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 suepervision. 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.

Daniel Blake (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*).

Ronald Parsley (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 -- "I

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.

Thomas Ebert (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.

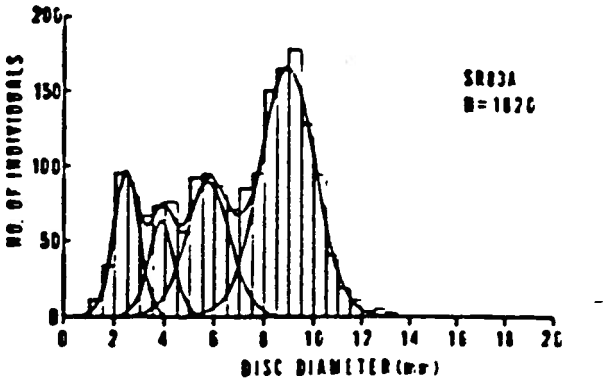


Fig 2 *Ophiura sarsu* Size-frequency distribution at depth about 250 m off Ōtsuchi on 10 March 1989 (Stn SR83A) Histogram denotes observed frequency Curves represent 4 Gaussian component distributions and their summed frequency fitted by numerical analysis The population was dominated by large individuals

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 ($n\ m^{-2}$) ± 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	8069	25.3	820.1	57.4
Conomurex luchuanus	1.11 ± 2.14	7286	78.3	833.2	59.8
Mullus mullus	0.281 ± 0.622	1840	14.0	233.1	19.3
Holothuria atra	0.163 ± 0.230	1070	53.9	190.5	13.4
Holothuria scabra	0.0089 ± 0.057	583	10.1	28.8	2.02

Muka; et al. 1989.

Vladimir Kasyanov (Institute of Marine Biology, Vladivostok). Before I came to Vladivostock I worked in Leningrad University and was engaqed 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.

Echinoderm Newsletter. 1992. No. 17.

HOW I BECAME AN ECHINODERM BIOLOGIST - PART II

Byrne, Maria (Histology, University of Sydney): As a youngster our holidays by the sea instilled a great interest in marine creatures and I spent hours scouring the flotsum and jetsum along the shore for washed-up treasures. My parents always managed to find space for each load of loot that I returned home with. My husband is equally bemused and when I am away will nip down to the shore between meetings to collect a monthly sample for me, donned with a suit and tie! Once I learned to dive, my eyes were opened to the world of invertebrates outside of "pickle" jars and of all the invertebrate groups, echinoderms held a particular attraction to me, being uniquely marine and so different from the rest. I was first able to explore this interest in my undergraduate research project in Ireland, working with Brendan Keegan. After this, I was well and truly hooked and have been lucky to be able to pursue my interests in echinoderms, seeing some of the world and making reat friends in the process. I became particularly interested in functional morphology and was fortunate to work with Arthur Fontaine in Canada, who has an uncanny understanding of echinoderm form and function. Arthur was a wonderful supervisor, giving me plenty of scope for independent work, but was always there for an insprirational brain storm. It was an exciting time for me working on mutable connective tissues while workers elsewhere ry the world were also making discoveries in this field. Echinoderms are a fascinating gruop with which to address interesting and fundamental questions and now I am steeped in the world of "devo-evo", development and evolution. I have heen lucky so far and hope thatI will be able to continue working with this most rewarding group of invertebrates.

David, Bruno (Paleontological Department, University of Burgundy): I have to admit that I became an echinoderm biologist by pure chance. Surprisingly, it was the French army that pushed me on the track of these spiny animals. Since my childhood I have been interested in natural life, probably largely because both my parents were involved professionally in natural sciences. During my studies at the University of Lyon I was equally attracted by structural geology and by paleontology. After finishing my master's degree, I definitely chose to be a structural geologist, and managed to undertake a PhD on the geology of the Carribean. But to start that project I still needed to get a two-year deferment. As the army refused it, I had to change my plan and switched back to paleontology, starting a study of Tertiary ostracods. After my military service, I moved to Burgundy and Dijon. At that time (1978) I had to engage in a PhD and opted for the paleontology of Lower Cretaceous sea urchins from the Alps. Four years later, pursuing paleontological researches on fossils as a full time researcher, the CNEXO (now IFREMER) offered me the opportunity to study Recent deep-sea forms from the North Atlantic. The fascinating architecture and shape of Pourtalesiids transformed me progressively into a sort of "Recent forms paleontologist". In other words I undertook the study of the evolution of sea urchins from morphological studies of Recent forms, and life has been going ahead in that path ever since.

Donovan, Stephen K. (Geology, University of the West Indies): The British system for the support of graduate students in palaeontology is for projects to be submitted to the Natural Environment Research Council (NERC) for consideration. A committee considers applications and supports a limited number (it used to be about 130) each year, while approving somewhat more so that candidates and departments can make their own decisions on the best combinations. A NERC list of approved projects is published which is a document of great interest amongst final year undergraduates. Competition is fierce.

My interests after 3 years as a geology student in Manchester centered on palaeontology, stratigraphy, and sedimentology, and I applied for a number of projects from the 1980 NERC list accordingly. The only limiting factor that I took into consideration was that I had no intention of returning to London to study, so that I ignored a proposal devised by Ted Rose (University of London) to work on mid-Tertiary echinoids form the Caribbean: if only I'd known then what I know now! However, I was successful in my application for the only other project on the list that was concerned with fossil echinoderms, supervised by Chris Paul in Liverpool. The project was one of obvious potential, analysizing the distribution of crinoid columnals, unloved and generally ignored, in the Lower Palaeozoic of the British Isles. I was shown around the Liverpool campus by Chris and his research assistant, Andrew Smith (was it compulsory toi have a beard to work on fossil echinoderms?), and was the last of five applicants to be interviewed. However, I was offered and accepted the studentship then and there, and the rest is history.

Gebruk, Andrew (P.P. Shirshov Institute of Oceanology, Russia): I am sure there is nothing extraordinary in my story, the usual situation with a student specializing in marine biology (or in my case, in invertebrate zoology), who meets with the leader or teacher.

