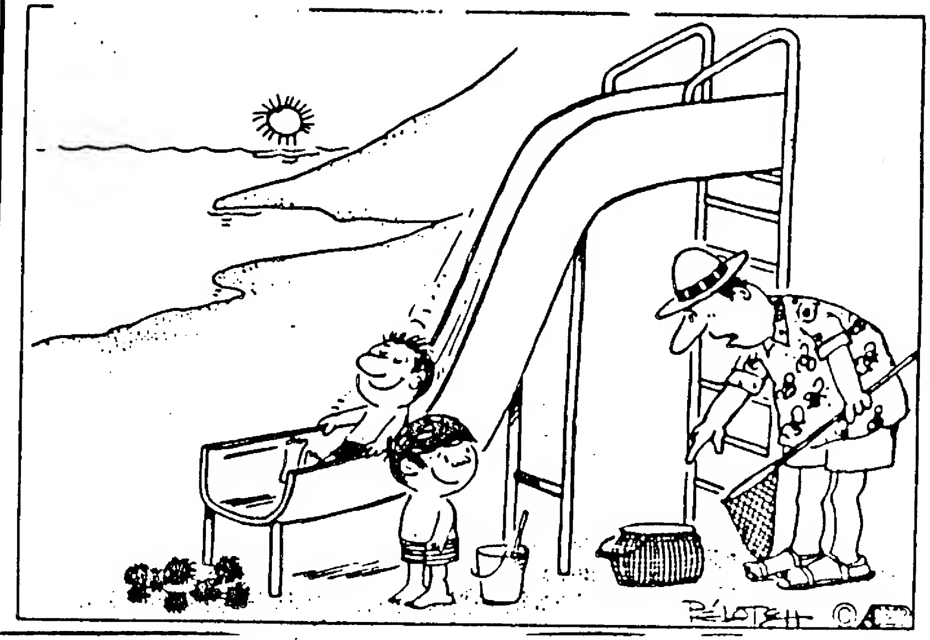
RUDOLF PROKOP 1988

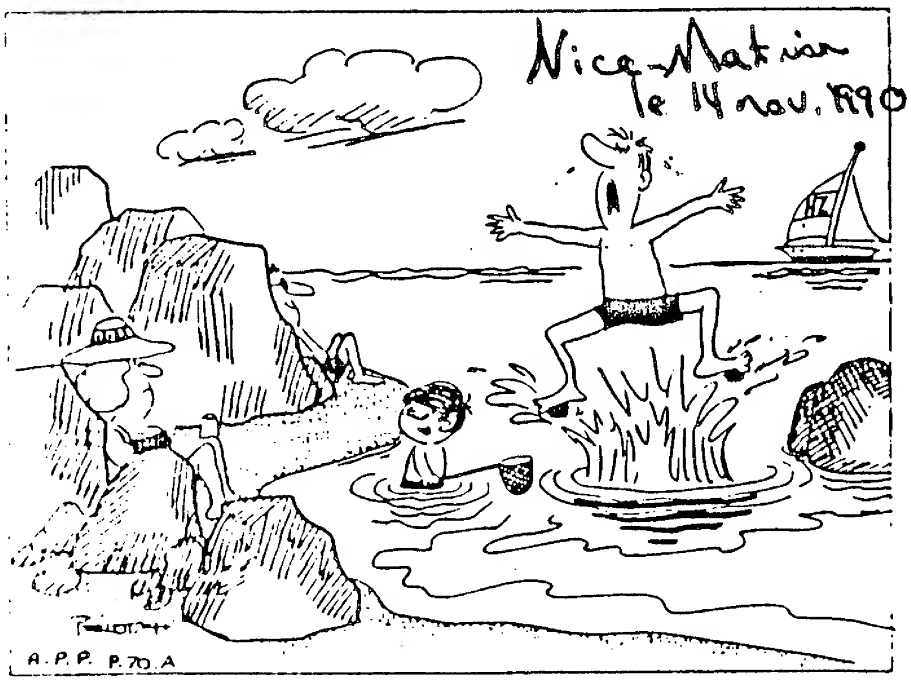


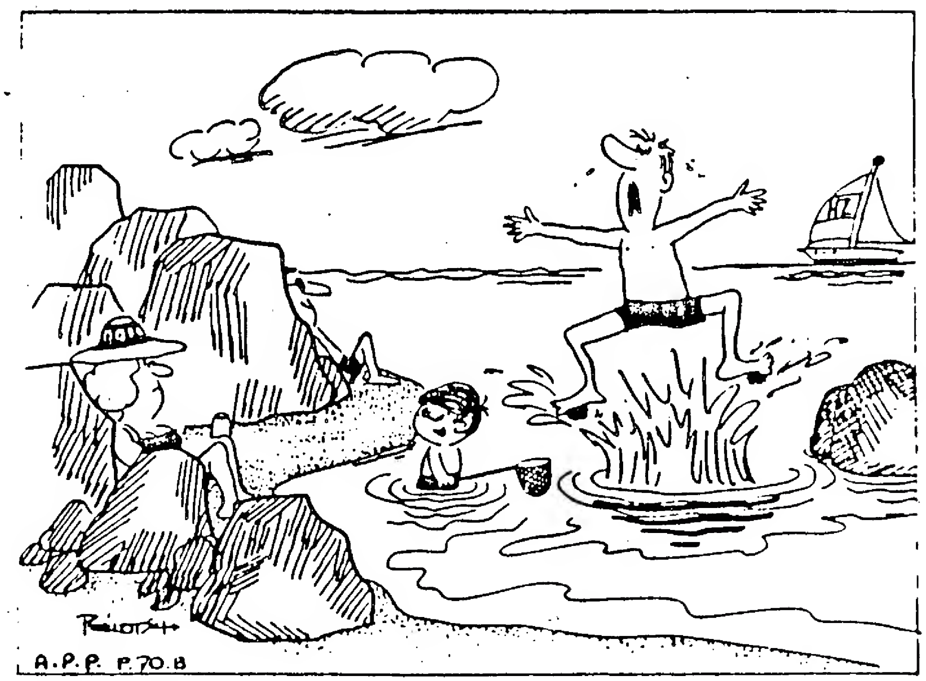
DOONESBURY by Garry Trudeau











- ÇA-Y-EST !! PAPA A TROUVÉ DES OURSINS !

LES SPORTS

Football Nice-Matin, le 27 novembre 1990

Monaco part de Gênes pour conquérir l'URSS

Torpedo : un oursin dans le caviar

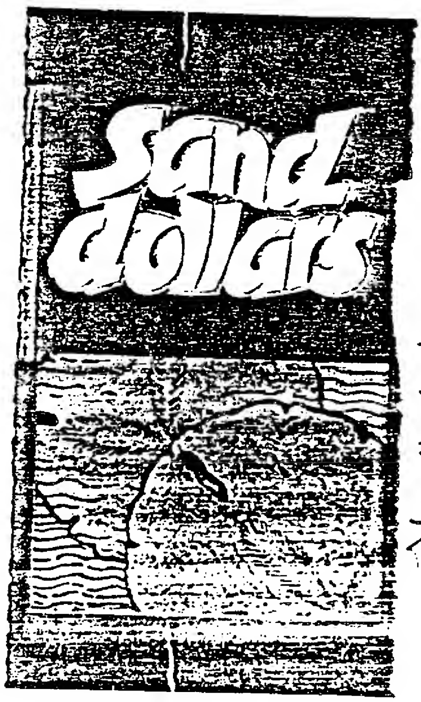
La "doc", comme ils disent, sur Torpedo de Moscou, les Monégasques la doivent à des cassettes — trois en l'occurence — et aux compte-rendus qu'en ont fait Henri Biancheri, Jean Petit et Jacques Van Kershaver à leur retour de Vlov où ils étaient allés superviser les Sovietiques contre Karpath en Coupe Nationale.

Les trois Monégasques avaient procédé de la sorte : Biancheri axait son analyse sur la défense, Petit sur l'attaque, Van Kershaver sur l'ensemble de l'équipe.