I grew up in Estonia, on the shore of the Baltic Sea, and spent my summer holidays on the shore of the Black Sea. From my early age I was influenced by the nature of the sea. Since the middle of the school period I was collecting sea shells. This collection is still with me. When I became a student in the Biology Department at Moscow State University there was no doubt that I would specialize in invertebrate zoology. And so it happened. I was planning to start as a malacologist, but in the second year at the University I met George M. Belyaev, the prominent specialist in echinoderms and in the biology of the deep-sea trenches. And he suggested to me that I try a revision of the Scotroplanes, one of the deep-sea holothurian genera. I started visiting the P.P. Shirshov Institute of Oceanology, where Dr. Belyaev worked, more and more often. The revision of the Scoplanes became my diploma work, and since that time the realm of deep-sea holothurians became my profession. Now I work together in the same Laboratory of the ocean bottom fauna with Dr. Belyaev and his other former students: Dr. Alexander Mironov (echinoids) and Dr. Nina Litvinova (ophiuroids).

Giudice, Giovanni (Universita di Palermo, Italy): I started to be interested in sea urchin embryos because there was in the University of Palermo a strong tradition of sea urchin embryology started by Professor Alberto Monroy, with whom I was associated for the first 15 years of my career.

James, D.B. (Tuticorin Research Centre, India): After obtaining my master's degree in marine biology from Andhra University in 1961 I was looking for a research career. At the end of 1962 I was offered a Government of India

Research Scholarship to work at Mandapam Camp (South India) under the supervision of Dr. S. Jones, the then Director of Central Marine Fisheries Research Institute and Founder President of the Marine Biological Association of India. Dr. Jones asked me whether I had any particular problem in mind to work. When I told in the negative, he asked me to discuss with his senior colleagues and come to him. When I met him after one week he asked me to take up the studies on the fascinating group Echinoderms since he already decided to ask his students to work on the little known groups like the Sponges, Corals, and Echinoderms from India. Ever since that time I am working on echinoderms of the Indian Seas. During the last 30 years I have examined material from all along the Indian coast, the Andaman and Nicobar Islands, and the Lakshadweep. I have worked and published papers on the taxonomy, ecology, zoogeography, toxicology, hatchery and culture of echinoderms from Indian Seas.

Levin, Valery (Institute of Marine Biotechnology, Petropavolosk-Kamchatsky, Russia): I became an "echinodermatologist" by necessity. Since 1967 I had been working as the head of a diving group in the Pacific Institute of Bioorganic Chemistry in Vladivostok. My work consisted of making extraction of marine animals for experimental analysis of the chemists. In 1972 I visited the tropical Pacific on board the ship"Dmitry Mendeleev", and made a large collection of marine invertebrates. Our chemists were most interested in holothuroids as they moved from an investigation of plant glycosides (ginseng for example) to animal glycosides. An investigation of the chemistry of almost 40 species of holothuroids was begun, but everyone was ignorant of the species. I was instructed to get to know the species. I took the collection of holothuroids to specialists in the Zoological Institute in Leningrad. To my surprise their knowledge of the tropical species was rather poor. I had no alternative but to surround myself with books, mostly in English which was difficult for me to understand, and learn to identify species by myself. As a result I defended my thesis after five years and my doctorate on the biology of holothuroids after thirteen more.

McKenzie, J. Douglas (Dunstaffnage Marine Laboratory, Scotland): While most echinoderm biologists will be able to tell you how they ended up studying echinoderms, I can tell you the exact moment that decided my career. It was on the 20th of May 1979 at Carrick Castle, in Loch Goil on the west coast of Scotland. I was an undergraduate at Glasgow University at the time and this was my first ever dive. At 20m I hit bottom and there, sticking out of the mud were peculiar animals that I thought looked like polka-dotted anemones. with branched, flame-red tentacles. The next week we were also diving in Loch Goil, opposite Carrick Castle. There again were these peculiar animals but this time I managed to lever one out of the mud using my diving knife and found that there was a very un-anemone like body burrowed in the mud. Bringing it to the surface I dissected it in our diving boat (I was keen in those days!) and recognized it to be a holothurian. Ferretingaround in the library in our Zoology Department I was able to identify it as *Psolus phantapus*. I also quickly found that my lecturers knew next to nothing about holothurians and there seemed to be very little published information about them. It is one of the more perverse aspects of my character that the more other people are interested in something the less interesting I find it and vice versa. A group of animals that no-one seemed to know much about and no-one seemed particualrly interested in struck me as a good subject to do my PhD on. So it was that I started work on sea-cucumbers and this in turn led

me to work on the other classes of echinoderms. Holothurians were my first love and I still have a soft spot for them, particularly *Psolus phantapus*, the animal that started it all. (Jamais arriere)

Mladenov, Philip (Marine Science, University of Otago): I grew up in Toronto with no early exposure to the sea shore. As a youngster, however, I was drawn to books on marine life that my parents seemed always to have about the house. I remember lingering longest on pictures of marine invertebrates, particularly those of the spiny-skinned variety.

This latent interest in marine life and echinoderms transformed into something more concrete early on in my undergraduate years at the University of Toronto. I was fortunate to become involved in Arctic research as a diving assistant and was truly excited about what I saw during dives in Resolute Bay, Corvallis Island. Later, for a project in zoogeography, I embarked on a hopelessly ambitious project involving the origin and dispersal of asteroid families. Nick Holland, another echinoderm biologist, may dimly remember my letter to him asking assistance with this project. I certainly remember his helpful and encouraging reply in the face of what must have seemed to him an outrageous study. While at U of T, I also carried out a project on the behaviour of *Asterias rubens*. I am grateful to my instructor in that course who allowed me to set up a re-circulating salt-water system in his land-locked laboratory and to ship in sea stars and clams, knowning full well that a project on butterflies or minnows would have been much easier and more sensible.

By the time I entered graduate school, my fascination with echinoderms was well established. As an MSc student at McGill University I was given the delightful opportunity by my supervisor, Carol Lalli, to work on just about any sensible project while based at McGill's Bellairs Research Institute in Barbados. It came down to a choice between two projects, one involving brittle stars, the other sea cucumbers. In the end, Carol steered me towards the brittle-star one. After that, I joined Fu-Shiang Chia's group and worked on crinoids while based at the Bamfield Marine Sttion. Towards the end of my dissertation, an important discussion with the late Dr. Robert Fernald of the Friday Harbor Laboratories served to keep me focussed and to convince me that pursuing an interest in echinoderms might indeed lead to a respectable career that would also feed a family.

So that is my story, more or less. It seems I may have become an echinoderm biologist because of an inherent interest that manifested itself early in life within the framework of a supportive family environment, combined with the good fortune of being exposed to broad-minded instructors and supervisors who were able to nurture the interests of a young biologist early in his career, and who also provided sensible advice at the times it was needed most.

Regnell, Gerhard (Geologiska Institutionen, Lunds Universitet): In the late 1920's I brought together a small and indeed very diverse collection of natural objects. My "cabinet of curiosities" has of course been disposed of long ago, but I still have a vivid memory of some of the treasures. Among these were cylindrical and annulated pieces which I had picked in the clay of a local brickyard. I had not the faintest idea of their true nature but took them for fossilized earth-worms. Eventually, I realized that the worms were in fact fragments of stems of Silurian crinoids which had been transported from the Island of Gotland by ice-streams in Pleistocene times. Other objects were more obvious. Quite trivial were steinkerns of Cretaceous sea

urchins which you could collect in quantities in the fields. In a class of itself was an exquisite speciement of -as I now know- *Trisalenia loveni* collected during my first visit to the Isle of Ivo in northeast Scania where there is a quarry in Upper Cretaceous rocks.

Not until many years later did I again come into contact with echinoderms. In 1933 I matriculated at the University of Lund in south Swweden in order to study natural science. I then met Torsten Gislen (1893-1954), professor of zoology, who was, and probably still is, well known from his studies of echinoderms, particularly crinoids, and maybe in the first place from his ideas of affinities between echinoderms, enteropneustes and chordates, a question which is still under dispute. I cannot say that at that time Gislen exerted any influence upon my choice of Lower Palaeozoic non-crinoid pelmatozoans as the theme for my doctoral dissertation several years later. But when working on my thesis I profited very much from discussions with Gislen.

Iconographia crinoideorum, the classical monograph by N.P. Angelin (1878), includes a condensed section on cystoids for which Sven Loven, also a classic among echinodermologists, was in charge. Afterwards, little attention had been given to the Swedish material. In view of this fact, professor Erik Stensio, Director of the Department of Palaeo-zoology of the Swedish Museum of Natural History in Stockholm, suggested to me to deal with cystoids and related groups. This I did in the period 1940-45, i.e. during World War II. It goes without saying that conditions for scientific work were not the best: You could not vist foreign colleagues or collections or obtain material for comparison, even correspondence with colleagues in other countries was practically impossible, photographic plates of sufficient quality were almost impossible to obtain, etc. Anyway, I completed my work and eventually came in touch i.a. with grand old men in the science of fossil echinoderms, like N.N. Yakolev and R.F. Hecker in the then Soviet Union and R.S. Bassler in the United States, all of which meant a good deal for my future work.

Looking back, I find it hard to realize that I encountered fossil echinoderms for the first time some 65 years ago. They are still around.

Roman, Jean (Institut de Paleontologie, Museum National d'Histoire Naturelle): My career as an echinologist was the realization of a dream: that which made many boys and girls fascinated by paleontology and who wanted to make it their profession. Like a large number of children I began by collecting fossils and by making a small collection. But I had the great fortune of being born in a family of naturalists: a great grandfather who was an artist, very much taken with nature and a collector of shells, minerals, and insects; a grandfather who was a professor of geology and a respected specialist on ammonites; a father who had a great knowledge of plants and who was a amateur entomologist. My grandfather would take his grandchildren to the areas near Lyon to collect fossils: gryphea (oysters), scallops (Pecten), and naturally ammonites, as well as a bizarre fossil, called by my grandfather "le fromage du pere Adam" (the cheese of father Adam) which is the product of the activity of a marine worm. Sometimes one saw as well the "coups de balai" (broom sweeps) which are the remains of alcyonarians related to gorgonians. I began my higher studies at Lyon and finished them at Grenoble, near the mountains. I had my first contact with echinoids in the Cretaceous of the southern Alps. Then Professor J. Roger called me to Paris to the Museum. He had just established the Center for Paleontological Study and Documentation. I would have loved to devote myself to the study of

ammonites. Now he proposed to me a subject of research on the echinoids and I had the opportunity to identify a large number of them. These organisms have less value than ammonites for dating formations, but they are much more interesting. In fact, the fossil urchins offer for observations a much larger number of anatomical structures than most of the other fossils, and these structures are directly linked to the life of the animal. They teach us about its way of life and its environment.

Rowley, Robert J. (Marine Science, Univ. of Otago): I started studying sea urchins when they ate the kelp bed in which I was studying fish. Since then I have become fascinated with echinoderms because they are often important or dominant in marine communities and they are so unlike most other taxa. The difficulties of working with them in field studies(difficult to tag or sometimes even measure, cryptic recruits, generally no good "growth rings") actually create opportunities for research if you can find innovative ways to "get a handle" on the wierd and wonderful critters.

Smiley, Scott (Institute of Arctic Biology, Univ. of Alaska): Although I recall finding my first sea cucumber on the Maine seashore when I was 5 years old, my obsession with them really began with a poorly produced nature show on TV in the late 60s called Oceans Alive. The TV naturalist squeezed a tropical Pacific sea cucumber and two pearl fish squirted out of its anus. I was fascinated and revulsed, but the fascination was intense. I spent an undergraduate semester in a marine lab working on gregarine parasites of a local sea cucumber. My interest in them grew until, by the time I graduated, I was a confirmed student of the Holothurians. In graduate school, I found myself asking advisors why I should not use a sea cucumber to answer this or that question. I was intrigued by the idea that sea cucumbers were so obscure that I might be able to read everything written about them while in graduate school. This is not to diminish the natural obscurity of their biology; the main reason there is so little written about them is because of their obscure biology. I felt that to understand Zoology, one must deeply understand a non-vertebrate animal. I also believe that Zoology is just another mode of human self expression. I chose to express myself through Zoology, and I chose to explore the manifold aspects of Zoology through sea cucumbers. I have read that unforeseen qualities emerge in a detailed multidisplinary understanding of a coherent group of animnals. I would like to believe that this is true, but I suspend my judgement on this optimistic view until I finish my work. I have studied sea cucumbers for 15 years now. I continue to study them, and I plan to study them for the foreseeable future. I still find them endlessly fascinating; in their molecular biology and biochemistry, their cell biology, their physiology, their development, their ultrastructure and anatomy, their taxonomy and systematics, and their natural history. I am even beginning to discover that their ecology is fascinating, in spite of the fact that this discipline is overwhelmingly complex for me. Like other children of the early 60s, I was preoccupied with fears of nuclear war, and a refleciton of this fear congealed in the tyranny depicted in the movie FAHRENHEIT 451. I suspect that I found solace in the thought that I might become the book of sea cucumbers.