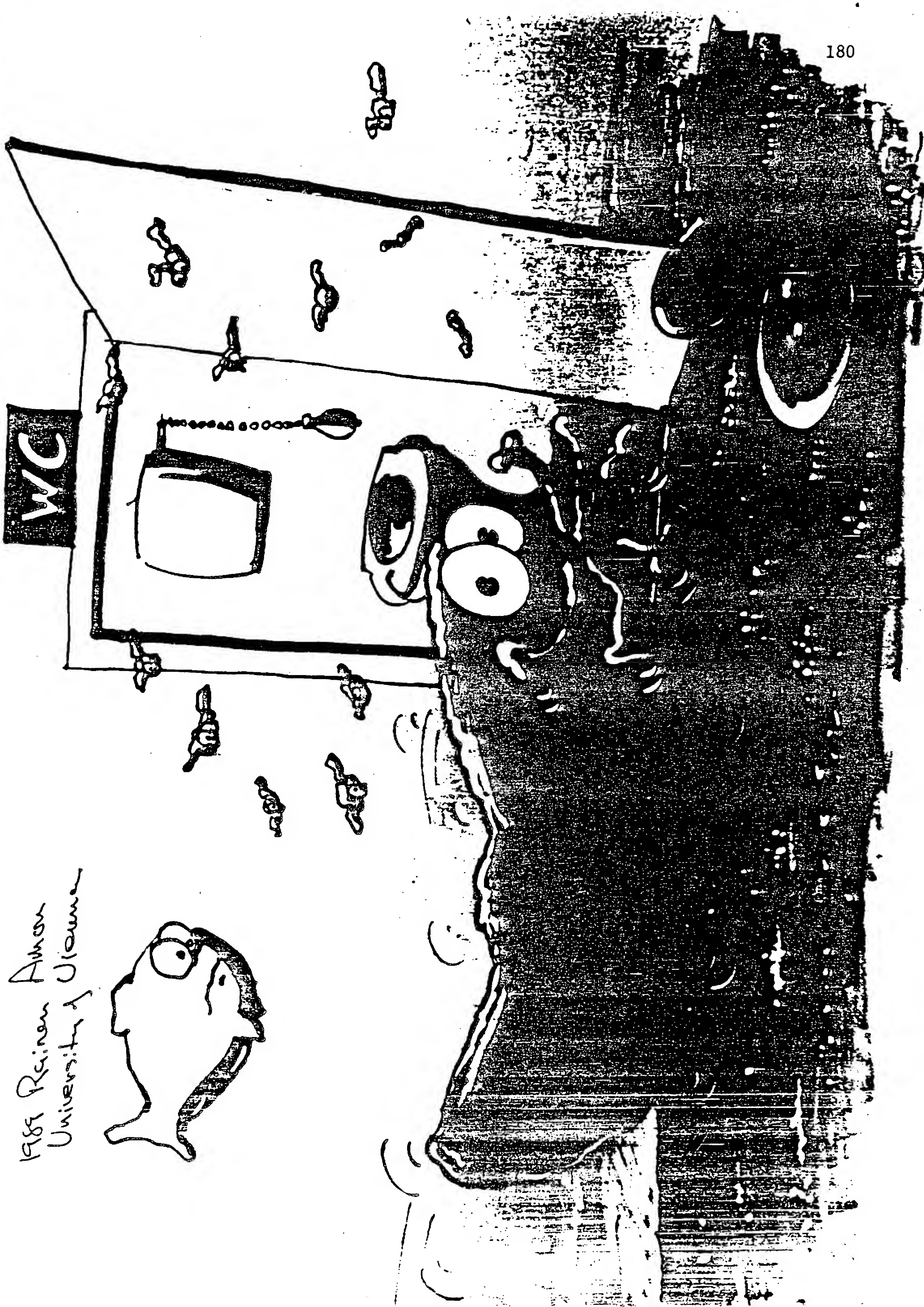
Les résultats ? Ils sont flatteurs pour les adversaires des joueurs de la Principauté. Torpedo c'est un oursin dans le caviar, dirait Bouvard :

« Il s'agit d'une formation complete dans toutes ses lignes » confirment les trois observateurs.

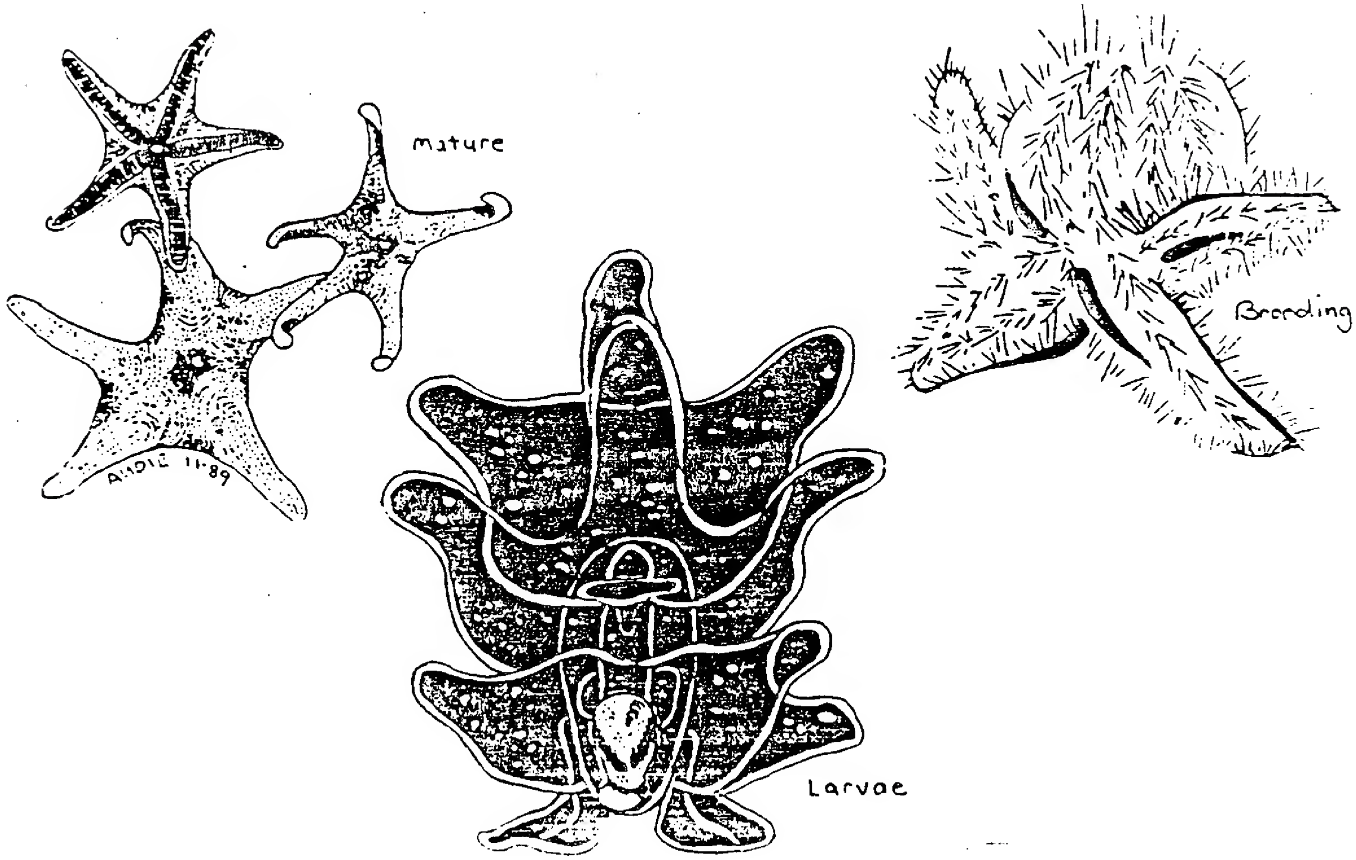
« Le terrain est occupé comme savent le faire les Soviétiques quand il est question d'occupation. Rien n'est laissé au hasard.



Florida Lottery


1989 Rainer Amon
University of Vienna
WC
89

STARFISH SEXLIFE
AT MCMURDO
PLUS A SPECIAL FEATURE !!!
MCMURDO - 1961 AND NOW !!