Stickle, William (Dept. of Zoology, Louisiana State Univ.): My fascination with the echinoderms began in 1966 when, as a M.S. student, I travelled to Seattle to present a paper at the American Malacological Union, Pacific Division and we took a field trip to lower Puget Sound where I was impressed with the species diversity and bright coloration of the intertidal echinoderms. My curiosity about the physiological adaptations of echinoderms was whetted a year later when I took part in an Oceanography Institute program at the University of Alaska's marine laboratory on Douglas Island which was located near Juneau. I was puzzled at the euryhalinity of a number of intertidal species of sea stars, sea urchins, brittle stars, and sea cucumbers when exposed to the freshwater lens which develops in coastal areas receiving freshwater input from melting glaciers during the summer months. Echinoderms were and are considered to be very stenohaline but the species observed in the vicinity of Juneau had not read that book! My education in the lessons taught about the role of echinoderms in the biological world matured when I spent a year at the Friday Harbor Laboratories and learned much about their natural history. I remain in awe of echinoderms some 25 years after my introduction to their beauty, diversity, and hidden secrets.

Tommasi, Luiz Roberto (Instituto Oceanografico, Universidade de Sao Paulo): I began to work with echinoderms because they are one of the most exotic, extraterrestrial group of marine invertebrates. Because of its fantastic geological history. And because not only in the sky we can find stars.

Yanagisawa, Tomio (Saitama Medical School, Japan): A short abstract (in Japanese) issued in Japan shortly before 1945 of Lindahl's work (1940) on the animalization of sea-urchin embryos by Li+-treatment evoked my first interest in echinoderm embryology. Amphibian metamorphosis was my first subject, but at the start of my doctoral thesis, my early emotion to echinoderm embryology and the reports on the nature of phosphate compounds in sea-urchin eggs by Whiteley (1949) and by Chambers (1953) led me to study the phosphagen-phosphagen kinase systems in gametes of sea urchins and starfish. i) The study elucidated the differential distributions of APK and CPK systems in echinoderm eggs and sperm (J. Fac. Sci., Univ. Tokyo, IV.8, 473, 481, 1959). Other early works were ii) studies on the acid-soluble nucleotides in sea-urchin eggs (in collaboration with Dr. N. Isono), in which we demonstrated the changes in the amounts of ATP and other nucleotides during development and the presence of UDP-sugar compounds (see Embryologia, 9, 184, 1966), and iii) studies on the flagellar movement of sea urchin sperm (in collaboration with Dr. H. Mohri), in which we elucidated the essential role of GTP bound to the microtubule protein and named the GTP-binding protein as "TUBULIN" (Exp. Cell Res. 52, 86, 1968). These early works opened the way for me to study the comparative biology of echinoderms.

How I began to study echinoderms... Part 3.

The section of the Echinoderm Newsletter containing personal accounts of how individuals began their studies on echinoderms has proved to be extremely interesting and popular. I have found them fascinating.

Anderson, John M. (Cornell University). The year was 1948. Returning to Academia from four and a half years' service as a naval office in WWII, I had finished my graduate training in insect physiology under Prof. Daniel Ludwig at New York University and managed to produce an acceptable dissertation. Settling into an assistant professorship at Brown University as a fresh-caught PhD (by now with a wife and two small sons), I found myself for the next couple of years casting about for a stimulating field of research for the long haul. Histological and histochemical studies on the male reproductive system of the Japanese Beetle (the animal whose metamorphic biochemistry I had worked on as a graduate student, some intriguing problems in the reproduction of fresh-water planarians, and even an investigation of the biological effects of ultrasonic radiation (on years, of all things!) occupied my questing attention. At one point my newly assigned research assistant at Brown (and I as well) needed training and experience in histological and histochemical techniques (the latter coming increasingly into vogue at the time), and in seeking not-too-difficult invertebrate practice materials we began to play around with such things as crayfish hepatopancreas and the pyloric caeca of sea-stars (then commonly referred to as starfish). Brown University is located in Providence, RI, not far from Narragansett Bay, and sufficient numbers of starfish could be had be special request from dragger operating out of nearby Bristol. Seeking to understand what we were seeing in our practice slides of the starfish material, it was natural to check into the existing literature - which revealed interesting gaps, inconsistencies, and obvious inaccuracies in previous descriptions. This, plus the fascinatingly <u>different</u> nature of the asteroid digestive system in general, led us to focus on the starfish sections to the exclusion of other materials - and thus began my career-long obsession with gross and microscopic details of digestive systems in various species of sea-stars.

In 1952 the offer of a tenured appointment in the Department of Zoology at Cornell University lured me away from the seashore, but summertime association with the Marine Biological Laboratory at Woods Hole, beginning in 1953, made it possible to continue studies on <u>Asterias forbesi</u> for the next several years. The shallow-water asteroid fauna of the region south of Cape Cod is relative depauperate, however, and it was not until 1958 that a sabbatic leave from Cornell, together with a Guggenheim fellowship, enabled me to spend several months at the Hopkins Marine Station at Pacific Grove, California, studying species of sea-stars I'd never seen before. This experience opened my eyes to the variety of ways in which different asteroid families had adapted, in a functional-anatomical sense, to different food habits and feeding methods.

Following up aspects o these diverse adaptations occupied my research interest during the remainder of my active professional career.

Birkeland, Charles (University of Guam). I have always been interested in animals, but as a boy I found terrestrial animals difficult to work with. They were either speedy, cryptic, at the tops of the trees, or hidden in the shrubbery. I enjoyed searching and getting glimpses, and frequently even good views. But they were frustrating for getting serious work accomplished. I thought birds, fishes, mammals and insects make good hobbies, but I would rather do serious work with large, slow animals.

In high school I had a summer job with the Illinois Natural History Survey, sampling forage-crop insects. We would take sweep samples in the open alfalfa fields, then dump several sweep-net loads into the cab of the pickup truck, hop in, close the door, and sample the galaxy of insects for particular species of economic interest as they spread themselves out on the windshield, attracted to the sunlight. In the Illinois summer, the temperature and humidity were usually about 100 (degrees F and %, respectively). As I worked in the hot, stuffy cab, searching and collecting selected species with an aspirator, the many insects would stick to me and drift into my eyes while they crawled in the sweat that poured down my face and neck. During those times, I thought that I would like to be a marine biologist, feel clean and never be hot and sticky.

Like many other marine biologists, I got imprinted on my first field trip in graduate school. On my first dive in Puget Sound, I encountered several species of starfish eating Ptilosarcus in a vast bed of sea pens. It was a spectacular and interesting sight. The starfish were large, surreal, bizarre, and beautiful, as were their prey. These echinoderms preying on anthozoans became the subject of my thesis right then, and for the last 22 years, it has been a major focus of my experiences on coral reefs. They have never become routine or boring.

Conand, Chantal (Universite de Britannia Occidentale). When I arrived from France and Senegal in New Caledonia in 1979, I wanted to continue studying fish biology. As in other tropical islands, the fishery in New Caledonia was considered at that time as not important enough to require scientific management. The New Caledonia economy was based on nickel and due to the nickel crisis the authorities wanted to diversify the sources of income and the artisanal fisheries. One of them, the beche-de-mer, was said to have been prosperous once but there was no information! I was asked by ORSTOM (Institut Francais de Recherches pour le Developpement en Cooperation) to undertake studies to determine which holothurian species are valuable, where they live, how they grow, reproduce, die, how much could be fished... I started sampling on reef flats and diving in the lagoons with admiration. It has been the start of my association with these wonderful creatures, although mostly depreciated by "non connaisseurs"! I soon met my new echinoderm colleagues at the Seminaire organized in Paris by Alain Guille and they became friends. (John, my English is

too poor to make a joke with nickel - "mining" - and nickel - "money" - with beche-de-mer!)

Farmanfarmaian, Allahverdi Abdul-Hossieh (Rutgers University). Toward the end of WW II, my guardian put me on a train in Teheran and, along with several of my brothers, sent me off to the American University of Beirut (AUB) Prep School (IC) "...so that I might become civilized and educated and leave my saintly mother to have some peace", his words. I was 13 and had never seen an echinoderm though I had collected shells on the beautiful shores of the Caspian Sea. Zenkevitch does not report any echinoderms in the Caspian (average salinity 12-13 ppt). To save fuel, the IC boarding masters dictated cold showers from April to October, and to make sure we "savages" took our showers, they herded us off to the beautiful AUB plage to swim in the Mediterranean. Mr. Damous, our athletics director, kept order with his piercing police whistle and giant torso. In spite of his severe injunctions and my bad right ear drum, I could not wait to explore the sea bottom. I had no diving implements other than my brief Bikini - the recyclable standard issue of the IC athletic department. It was there on an algae-covered rock, about 14 feet below, that I saw a purplish greenish spiny fuzz-ball - larger than a golfball - moving on that rock. I took a breath and returned to the same rock, and the creature was there and moving. I looked and found no head, no eyes, no antennae, no legs, arms, fins or claws. A little afraid, but mostly curious, I went to my brothers who were attending Mr. Damous' high diving lessons near the diving board. They would not believe my story and laughed at the idea of the moving creature without a head, eyes, legs, and we almost came to blows when my brother Tari said, "Oh, yeh, we have several of those in our class and one is named Verdi". Mr. Damous broke up the fight and ordered us to the showers. He told us to get dressed and report to him just outside the University gates where the vendor Hatab sold different kinds of foods and sandwiches to students. We dutifully turned up at the appointed time and place. Mr. Damous said something in Lebanese Arabic to Hatab. We Persians did not understand. Hatab went behind his cart and came back with a bucket of chilled sea-water, a plate, a loaf of French bread, a couple of fresh lemons and a peculiar knife. He then reached into the bucket and pulled out my creature - the Mediterranean <u>Echinus</u> of Aristotelian fame. I started to scream with laughter at my brothers who were looking for cracks to crawl into. Hatab deftly cut the creature at the ambitus into clean halves and placed it on the plate. Mr. Damous showed us how to pick the yellowish gonads with a small fork, place it on a piece of bread, squeeze a few drops of lemon juice and eat it. Tari did not like it but the rest of us enjoyed several of these sea urchins. Mr. Damous paid Hatab 80 Lebanese piasters and dismissed us in his usual military manner.

For years thereafter I looked for these creatures without heads, tails, right or left, front or back on shores, in museums, and in exhibitions with great curiosity. As a sophomore in my first invertebrate course, and later as a graduate student in D.P. Abbott's Marine Invertebrates Course and A.C. Giese's Comparative and Ecological Physiology Course at Stanford's Hopkins Marine

Station, I studied a variety of echinoderms. Scuba diving around Monterey, Catalina, Florida, Cayman, Woods Hole and Palau, I observed and collected many echinoderms and never ceased to marvel at their beauty and behavior. I did research on more than 30 species, representing all five living classes and ranging from the depth of the Monterey Canyon to the shores of Cape Cod, the sea tables of Naples, and the rocky beaches of Hormuz in the Persian Gulf. I read Cuenot and Hyman cover to cover twice and in part several times and consulted tons of other literature in several languages including German and Japanese. I published and presented many papers on the respiratory, circulatory, digestive, absorptive temperature tolerance, osmoregulatory, and reproductive physiology of echinoderms. For several years I taught a highly specialized course in echinoderm biology at Woods Hole. Finally, though I have worked on other animals, I have never stopped puzzling about echinoderms for the last 50 years (13-63). The puzzle never ends. I admire all who continue the struggle to unravel these great secrets.

Fenaux, Lucienne (Station Zoologique, Villefranche-sur-mer). After having obtained my Licence en Sciences Naturelles (Academie de Paris, 1958), I had two possibilities: commencing a third cycle of biological oceanography with the obligation of returning to my country Haiti after finishing my studies, or having a post as technician in a laboratory of plant physiology at the University of Paris. I liked the second possibility better as my future advisor, Dr. Camus, gave me the opportunity of beginning a doctoral program under his direction. Then I went to Villefranche to see Robert Fenaux, my future husband, who introduced me to Mr. Roger Lallier, a scientist with CNRS. Mr. Lallier spoke to me of his studies on embryonic determination and showed me the effects of lithium and zinc on the embryonic development of urchins. This was a blow to the heart! The material was fantastic: it was easy to observe under the stereomicroscope and the changes induced by lithium and zinc were spectacular. Now I knew that I wanted to work on echinoderm larvae but how to choose in a field so vast? Professeur Paul Bougis, director of the Station Zoologique of Villefranche-sur-mer, received me and spoke to me about larval nutrition that was still poorly known, of the experiments that could be done on larval growth raised with particles encountered naturally in the marine environment. This time my research project took form. But it was first necessary to know well larval ecology <u>in situ</u>, the gametogenic cycle of adults, the different changes in form the larvae took during the course of gametogenesis. The adults I could collect at Villefranche still had an unknown larval development. The literature of Muller, Mortensen, Giese and his collaborators, and those of other authors revealed by reading the book edited by Boolootian "Physiology of Echinodermata" became familiar to me... And this is how I presented a thesis titled "Aspects ecologiques de la reproduction des Echinides et Ophiurides de Villefranche-sur-Mer". Later I discovered that Richard Strathmann had the same passion...