SUNDAY SCIENCE LECTURE
3 DECEMBER 1989 2000-21000

E-SIDE OF GALLEY
PRESENTED BY JOHN PEARSE S-016

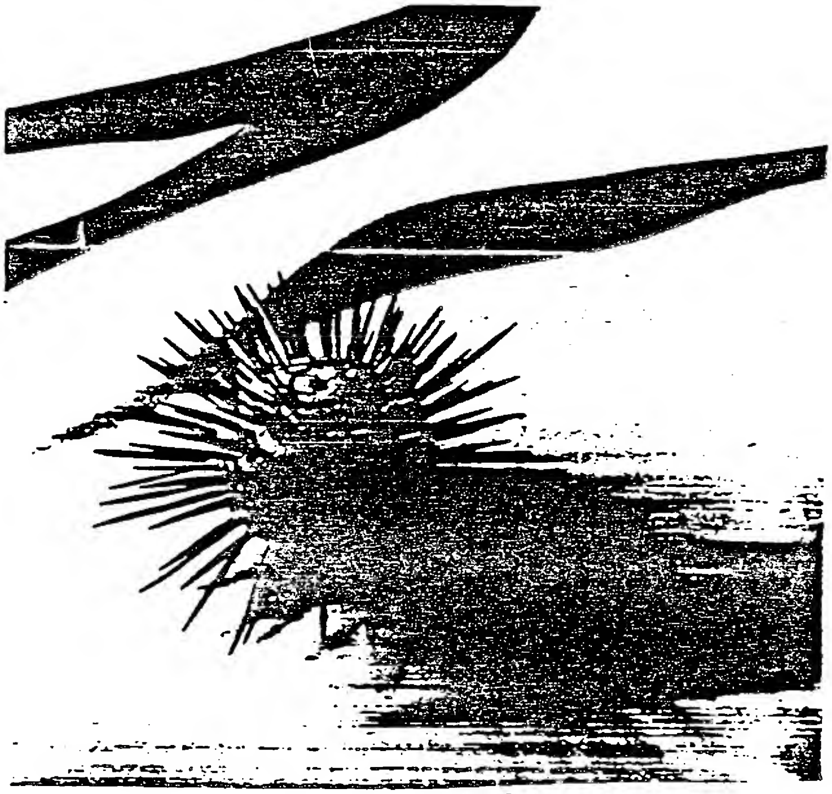
Sea Biscuits
Clypeaster rosaceus

Photograph by D. S. Baughman

SEASONS GREETINGS

The Belle W. Baruch Institute
for Marine Biology and Coastal Research
The University of South Carolina

IL Y A DE L'URGO DANS L'AIR



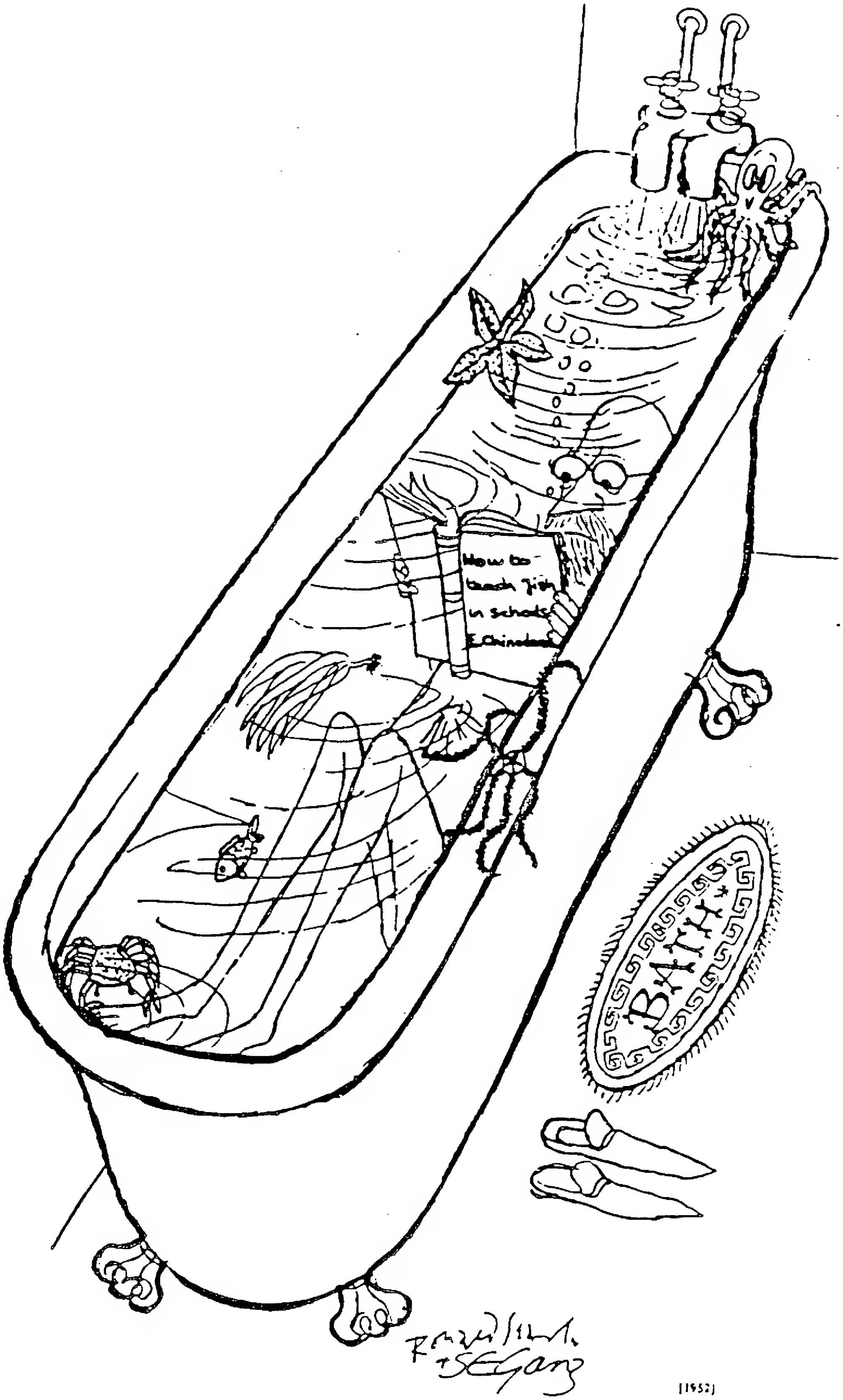
Advertisement about sticking plaster in a french newspaper 06/1989.

12 Friday, February 16, 1990 The Honolulu Advertiser

HAWAII HAIKU

suddenly, a breath
of starfish in the crystal
breezes of morning

— *Susan Marie La Vallee*
Kailua



[1952]

Roland Emson—
emersed in his studies.

琉球新報 1989年（平成元年）7月12日 水曜日 1版 教育 （16）

生物学の基本を歌で講義

記憶に効果的と好評

琉大の本川助教授 公開講座向け20曲作る

恋のオアシス・サンゴ礁 繁栄の大海の 中に広がる楽園は 多様ないのちの育つ場所―。生物学の基本を歌で学ぼうとユニークな講義をしている〝シンガーソングライター教官〟がいる。琉球大学理学部生物学科の本川達雄助教授（40）がその人。本川助教授はおよそ十年前から同大教養部での講義で、講義内容の要点をまとめた自らの作詞、作曲の歌でその日の講義を振り返っている。これまでに生物学関係だけでオリジナルソングは二十曲を数えた。本川助教授は、今月三十日から八月六日までの琉大公開講座で高校生以上の一般市民を対象に「歌う生物学」を開講する。

本川達雄琉大助教授

本川助教授は「同世代の四〇%が大学進学している中で、昔のような難しい理論ばっかりの講義をしていては学生に少しも理解されていないことが分かり、どうすれば分かりやすい講義になるかと考え、講義内容のエッセンスばかりを集めて歌にした」と歌を通して学ぶ講義をはじめるきっかけを話す。

最初に歌を作ったのは一九八〇年。その後専門のナマコやウニ、ヒトデなど棘皮（きょくひ）動物に関する歌やサンゴの生態や今のままでは絶滅してしまうと警鐘を鳴らす「サンゴのタンゴ」、ゾウとネズミでは体の大きなゾウが長生きするが、それでも一生に心臓を打つ回数は同じという生理学的時間を分かりやすく歌う「一生のうた」。

ゾウさんも ネコさんも心臓は ドッキン ドッキン ドッキンと 十億回打って止まる。
ウグイスも カラス トンビに ツル ダチョウ
スゥハァスゥハァスゥハァと 息を三億回吸って終わる
ヒトはみな なべてけものは一生に 一キログラムの体重あたり 八十万キロジュール消費する

このほか、サンゴの光合成を引き受ける褐虫藻、その褐虫藻のリンやチッソを供給するサンゴの関係、テッポウエビとハゼなど共生の関係を歌った「二人は仲間」など難しい生物学の基本を歌にしている。

歌での講義を始めてから「歌だと記憶するのも効果的」「教室はシアター」「授業がまだ終わらないでほしい」との声が学生から出て、好評だという。

本川助教授は、今月末から公開講座に向けて生物学に関する二十曲の歌のダビングテープと楽譜を制作中。公開講座の受講生全員にプレゼントする。小学校から大学まで合唱団に入団していた経験を持つ本川助教授は、公開講座で一般の人にも生物学が楽しく学んで[illegible]命だ。「歌う生物学」公開講座への問い合わせは[illegible]理学部、☎[illegible]

I am a Starfish, the Queen of the Sea

(Song of Starfish)

by Tatsuo MOTOKAWA


er? Oh, sure! I'm wil-ling I'm wil - ling to tell for you.
I have in my bo — dy wall mys-teri-ous won-der-ful tis — sue. The
catch con-nec — tive tis - sue that changes the stiff-ness fast. When
When
it is in the cat — ch state. My bo-dy is ca-stle no one can beat. When
it gets stiff. My bo — dy 'stands the for-ces of tu - be feet open-ing clam. When
it re-lax — es. My bo-dy fits in — to a-ny cre-vi-ces for hi-ding.
it's very soft. I cast off my arm and get a-way from fa-tal ha — zards.
It is a fool it is a fool that stands a-gai-nst fu - ry of O-ld Nep-tune.
that pro-ceeds on-ly with-out know-i-ng re-treat.
I am a star-fish, no-ble crea-ture am I. They call me the Queen, the
Queen of the vast sea floor. Have you un-der-stood why they res-pect me so
much? I know in your eyes the light of res-pect has born.