Ferguson, John Caruthers (Eckerd College). Before deciding to be

an echinoderm biologist, I had to elect not to follow my parents into medicine and biomedical research. This departure occurred as an undergraduate at Duke, after reading N.J. Berrill's The Living Tide, with its description of marine life in the Dry Tortugas. A life studying sea animals pictured as much more rewarding than one emersed in human blood and guts. Knut Schmidt-Nielsen and his Comparative Physiology course further fascinated me with the beautiful diversity of animal functions. While enquiring into graduate schools to pursue this new interest, John Anderson intercepted my letter and invited me to focus my attention on invertebrates with him at Cornell. It as a big step to give up animals with backbones, but there was a lot to discover in these "other" animals, and they could be a good excuse to spend a lot of time at marine labs. Arriving at Cornell, I was surprised to find John Anderson off on sabbatical, leaving a note telling me, in effect, to choose an animal and get to work on something - anything! Thus, I had complete freedom on choose any animal group for my career. After considering all the alternatives, the answer was clear: starfish (and echinoderms were weird, puzzling, casually fascinating, and definitely marine - what else could be more interesting! Further, since Anderson also worked on them, he could provide me unique support and guidance. When Anderson finally did return, I found in him a true mentor who never farmed his work out on me, but provided a free, intellectual environment that fully encouraged my own creativity, subject only to the rigors of his constructive criticism. Being fortunate to find employment on a sea-front campus in Florida, I have been able to investigate through the years a number of basic properties of echinoderm biology. Each January I lead a sailing and study expedition with students to the Dry Tortugas, and try to pass on to them some of the spirit I inherited from Berrill (whom I have never met), Schmidt-Nielsen, and John Anderson.

Fischelson, Lev (Tel Aviv University). It was just at the beginning of my studies in the Gulf of Aqaba in 1951 when I became fascinated by the changeover from day-active to nocturnal animals. The most impressive was the appearance of the crinoids Lamprometra klunzingeri and Capillaster multiradiata that at this time covered all the coral forereef like a long-haired carpet. To observe this we used a normal flashlight inside a glass jar. This was before underwater lights became common.

The obstacle to overcome in observing crinoids was that one had to "fight" one's way through and between the most frightening long spines of the common Diadema setosum. Getting stung here and there on the stomach was worth it, however, and so one night I went out without a wetsuit, manoevering between the hostile spines. And there it was, on one site, that I lost my balance and fell over on my behind, landing of course on dozens of spines. It was very painful and I got angry and decided to crush this Diadema. Turning around, I pulled it out of me and discovered that it was not a Diadema, despite its black appearance. This was my first encounter with Echnothrix calarmaris, then a rare animal indeed on the Eilat reefs. From this time on I decided to study echinoderms and the rest is written history.

Holland, Nicholas Drew (Biological Oceanography, Scripps Institution of Oceanography, La Jolla). Growing up in southern Florida, I spent much of my time combing beaches for sea shells. I even took my specimens to the public library to match them up with the pictures in shell books to learn the scientific names. Although I was not adverse to including dried remains of starfishes and sea urchins in my collection, I was definitely not an echinoderm biologist in those years. Even so, whenever a grown-up would inquire as to my plans for a future career, I would always tell them I would be a marine biologist. Neither they nor I really knew what marine biologists really did for a living, but my answer never failed to satisfy everyone concerned. After leaving all oceans far behind, I majored in biology at a very small college in Minnesota. There, I stayed interested in the invertebrates in spite of a lean offering of living material (hydras, planarians, earthworms, and crayfishes). My differentiation into an echinoderm biologist took place at the MBL at Woods Hole in the summer of 1960 between my undergraduate and graduate school. I took the MBL invertebrate course (which long ago vanished beneath the rising tide of reductionism), which was taught by a series of instructors, each entrusted with a phylum or two. As a result, the quality of the teaching fluctuated wildly from the ridiculous to the sublime. Certainly, the best lecture series was given by Verdi Farmanfarmaian, who covered the echinoderms. That lecture series played a big part in bringing me into the echinoderm fold-- but it was not quite the whole story. The critical moment occurred in the middle of Verdi's performance, when the student next to me blurted out: "This sure is interesting, it's too bad you can't make a living doing it." I looked her in the eye (she's a college administrator now, and a very good one and I said: "We'll see about that!) The rest is history.

Jangoux, Michel (Universite Libre de Bruxelles). Until the age of 18 I was not particularly interested in biology, nor anything else except reading novels of all kinds, walks in the woods, and going out with friends. I registered in the school of medicine at the University of Brussels....as that pleased my parents, especially my mother. One of the required courses was zoology. The course was remarkably taught by a true zoologist (a specialist in fresh-water sponges) and with such enthusiasm that I decided to abandon the medical direction and registered in the section of biology of the faculty of science. In reality, all aspects of fundamental biology interested me and when after three years it was necessary to choose between botany, zoology, and molecular biology, it was a true rending. If I finally chose zoology, it was because it was the only department where research could be done in the marine environment. It was thus quite natural that, a year later, I went to the director of the laboratory of marine biology, Prof. Jean Bouillon, a specialist of hydrozoans, to ask him to accept me as a master's student. He very cordially welcomed me and asked me which group of animals I wished to study. I was not at all prepared for this question, being convinced that he was going to propose a study on hydropolyps or hydromedusae to me! He explained to me that he found it much more rewarding to have a student work on subjects of

which he was not a specialist. He then gave me two books (one of Monton on molluscs, and the other edited by Boolootian on echinoderms), and asked me to read them and return to see him two months later...this was in August 1968. The echinoderms pleased me more than the molluscs, both for aesthetic reasons and as I found them very mysterious. I was especially interested in reading the chapter by J.M. Anderson ("Aspects of nutritional physiology") and very intrigued by a small paragraph reporting the existence, in starfish, of small digestive organs of unknown function: the rectal caeca. I thus proposed to Prof. Bouillon to make this the subject of my master's thesis....and it was thus my researches on echinoderms began.

Johnson, Craig (University of Queensland, Brisbane). My story is simple. I had good lecturers as an undergraduate at the Univerity of Tasmania so from the beginning found echinoderms both interesting and aesthetic creatures. I was further motivated by Ken Mann when he visited the University on a lecture tour as a Senior Queens Fellow in my third year as an undergraduate. Ken gave a tremendous talk about the Nova Scotia "urchin situation". I was fascinated to hear of the outbreaks and destruction of kelp, and of the best pieces of Breen's, Fong's, Guerinot's and others of his students' work. Some good slides certainly helped stimulate my interest. Subsequently I wrote to Ken about the possibility of pursuing a PhD under his supervision in Halifax, and the rest, as they say, is history.

Levitan, Donald (University of California, Davis). In the summer of 1983 I went to the U.S. Virgin Islands to teach a course, and start my dissertation research on overgrowth interactions between encrusting taxa. When I got to the shore, I quickly realized that entering the water was impossible; from the intertidal down to the sand halo, the entire reef was covered spine tip to spine tip with the poisonous sea urchin Diadema antillarum. In fact, from a distance, the reef had a black hue caused by the hugh numbers of Diadema. When I finally managed to get into the water (by jumping off a dock), I noticed that the surface the sea urchins were feeding on were grazed clean. I began to wonder how individuals could survive and how populations could persist under these apparently food-limited conditions. This changed the direction of my research and started my interest in echinoderm biology.

Manchenko, Gennady (Institute of Marine Biology, Vladivostock). I am not an echinoderm biologist in the strict sense of the term. However my entering biological science was tightly connected with echinoderms. When I was still a school boy I, as many children in the former Soviet Union, dreamt to become a military pilot. In 1964 my dream almost became true after my entering the military aviation high school. However after only one year of studies at the school I drastically changed my mind and left the school. This mistake in my life-strategy cost me four years of life which I had to spend surviving in the Soviet Army. Nevertheless, I am very thankful to this period of my life as it stimulated me to think much more deeply about my being. As a result, I firmly decided to

enter the Division of Natural Sciences of the State University of Novosibirsk. I entered Novosibirsk University in 1968 and was graduated in 1973, majoring in "cytology and genetics". About one month before graduation from the University, I met Dr. Alexey V. Zirmunsky, the Director of the Institute of Marine Biology at Vladivostok. He invited me to work at the Genetics Laboratory headed by Alexander Pudovkin. The Institute was very young (it was founded in 1971) and no zoologists were very familiar with the great variety of invertebrate species inhabiting the Sea of Japan. Echinoderms and molluscs were perhaps the only invertebrate groups represented by species with large, attractive, and well-diagnosed individuals inhabiting the sublittoral zone and thus easily available for collection and identification. Fortunately, the most beautiful sea animals, the sea stars, were almost completely unstudied at that time in respect to the level of intraspecific genetic variability. So I began to study allozymic variation in sea stars using the enzyme electrophoresis technique. Since that time I studied isozymes in sea stars, sea urchins, sea cucumbers, and sea lilies. In 1981 I was invited by John Lawrence to take part in the International Echinoderm Conference at Tampa Bay and to prepare a report on genetic variation in echinoderms. However, my attempts to visit Tampa failed because of the well-known difficulties concerning travel from the U.S.S.R. at that time. My report was also not submitted to the Conference because of some unexplained delay of Soviet authorities in supplying me with the necessary permission to send the manuscript abroad. Although I am rather an isozymologist than an echinoderm biologist, I love echinoderms as they are beautiful and studying them is associated with a substantial part of my scientific life. I believe my love is not yet finished.

McNamara, K.J. (Palaeontology, Western Australian Museum, Perth): The lure of fossil echinoids has been a pervasive influence on my palaeontological career, even from the earliest days when I first started collecting fossils. Having been brought up on the chalk downland in Sussex in England, it is not surprising that when I first got bitten by the fossil bug when I was 9 years old that echinoids should have been one of my sought after treasures. While many Museum fossil collections in England would seem to indicate that the English Chalk is riddled with echinoids, this was certainly not the case in Sussex, and I spent many hours searching for those elusive urchins. My university training took me away from fossil echinoids, and following 4 years in the Precambrian at Aberdeen University my PhD at Cambridge was on Ordovician trilobites.

My first employment after completing my doctorate was at the University of Queensland in Australia. There I dabbled in trilobites and ammonites. After two years the job folded, and it was a case of returning to the UK or finding another in Australia. Scanning the local newspapers I found a 3 or 4 line advert that was to affect my future career quite dramatically. Graeme Philip, then Edgeworth David Professor at the University of Sydney, wanted a research assistant to work on Tertiary irregular echinoids with

him. Not being able to resist the lure of echinoids, I applied and got the job. As my research background had precluded any studies of echinoids I asked and got the job. As my research background had precluded any studies of echinoids, I asked Graeme what papers I should read. "Don't you dare read anything", he threatened. "I don't want you to be influenced by what other people have said. Work it all out for yourself!" This, curiously, turned out to be really quite good advice and perhaps was one of the reasons why I was able to combine my interest in heterochrony with the echinoid studies. Southern Australia has a magnificent Tertiary echinoid fauna, much of which had been hardly worked on. Not only did I have access to magnificent collections made by Bob Foster and his mother, but I was able to draw on many of the untouched collections in the Museums of Victoria and South Australia.

Not longer after starting in Sydney the job as Curator at the Western Australian Museum was advertised. With some reluctance I applied, having just got into the echinoid studies with Graeme, but when offered the job I could hardly refuse. But this opened up the even more untapped echinoid treasures of Western Australia and a lifetime's work.

Mooi, Rich (California Academy of Sciences). I was fortunate in being born to two extraordinary parents who fostered my interest in the natural world from a very early age. This was reinforced by a synergy with my younger brother. I remember sitting in the forests of local conservation areas around Toronto, Canada, drawing plants and animals from life, and spending hours with identification guides, learning the rudiments of evolutionary biology and systematics. I also recall watching every nature program that we could get on TV, and through this window on the planet, I discovered an inner drive to work in the ocean. At the age of 10, I decided that marine biology would be my calling, and almost every move I made in subsequent years was aimed at fulfilling this goal, in spite of my landlocked situation in the middle of Ontario. Camping trips to both coasts of Canada enhanced my desire to study marine organisms, and I practically lived in the pages of Rachel Carson's books.