I am a Starfish, the Queen of the Sea
(Song of Starfish)

I am a starfish, noble creature am I.
They call me the Queen,
  the Queen of the vast sea floor.
Do you want to know
  why they respect me so much?
Oh, sure! I'm willing to tell you why.

To be respected, you must be powerful.
You know the forces I open mussel
Even fish run away
  from chemical weapon in my wall.

To be respected, you must be beautiful.
I am a star, perfect pentagon.
Who can doubt
  that I was up heaven born
Came down sea to rule

To be respected, you must be visible:
You must be large;
You must not run;
You must slowly walk in the open field
  to be admired.

To be respected, you must be awesome.
Corals, sea-urchins, mussels,
  and clams, barnacles,
Your defense is all in vain before me.

To be respected, you must be mysterious:
You must have something others have not,
Have something
  that others don't understand,
Keeps puzzling them all.

I am a starfish, noble creature am I.
They call me the Queen,
  the Queen of the vast sea floor.
Do you want to know
  the secret of my power?
Oh, sure! I'm willing to tell for you.

I have in my body wall
  mysterious wonderful tissue,
The catch connective tissue
  that changes the stiffness fast.
When it is in the catch state,
My body is castle no one can beat.
When it relaxes,
My body fits into any crevices
  for hiding.
It is a fool that stands against
  fury of Old Neptune.

I have in my body wall
  mysterious wonderful tissue,
The catch connective tissue
  that changes the stiffness fast.
When it gets stiff,
My body 'stands the forces
  of tube feet opening clam.
When it's very soft,
I cast off my arm and get away
  from fatal hazards.
It is a fool that proceeds only
  without knowing retreat.

I am a starfish, noble creature am I.
They call me the Queen,
  the Queen of the vast sea floor.
Have you understood
  why they respect me so much?
I know in your eyes
  the light of respect has born.

ULAMINA AND THE STOLEN CANOE

Lying off the northern coasts of Australia was an island, rich in fruit and game, which the Bandicoot-men could not visit because the only canoe in the country was owned by a selfish Star-fish man, Ulamina, who refused to lend it to anyone.

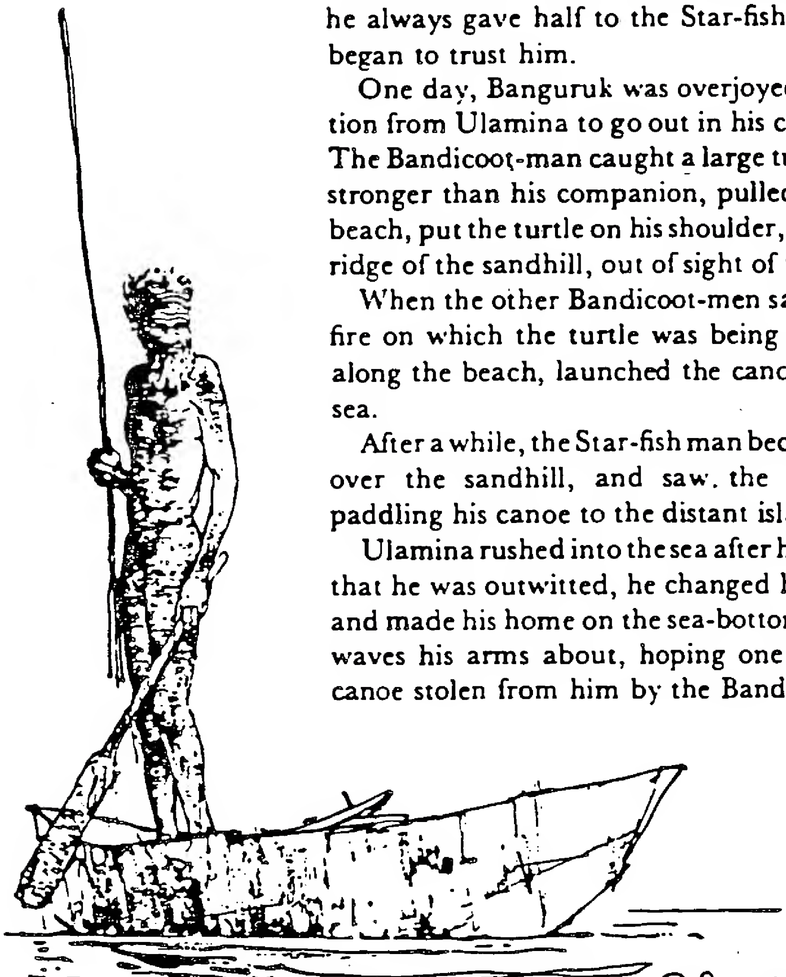
One Bandicoot-man, Banguruk, who was determined to steal the canoe, set out to make friends with the Star-fish man. If Ulamina needed help, Banguruk was always ready to assist, and should the Bandicoot-man spear a kangaroo, he always gave half to the Star-fish man, until the latter began to trust him.

One day, Banguruk was overjoyed to receive an invitation from Ulamina to go out in his canoe on a turtle-hunt. The Bandicoot-man caught a large turtle, and, being much stronger than his companion, pulled the canoe up on the beach, put the turtle on his shoulder, and carried it over the ridge of the sandhill, out of sight of the sea and the canoe.

When the other Bandicoot-men saw the smoke from the fire on which the turtle was being cooked, they sneaked along the beach, launched the canoe, and paddled out to sea.

After a while, the Star-fish man became suspicious, looked over the sandhill, and saw the other Bandicoot-men paddling his canoe to the distant island.

Ulamina rushed into the sea after his canoe, but, realizing that he was outwitted, he changed himself into a star-fish, and made his home on the sea-bottom. Even to this day, he waves his arms about, hoping one day to recapture the canoe stolen from him by the Bandicoot-men.



communicated by Malcolm Slick.

LARVAL FORMS

AND OTHER ZOOLOGICAL VERSES

BY THE LATE

WALTER GARSTANG

M.A., D.Sc. (Oxon)

Emeritus Professor of Zoology in the University of Leeds
and one time Fellow of Lincoln College, Oxford

WITH AN INTRODUCTION BY

ALISTER C. HARDY, M.A., D.Sc., F.R.S.

Linacre Professor of Zoology and Comparative Anatomy
and Fellow of Merton College, Oxford

Walter Garstang

BASIL BLACKWELL
OXFORD
1951

In *Echinoderm Larvae* he sketches the main differences in the larvae of the different classes of echinoderm and speculates upon a possible *larval origin* of that quinqueradiate symmetry of the group. The recapitulationists are again attacked in *The Pentacrinule* in which he has an imaginary conversation with this young stage of the crinoid feather-star *Antedon*, showing how many of its features are developmental adaptations peculiar to itself instead of being repetitions of ancestral traits.

THE PENTACRINULE

I FOUND a pretty Pentacrinule
Still without the arm and pinnule
  That adorn an *Antedon*:
Desiring much to see her face,
I said, "Coy creature, yield with grace,
  And this slight favour grant a don!"

She split, and to my ardent gaze
Displayed her mouth and radial ways
  With tentacles beside them:
But as I viewed her dainty fringes,
Five trap-doors on five broad hinges
  Promptly dropped to hide them.

Annoyed, I said: "You naughty minx,
They told me you preserved the links
  With early Crinoid nature.
Your oral plates you've undermined!
I'm sure they weren't as flaps designed.
  You've changed a primal feature!

"And other things I find amiss:
A calyx with no radials, this . . .!
  Oh, Recapitulation!
A finless tadpole, I confess,
Caricatures ancestry less
  Than your sad aberration.

"But I'll not blame you, *Pentacrinus*:
Haeckel's catchwords still entwine us,
  Parrot-like we talk!
And, though a vestibule has cleft you,
One old vestige still is left you
  Till you quit your stalk!"   1922 (or earlier).

ECHINODERM LARVAE

and the Origin of Quinqueradial Symmetry.

BIPINNARIA should a tale unfold when she gives up life afloat
And anchors by her bows, Crinoid kinship to denote:
She might by just a twist reveal how Starfish went astray,
But no! She merely buds one out, and fades herself away.

This is highly tantalising, but at least *Auricularia*
(Her sister who in course of time becomes a *Cucumaria*)
Is kinder and throws welcome light on some important things,
When breaking up her feeding band for locomotive rings.
Admittedly old families some episodes must hide,
But she displays possessions that feed a proper pride,
And in her circumoral band shows upper class connections,
Which her sister, just for anchorge, dismembers into sections.
Their two twin sisters all conventions openly defy,
And drift about their business as simple *Plutei*:
Contentedly upon their backs, oblivious of scoffs,
They stretch their circumoral pits into spacious feeding troughs.

But, in spite of all their differences in form and modes of swimming,
A constant pattern underlies their circumoral trimming:
The pit itself expands each side like a transverse figure 8—
Two tiny pools connected by a narrow oral strait.
And each is fringed by brachioles approximately 5—
A number too suggestive for mere chances to contrive—
Their feeding streams converge upon the circumoral floor,
And all together constitute a bilobed lophophore.

Since the larval lophophore of *Actinotrocha* is supplied
With a pair of "collar" coelomes, these can scarcely be denied
To former Echinozoic fry, which hydraulic pressure needed
To support their lateral armlets ere a skeleton succeeded.

At the ensuing metamorphosis all larval frills are lost,
The eventual adult body's built at the larval body's cost:
Quaintly reminiscent of the birth of Adam's bride,
The Starfish as a bud grows out from its larva's own left side.
To this strange rule a fortunate exception still survives:
Auricularia a transitional pupal state contrives,
In which the mouth and pharynx undergo a double twist,
First sideways to the left, then to the apex of the cyst.
The twist involves no torsion of the actual body wall,
But a simple shifting of the mouth alone and once for all.
If we reconstruct the lophophore, the fact is then revealed:
The mouth has turned aside within the circumoral field.

The right half, losing value, degenerates with the torsion:
Its hydrocoele accordingly undergoes complete abortion.
And, whereas in the larva the bilobed lophophore was
ventral,
The left lobe, now around the mouth, becomes terminal and
central.
'Tis known from countless fossils that the quinqueradial
change
Was first achieved within the circumoral feeding range:
But how or why has not been clear, so it seemed worth
while to try
If the explanation might be found in the structure of the
fry.

Soyer, A. 1853. The Pantropheon, or a history of food and its preparation in ancient times.

SEA-HEDGEHOG.

Under this denomination were classed all animals, more or less orbicular, whose envelope bristles with calcareous points, on which account they were compared to hedgehogs.

The Greeks thought them delicious when caught at the full moon,[243] and prepared with vinegar, sweet cooked wine, parsley, and mint.[244] Oxymel often replaced vinegar.[245]

The Romans also esteemed highly this dish, which was recommended to sluggish appetites under the auspices of the faculty;[246] and Apicius furnished the following recipe for the preparation of it:—

"Procure a new saucepan," thus says the great master, "place in it a little oil, garum, sweet wine, and pepper. When the mixture begins to boil, stuff the sea hedgehogs, then submit them to the action of a slow fire; add a large quantity of pepper, and serve."[247]

243, 244, 245. Athen., i, 6. 246. Trallian, De Epilepsia. 247. Apicius, ix, 8.

Goode, J., + C. Wilson. 1979. The original Australian and New Zealand Fish Cookbook. (rev ed.) A.H. + A.W. Reed Pty. Ltd. Sydney.

Sea urchins *(or sea eggs)*

Kina (NZ)

Sea urchins have been considered a great delicacy in many places since the times of ancient Athens, and are well worth investigation by an adventurous gourmet. Our introduction in Australia came via an expatriate Maori. Since then, we have known no Maori who, when offered a feed of *kina*, has not gorged him or herself to excess.

However sea urchins must be handled with extreme care. If the needle-sharp and barbed spines become embedded in your skin, they take a long time to extract and can be very painful.

As the edible portion is the sea urchin's gonads, they are best caught in the spring. This is the time when they are filled with caviar-like golden roe which so much resembles the yolk of an egg. Similarly, the yellow roe of the Australian cunjevoi or sea squirt, obtained by cutting the animal in half, may also be eaten raw.

Preparation.

Knock off spines with a knife then cut off the concave end of the shell and allow any liquid and dark matter to drain away. Wash in seawater, drain thoroughly to remove any excrement and extract the five yellow or orange segments. Wade Doak remarked that sea eggs are the best feed for divers while underwater and 'staging'. There, he says, it is possible to eat them by using a sucking kiss which we have yet to see demonstrated *in situ*.

Otherwise, Wade suggests you get a sugar bag full, tip the cleaned segments into a bowl and using one cleaned shell, fill this with gonads and place it in the ashes of a fire. During this gentle cooking, they separate into what Wade describes as 'ambrosial scrambled egg'.

Raw sea urchin

Squeeze a little lemon juice on to the washed roe and eat raw. If this is asking too much, then try:

Boiled sea urchin

Lightly boil the prepared sea urchin in saltwater. Eat by dipping narrow slices of toasted or fried bread into the yellow roe.

Hot sea urchin sauce

Gonads of 12 sea urchins, mashed with a small amount of olive oil. Mix with ½ cup of Hollandaise Sauce (see Whiting page 38) and pour over hot fish.

Cold sea urchin sauce

An excellent sauce for serving with cold fish can be made by rubbing the sea urchin's eggs through a sieve, mixing the purée with mayonnaise and sprinkling with paprika.

Kina

Kina, or sea urchins, have always been enjoyed with gusto by the Maori and for some unfathomable reason scarcely tasted by the European New Zealander. Certainly attacking kina for the first time can be a little daunting. I put them in the kitchen sink and attempt to open each one with a swift blow from an old carving knife. It works well enough most of the time. The sloshy purple liquid can be tipped out and then you are left with the little orange roes (or preferably big orange roes) which are what you want. The size and condition of the roes can vary considerably and there's no way of telling what your kina will yield till it is opened. Gather the roes together and serve with lemon wedges, black pepper, tabasco, brown bread and butter, or hot buttered toast, if you don't want to eat them unadorned straight from the spiny shell.

To cook the roes poach lightly in milk with salt and pepper. Or better, combine with garlic and fresh chillis to make the following sauce. Eat with hot French bread or hot buttered toast.

Kina and chilli sauce

3 to 4 tbsp kina roes
1 tbsp butter
1 tsp fresh chilli pepper, finely chopped
2 tsp onion, finely chopped
1 clove garlic, finely chopped
1 tsp lemon balm, finely chopped
½ tsp vinegar

(These proportions can be expanded according to the amount of roe. The above quantities make little more than a snack for one — but it is very rich.)

Melt the butter and when foaming add the onion, chilli, garlic and lemon balm (or other fresh herb) and cook on a very low heat for 1 or 2 minutes. Add the roes to cook for another 1 or 2 minutes, stirring until they are puréed. Add the vinegar and serve.

The sauce can also be used on white fish but I think it's at its best as a lunchtime snack on bread, with an ice-cold drink.

20 Miles, S. 1980. A taste of the sea. The Cookery of New Zealand Seafood. Heinemann, Auckland.

Maori food and Cookery. in Burton. 1982

Shellfish

The rich marine life of the New Zealand shoreline provided the Maori with a vast array of shellfish: mussels, paua, pipi, toheroa, tuatua, tuangi, oysters, scallops, kina (sea eggs) and even pupu (catseyes).

Shellfish were either steamed, cooked in embers or placed inside a ring of fire until the shells opened. Those that were not immediately used were threaded onto strips of flax and hung out to dry for two days. They were then pounded flat and hung up again to dry completely.

Kina, according to Maori lore, are best gathered at low tide on the first, second and third days after full moon. Still a popular food, they can be prepared by making a large hole in the top of the shell, removing the purple membrane and grit and filling up with more pulp. They are then roasted and served hot.

Kina poha (kina roes)

Collect a sugarbag full of kina and scoop out the red roes of each, taking care not to include membrane or grit. This should fill a 1200 ml jar which will keep for 3–5 days under refrigeration. The roe is usually eaten raw, often on slices of bread and butter or as a relish with meat and potatoes.

Kina kotero (cured kina)

Place a bag of kina at the end of a rope in a fast-flowing stream or in a large container of fresh water. Leave for 2–3 days.

Remove the entire inside of the kina and eat raw as a relish for kumara or on slices of bread and butter. This is an acquired taste.

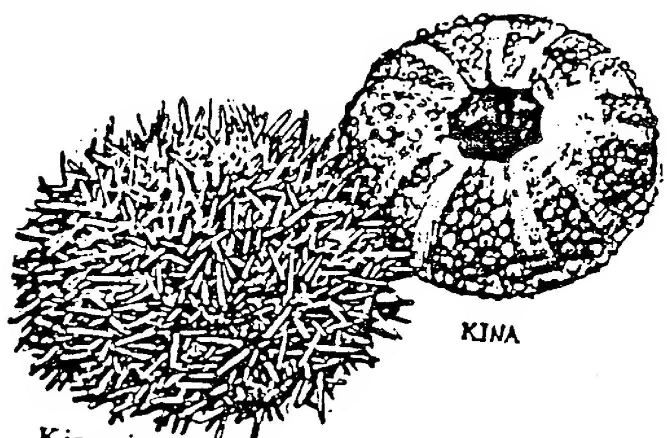
Chilli kina

Serve this on toast for lunch. The quantities are small but the dish is very rich and filling.

¾ C kina roes
1½ Tbs butter
2 tsp finely chopped fresh chilli pepper
1 Dsp grated onion
1 clove garlic, crushed
1½ tsp finely chopped fresh sweet basil
1 tsp lemon juice

Melt butter, add chilli, onion, garlic and basil and fry gently for 2 minutes. Add kina roes and stir for another 2 minutes, mashing the roes with a fork until blended with other ingredients. Add lemon juice and serve hot.

Serves 2.



Kina pie

This was a common dish during the early days of European settlement in New Zealand.

2 C kina roes
1 C breadcrumbs
2 rashers rindless bacon, chopped
1 Tbs butter

Place alternate layers of kina and breadcrumbs in a greased ovenproof dish. Finish with a layer of breadcrumbs, cover with bacon and dot with butter.

Bake at 180°C (350°F) for 30 minutes.

Serves 4.

Kina or sea eggs

Kina are a species of greenish-purple sea urchin, 10–15 cm across and covered with prickly spines. Common on all New Zealand coasts, they can be found at low tide in rock crevices and under rock ledges.

The five edible roes are yellow or orange (sometimes brown) in colour and are at their best during the breeding season, when they are plump and sweet. Unfortunately, kina breed at different times in different areas, but as a rule are best gathered in the spring or summer. Kina are said to be in breeding condition when they are covered with small piles of stones and other debris. There is a daily collection limit of 50 per person.

Eaten raw, kina have a distinctive flavour which some have likened to fruit salad! They can be used to accentuate the flavour of sauces such as mayonnaise or hollandaise which are served with fish. For those with a taste for the exotic, kina roes may be eaten at the seashore with chopped Neptune's necklace or karengo seaweed. They're good in hangis, too.

Marinated kina

24 raw kina
½ C chilli sauce
1 Tbs lemon juice
1 tsp grated onion
1 tsp horseradish sauce
1 tsp worcester sauce

With a sharp knife slice through each kina, retaining the half shells. Scoop out the roes with a teaspoon and wash well. Combine with all sauce ingredients and spoon mixture back into shell halves to serve.

Serves 4–6.

Burton, D. 1982. Two hundred years of New Zealand Food and Cookery. A.H. + A.W. Reed Ltd. Wellington

La Cuisine Antillaise

Composé en France par Publications-Elysées
Imprimé au Japon par Obum Printing Co.

ISBN : 2-85700-037-5.

tarte d'oursins

Pâte brisée : 250 g de farine, 125 g de beurre, 20 cm³ d'huile ou 30 g de saindoux, sel et eau.
Préparation : le contenu de 75 oursins, 100 cm³ d'huile, laurier, 6 cives, 3 graines de bois d'Inde, 1 gousse d'ail, 1 citron, sel, poivre, 2 tomates.
Pour 4 personnes.

Faites d'abord une pâte brisée avec les éléments ci-dessus en dressant un tas de farine dans le milieu duquel vous faites un trou où vous mettez le beurre en morceaux, l'huile et le sel ; mélangez en ajoutant peu à peu l'eau, remuez sans cesse avec une cuillère puis avec la paume de la main ; la pâte bien « pâteuse » terminée, laissez-la reposer pendant 24 heures, roulée en boule sous un bol, et au frais.
Puis étendez cette pâte au rouleau et donnez-lui la forme d'une tarte de 5 millimètres d'épaisseur sur 25 cm de diamètre.
Pour la garnir faites dorer dans l'huile les cives, les graines de bois d'Inde, le laurier, l'ail écrasé et les tomates en morceaux ; sel, poivre, et jus d'un citron ; ajoutez finalement le contenu de 75 oursins et laissez mijoter le tout pendant 5 à 10 minutes.
Etendez cette mixture dans la tarte, dont vous avez relevé les bords, et mettez à four moyen pendant 20 minutes.
La moitié des gens réclame un vin blanc sec, genre Sancerre ; l'autre, un vin blanc très moelleux, Montbazillac par exemple. Le Minervois est lui aussi recommandé.

blaff d'oursins

(D'après Mme Maguy Jaulent)
Marinade : 50 oursins, poivre, sel, 1 gousse d'ail écrasé, jus de 10 citrons, 1/2 piment émietté.
Préparation : 200 g d'oignons, 60 cm³ d'huile, 1 gousse d'ail, 3 cives, 4 tomates, 1/2 litre d'eau, 4 graines de bois d'Inde, 1 clou de girofle, 1 bouquet garni.
Pour 4 personnes.

Faites mariner pendant 20 à 30 minutes le contenu des 50 oursins dans la marinade ci-dessus.
Pendant ce temps, faites blondir dans l'huile, l'oignon émincé et l'ail haché ; l'oignon ne doit même pas blondir, mais « tomber » ; ajoutez ensuite les tomates en morceaux et faites alors vraiment revenir le tout.
Après quoi l'on ajoute l'eau chaude, le bouquet garni, les cives, le girofle et les graines de bois d'Inde ; on laisse réduire de 1/3 et on ajoute les oursins avec leur marinade.
On laisse mijoter pendant 20 minutes et l'on sert chaud avec un bon vin blanc sec, comme ceux, ci-dessus énumérés.

Dr Henry Gwynne Vevers

13 November 1917–24 July 1988

Gwynne Vevers was the Society's Assistant Director of Science and Curator of the Aquarium from 1955 until 1981—but with an association with the Society that went back much further than those 26 years, right back to his childhood. His father, a qualified medical man, had become the Society's Superintendent when Gwynne was only six years old, and the family home was no more than a few hundred yards from the Zoo. Geoffrey, Gwynne's father, had served in the RAMC during the first world war, and after being demobilized became a Beit Research Fellow and Assistant Herpetologist at the Gower Street School of Tropical Medicine. In those days comparative parasitology was a lively subject, and the intestinal worms from the droppings of newly arrived animals and from animals that had been autopsied in the old Prosectorium were taken for diagnosis to Professor R. T. Leiper, FRS, under whom Geoffrey worked, in the same way as blood samples were sent for the identification of uncommon blood parasites to Professor C. M. Wenyon, FRS of the Wellcome Laboratories of Tropical Medicine in Euston Road. In 1923 Geoffrey was persuaded by Chalmers Mitchell, the Society's Secretary, to abandon his research career, and to join the Society's staff. When he retired in 1948, he settled down in a house in Whipsnade, in the development of which he had played a highly significant part. He was still there when Gwynne became the Society's Assistant Director of Science.

Gwynne was a Scholar at St Paul's School, and in 1935 went up to Oxford as an Exhibitioner where, as an undergraduate at Magdalen, his tutor was J. Z. Young. In his final year I tutored him in his special subject, 'secondary sexual coloration'. He took his BA in 1938, winning the Christopher Welsh Research Scholarship, and until the onset of war in 1939 he remained in Oxford. Influenced by the colourful James Fisher, who was still around when Gwynne went up, he led an undergraduate team to the Faroes in 1937, and then to Iceland in 1939, making censuses and studying the gannet, guillemot and puffin. When war was declared, his eyesight barred him from joining the Royal Navy, his first choice, but he was accepted by the RAF as an Intelligence officer. Posted to Iceland, he investigated the movement of ice floes in order to help chart deep-water channels. This work led him to play a part in predicting the course that the giant new German Battleship, the *Bismarck*, would take as she tried to break out into the Atlantic from the Norwegian fjord where she was sheltering. The ship was attacked and sunk as she headed for Brest. Gwynne's tour in Iceland must have been an exciting time, and his work in intelligence was crowned with the award of the MBE (military).

The war over, Gwynne joined the Marine Biological Laboratory at Plymouth, in whose administration he played a part, and where he started to do research into the natural history and chemistry of animal pigments. He took his Oxford MA in 1947, and his DPhil in 1949, the subject of his thesis being the hormonal control of the plumage changes in the Amherst pheasant—a follow-up of the tutorials he had had with me. Animal pigmentation remained his permanent interest. He continued to work on the subject, much of his research being carried out in collaboration with Dr Gilbert Kennedy of Sheffield University, with whom he published several papers. He also played a big part in the development of underwater photography, and launched himself on to what turned out to be a prodigious and highly-successful writing career of popular scientific works. His natural history books for children were particularly successful. Living close to the sea as I do, for long I used to carry his *The British Seashore* in my pocket as I strolled along the nearby beach. In all. Gwynne wrote and translated nearly a hundred books. He was an excellent linguist, and his translations covered eight languages.

In 1955, Dr L. Harrison Matthews, the Society's Scientific Director (and at the same time also Director of the Regent's Park Gardens and Whipsnade) persuaded Gwynne to leave Plymouth and to join him as Assistant Director of Science in charge of the Aquarium. He thus became one of only some six professional scientists then on the Society's staff.

There could never have been a better choice. Gwynne soon became a mainstay of the Society's scientific meetings as well as the Editor of its scientific publications. He also continued with his researches, collaborating with Professor Harold Munro Fox, FRS, the head of the Department of Zoology at nearby Bedford College. In 1960 the two published what is now a standard text—*The Nature of Animal Colours.*

Gwynne was the most amiable of men, and got on easily with the Society's other professional and keeper staff. He was universally liked. Throughout the time he was with the Society I was a member of the Council, and during my term as Secretary, and therefore by statute the Society's chief executive, I knew him as an old friend to whom I could turn for help at any time. He understood immediately what was wanted, smiled, went away, and it was done. He was never demanding, never seemed frustrated, and I never heard anyone complain about him. He knew how to delegate, and in due course turned over the bulk of his editorial duties to Dr Marcia Edwards. He was a tower of strength when the Society started to reinforce the scientific and educational functions that are its *raison d'être*, and to build the Wellcome Institute of Comparative Physiology and the Nuffield Institute of Comparative Medicine, today the two main components of the Society's Institute of Zoology.

I never did fathom how Gwynne was able to discharge his duties to the Zoo, and also carry on writing and preparing radio and TV programmes. He was given leave to participate in the Royal Society expeditions to the Cook and Solomon Islands, and also gave much time to the Society's sister Society, the Linnean, to which he was devoted. He was a member of its Council from 1958 to 1967, serving for one term as Vice-President and another as Zoological Secretary.

Gwynne was highly sociable, and at the same time a very private person—few knew anything about his family life. Like his father before him he was a staunch member of the Savile Club, at the same time as he made it his business to invigorate the Society's ancient Zoological Club, founded in 1866. He rarely missed any of its dinners. I well remember the great turn-out which he organized for the thousandth dinner of the Club.

Gwynne was a model official of the Society. He served it in a manner that was both true to its best traditions, and in a way that enhanced the purposes for which it was founded—the advancement and spread of zoological knowledge.

LORD ZUCKERMAN
AUGUST 1989

Pigment Cell Research 1:209 (1988)

IN MEMORIAM

Walter Weber
1923–1987

Dr. Walter Weber, Professor of Zoology at the University of Cologne, West Germany, died of heart failure in October, 1987 leaving behind his devoted wife, Ruth, and two lovely daughters. His research field over the last 15 years concerned the light-dependent color change in a diadematid sea urchin. His ultrastructural studies and observations on isolated chromatophores beautifully revealed the amoeboid nature of these cells in which light induced alterations in cell shape are linked with pigment displacements.

Professor Weber began his studies in biology, chemistry and geography at the University of Cologne in 1948. In those hard times, a condition for matriculation was to work at bricklaying as well as studying in order to rebuild the university out of the ruins of the war. After having received the degree of a Dr. rer. nat. he spent two years at the University of Fribourg in Switzerland as a research and teaching assistant. After his return to Cologne he was promoted to Dozent and in 1969 he achieved the rank of professor.

Professor Weber's early research dealt with wound healing in amphibians and neuroendocrinology in amphibians and birds. On the occasion of a visit to the Zoological Station in Naples, Italy in 1966, he decided to focus on color change and chromatophore mechanisms in cephalopods and echinoderms. Subsequently he periodically returned to this most famous of marine stations for a week or month's research stay. It was here that he became acquainted with pigment cell biologists at the international level and this led him to become a member of the International Pigment Cell Society when it was formed. Later, he became a member of the Editorial Board of Pigment Cell Research, the official Journal of the society. He was a frequent participant in International Pigment Cell Conferences including those held in the United States. The latter had special meaning for it allowed him to make a sentimental visit to Arizona where, as a very young man, he spent time as a prisoner of war. This return revealed the sensitive and artistic nature of Professor Weber as expressed by the wonderful movies he produced from film taken on these trips.

Professor Weber was a respected scientist whose counsel was often sought. He was fair and just. He was a quiet and modest person that belied his excellent sense of humor. Professor Weber was a warm, giving and loving person who was always pleased to offer help and friendship. His students, colleagues and friends will not forget his contribution to their scientific work and personal needs. We have lost an elegant human being.

Martin Dambach
Joseph T. Bagnara

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SIR ERIC SMITH

Sir James Eric Smith, CBE, FRS, secretary, Marine Biological Association of the UK, and director Plymouth Laboratory, 1965-74, died on September 3 aged 81. He was born on February 23, 1909.

NEUROBIOLOGY, today a topic singled out for special study in biomedical research, was a none-too-popular subject when Eric Smith began his academic career as a student probationer at the laboratory of the Marine Biological Association at Plymouth in 1930. Techniques were being developed which allowed nerve pathways to be followed under the optical microscope, and Smith devoted his experimental talents towards developing such methods to study the nervous system of the starfish, to help explain how it could move off with any of the five arms leading, yet with the rest of the arms getting into the swing behind the leader.

His elegantly beautiful studies of several British starfishes and their relatives, published by the Royal Society between 1937 and 1950, utilised his technique of vital dyeing, in which the fibrous tissues, especially the nerves, take up colour to enable their pathways to be followed. This monumental series of papers showed him to be an investigator of considerable patience and ability, making a corner of marine biological research his own. It is hardly surprising that he later returned to the Plymouth Laboratory as its director.

While he was based principally in Manchester, Sheffield and then Cambridge, Smith's outstanding abilities as a university teacher and patient guide of students led him naturally towards a headship of department, and he took the chair of zoology at Queen Mary College, London, in 1950. Many of those who were struggling to make sense of the tantalisingly unique sought his guidance. Smith often admitted that these animals, "with five front ends and a patently absurd way of doing things", were infuriating, yet he obviously delighted in discussing the latest peculiarities that had been uncovered by research. He himself was to summarise his extensive work on co-ordination in echinoderms in a keynote address to the first international conference on echinoderm biology in Washington in 1963, a brilliant summary of his pioneering research.

Soon, however, the leadership of Freddie Russell at the Plymouth Laboratory came to an end, and Eric Smith was appointed director in 1965. There, his ability to persuade by gentle reason, to reconcile opposing views, was instrumental in maintaining the upward trajectory of the laboratory's research reputation, and, equally important, the welcoming atmosphere for visiting scientists, especially the many eminent researchers in neurobiology. He also fostered the historic long-term ecological studies of the waters of the English Channel, realising the importance of ongoing data collection in the investigation of long-term trends in the ability of the waters to support fisheries.

In 1967, not long after his appointment as director, the *Torrey Canyon* spilt its cargo, of crude oil on to the shores of Cornwall. For more than a year almost the entire effort of the laboratory was directed towards the study of this major pollution incident, its effects on marine life, and, importantly, the biological effects of the methods used in its attempted dispersion. Smith edited a special volume, *Torrey Canyon Pollution and Marine Life*, which became a classic in the literature on this terrible side-effect of the modern world.

Smith's skills as a scientific administrator and his experience of this incident were used to the full when, in the early 1970s, he was seconded from the MBA for two lengthy periods to chair the Royal Commission on the likely effects of oil exploration in the northern Great Barrier Reef. Both before and after this he chaired many influential committees, such as the Unesco advisory committee for the Indian Ocean Biological Centre, the advisory committee for the Universities' Marine Biological station at Millport and, a task which gave him particular pleasure and challenge as a zoologist with wide interests, the Board of Trustees of the British Museum (Natural History).

After retirement in 1974 in Cornwall, he pursued several interests that had had to lie dormant through his full professional life, particularly a study of the pioneer naturalists of the south-west of England. He delighted in presenting papers to such bodies as the Society for the History of Natural History, of which he was president from 1984. The University of Exeter had conferred on him an honorary doctorate in 1968, and throughout the 1980s he gave generously of his time to its Institute of Cornish Studies.

One evening in 1984, Smith was driving back from a visit to the University's internationally-famous Cornish Biological Records Unit, then housed in rickety-floored premises in Redruth. The tiny cinema next door had burnt down a few days earlier, and Smith shuddered at the thought that the unit's rooms and those irreplaceable card indices might have been destroyed too. Shortly afterwards, he set about investigating the possibility of putting the entire index on computer disc, undeterred by an initial calculation that it might take one man 60 years to input all the data. Today, ERICA (Environmental Recording in Cornwall Automated) has a dedicated mainframe computer at the university and landline to new premises in Redruth, where a team of operators is not only steadily transferring the priceless records to disc, but is leading research into information storage and retrieval of biological records.

Smith leaves a son and

Professor Norman Millott

Norman Millott, who did outstanding work in echinoderm physiology in the 1950s and 1960s, died on 24 February 1990. He had lived for the last 20 years near the University Marine Biology Station at Millport, on the Isle of Cumbrae, in Scotland. His house overlooked the rich waters of the Firth of Clyde, and many of us who used the area for our experimental work visited him and his wife Margaret while we were at the Laboratory. We were always given a warm welcome and could be sure of a chat about echinoderm biology and the people who work in it. Norman had suffered from arthritis for several years, but this never dulled his sense of fun, his relish for stories about the people he knew, or his explosive anger about the under-recognition of scientific research and higher education.

Millott graduated in zoology at Sheffield University in 1934. Two years later he was appointed to the Rouse Ball Studentship at Trinity College Cambridge, where he enjoyed the huge advantage of working in the dynamic and pathfinding atmosphere of the Zoology Department at Cambridge, where Professor Sir James Gray and Professor Carl Pantin were establishing one of the foremost experimental zoology schools in the world. Millott initially worked on annelids, but saw the error of his ways soon enough, and turned his attention to the experimentally much-less-popular and more difficult sea-urchins, whose nervous system was to prove such a challenge to anybody who expected to be able to use conventional techniques on them. He showed at that time, according to his Supervisor, great originality and meticulous attention to detail, characteristics which were to remain with him and be such an advantage throughout his career, not only in his scientific work but also in the administration of his laboratories.

His first academic job was as Lecturer in Zoology at Manchester University from 1938 to 1947, with a break for military service in the RAF Technical Branch during the Second World War.

He was only 35 when he was appointed Professor of Zoology at the Jamaica campus of the newly-founded University College of the West Indies. With his enormous capacity for work, he built up a most successful Department there, urging his Staff to research on strategic projects of use to the local economy, while not neglecting the pursuit of knowledge for its own sake. He himself worked mainly on colour change, pigmentation and photosensitivity at this time and collaborated with several junior colleagues on papers describing these systems in Diadema.

In 1955 Millott was sought by the University of London to succeed Professor Hans Munro Fox in the Chair of Zoology at Bedford College London. There, for the next 15 years, he created a reputation for teaching and research which was instrumental in attracting not only a steady stream of highly able undergraduates (all women then), but also graduate students and assistants, particularly from Japan. Early on, Masao Yoshida was to become his Research Associate, and to embark on a series of experiments on the shadow reactions of Diadema which marked out the way for Millott's principal research thrust for the rest of his working life. It is tragic that Yoshida died of cancer in 1988.

In 1960 Yoshida's place in Millott's laboratory was taken by Keiichi Takahashi, who worked, among other things, on the innervation of the sea-urchin spines. Millott and Takahashi were to map the linear nerves of the deep plexus which emerge via the tube-foot pores to track over the test surface to the spines. They recorded spine movements resulting from changes in illumination impinging on the external surface of the urchin.

In 1963 Millott had been one of the fairly large British contingent to the very first international meeting on echinoderms as part of the Zoological Congress in Washington, which resulted in the formidable volume on Physiology of Echinodermata, edited by R.A.Boolootian. Four years later he was invited by the Zoological Society of London to convene a British meeting on echinoderms, which resulted in a much slimmer volume of symposium proceedings which he called Echinoderm Biology (1967). He wrote in the Foreword: "Happily, once again echinoderms are being viewed as a diverting group of animals and not solely as egg-batteries". He went on: "It is with satisfaction that we observe the vigour, sparkling enthusiasm and the preponderance of youth among those who have chosen echinoderms as their sphere of activity, but I pause to reflect by what a long time-span I am set apart from many of those who helped make this meeting a success".

In 1970 the Universities of London and Glasgow took over the former fisheries laboratory at Millport to found a Marine Biology Station for the two Universities, and Millott was the obvious appointee as first Director, combining as he did academic excellence with organisational flair, so that the Station flourished under his leadership. After retirement in 1976 it was natural that he should remain at his home adjacent to the Laboratory, welcoming visiting colleagues with a steady stream of opinions, ideas, criticisms and chit-chat.

Norman Millott was a prodigious talker, the natural centre of conversation, the person to take the social initiative. He could be terrifying as a PhD Examiner, bombarding the victim with a stream of questions and hardly giving his co-examiners a look-in. Yet he was very approachable, so helpful and considerate to everybody within his circle of students, colleagues and friends. He had gained his own reputation as a scientist by hard work in a subject for which he had great aptitude, and he expected others to earn respect by their own efforts. He was not easy to get to know, and may indeed have sometimes seemed aloof and distant, perhaps betraying too tightly disciplined a personality. But on second or third meeting you realised the warmth that lay beneath the rather formal exterior.

David Nichols
University of Exeter, U.K.

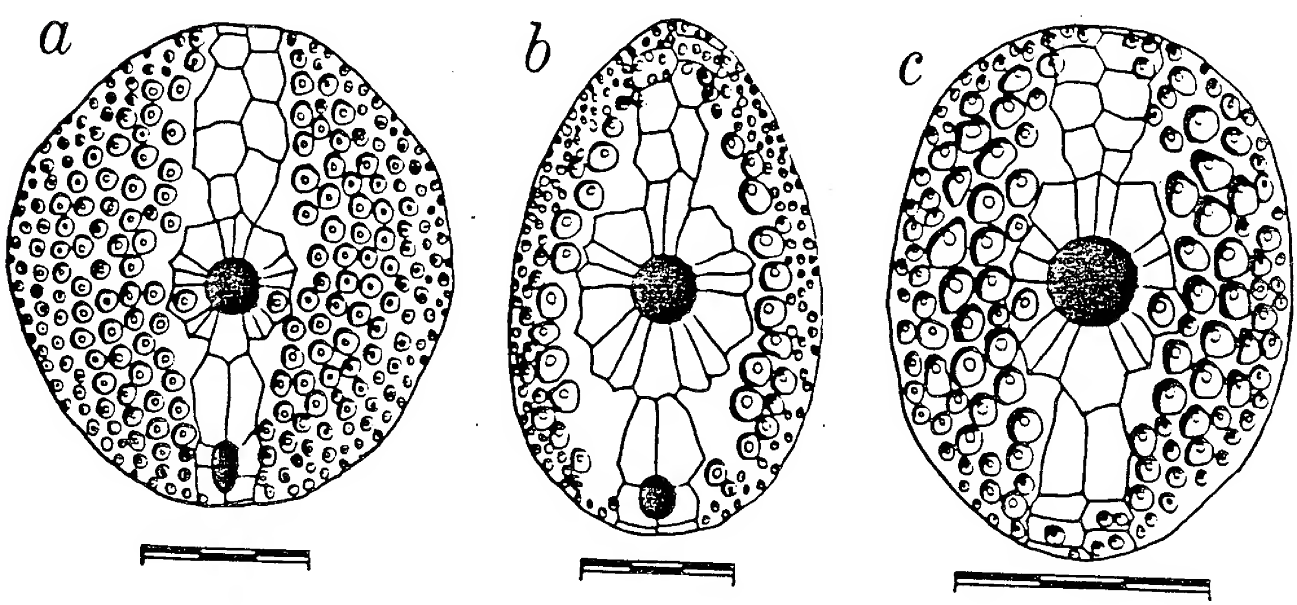

FIGURE 22.—Tuberculation on oral surface of laganines and a scutelline: *a*, *Lenicyamidia compta* Brunnschweiler, after Durham et al. (1966:U470). *b*, *Leniechinus herricki* Kier, after Kier (1968:6, pl. 1, fig. 4); *c*, *Lenita patellaris* (Leske), MNHN, no number. (Peristome and periproct in solid black; anterior towards top of page; plate pattern shown only in naked zone (ambulacrum III and interambulacrum 5); scale bars = 3 mm.)

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