In my first year at the University of Toronto, I had the audacity to think that I could just march into the office of the campus' resident marine biologist, and demand information and ideas for how to pursue my calling. Luckily, the man occupying the office was Malcolm Telford, and he indulged my brash enthusiasm to the point where my energies could be focused on a library project that searched databases for papers on deep-sea ecology. Little did I know that Malcolm was to become not only the most important academic influence on my career, but one of my closest friends as well. Naturally I took his marine biology field course, and the invertebrate zoology course, too. I really enjoyed all the stuff about worms, molluscs, and crustaceans, but it wasn't until he introduced the echinoderms as a weird bunch of mutated space garbage left over from an extraterrestrial's picnic that I had my niche. By this time, my early experience with drawing had developed into a real interest in wildlife painting and technical illustration, and it seemed as though the Echinodermata were the

perfect blend of artistic, aesthetic, and scientific wonder. I became a graduate student of Malcolm's who insisted that I was not working for him, but with him, an important distinction that emphasized to me the value of collaboration.

My master's degree dealt with tube-foot morphology of sand dollars, and I soon realized that as good as functional morphology was as a topic, it seemed to obtain much greater value as a comparative study. Which led me to phyogenetics, which in turn led me to Rick Winterbottom, a Royal Ontario Museum ichthyologist who introduced me to cladistics, and made me realize that phylogenetic analysis should be the basis of all comparative biology. My doctoral thesis put this idea to work, using sand dollars as a model for some of my wilder thoughts about miniaturization, and heterochrony within the Echinoidea. I obtained a post-doc with Dave Pawson at the National Museum in Washington, where I was fortunate in having access to the famous collections, as well as a conduit to collaborations with many international figures in echinology. My interests have consequently expanded to include deep-sea echinoids, and the evolution of the phylum as a whole - projects that I am fostering with Bruno David in Dijon, France. I have tried as best I can to maintain these contacts and am now pleased to have the opportunity to do so from a position at the California Academy. They seem happy to suffer my eccentricities for echinoderms, and take delight in pointing out to me that the value of the echinoid type of dollar is higher here than in Canada. Dendraster does seem to be larger in California.

Pentreath, Victor W. (University of Salford). A required component of my first degree in Zoology at St. Andrews University, Scotland, was the completion of a research project. My supervisor, Glen Conttrell in the Gatty Marine Laboratory, who was studying neurotransmittors in a range of invertebrate nervous systems, suggested I investigate the cholinergic system in starfish nerve. This proved an immediate fruitful source of the cholinergic triad, thus allowing me to extend the early observations of Bacq, and also to make some functional interpretations. However, the main growing awareness for me then was how little was known about the echinoderm nervous system and how few biologists had made a serious study of it.

Cold but happy hours spent on the windy Scottish shoreline, collecting various Asterias, Ophiothrix and Antedon with my friend and colleague Jim Cobb, also at the Gatty Marine Laboratory, led to a series of valuable collaborative investigations. Although it is now almost impossible to obtain funding for studies of echinoderm neurobiology, my deep interest remains.

Propp, Michael (Institute of Marine Biology, Vladivostock). I remember my first encounter with sea urchins perfectly well. From childhood I was fascinated by books of Jules Verne and about the sea, and dreamed myself as an explorer of the Ocean. So, when SCUBA appeared in the fifties, it as my chance. But Leningrad where I began to dive in 1957, is on the practically fresh Baltic

and Black Seas and nearly devoid of echinoderms. But in August 1959 I stood on the rocky shore of the Barents Sea in very cumbersome, home-made SCUBA ready to become the first man to dive in the Russian part of this sea. I stepped into the water - and this was my first contact with the wonder of Strongylocentrotus droebachiensis - as all the needles pricked my heel followed by trickles of ice-cold water. I slipped and bumped by bottom on the rock and - O! O! O! -the urchins were everywhere. I grabbed stones to regain my balance -and they were all covered by these wonderful animals. So a little later, having obtained the proper skill to extract crushed needles from my own skin, I simply could not make them the main point of my Ph.D.

Later I chose to supervise the research of my disciples and many urchins were sacrificed to measure respiration rates, dry weights and many other things. So I had my vengeance, but in due turn the urchins had theirs when I advised my last disciple to begin work with Diadema - he fled to Sebastopol on the Black Sea where he was unable to find any living echinoderms. This, unfortunately, happened to be the end for me of researching these fascinating animals.

Scheibling, Robert (McGill University). I suppose I became interested in echinoderms in a rather round-about way. When I enrolled in graduate school at McGill University in 1973, I was undecided about whether I wanted to study marine biology or animal behaviour. My supervisor, Carol Lalli was a malacologist and I thought I could indulge both of my interests, as well as my desire to work in some exotic place by undertaking a field study of predatory behaviour and territoriality in tropical octopuses. Somewhere in the Caribbean would be perfect, and the fact that McGill had a research station in Barbados fit well with my plan. So I diligently devoted myself to learning all I could about octopuses, and went to Barbados that first winter to begin some pilot studies. As it turned out, Barbados was no place to study octopuses (only because there were very few of them about), although I knew the Caribbean was right for me, maan! While on the rebound to find a new tropical animal to study, another student of Dr. Lalli's suggested I work on Oreaster reticulatus. He told me these sea stars occurred in large numbers in the Grenadines, where he had observed them feeding on urchins in seagrass beds. At the time, I was taken by Bob Paine's work on sea stars as keystone predators, and I thought I might be able to find a tropical analogue in Oreaster. In any event, I was interested in predator-prey interactions, and even if sea stars were brainless, it was still the Caribbean. When I searched the literature on Oreaster, I found that virtually nothing was known about its biology and ecology. It appeared that, while this species used to be widespread throughout the Caribbean, it had long been collected as a curio due to its handsome appearance and was now rare among the more populated islands like Barbados. I happened to see my first specimen in a shop window in downtown Montreal. It was part of a clothing display but I convinced the shop owner to sell it to me, and so the love affair began. The next thing I knew, I was on Carriacou, a remote desert island in the Grenadines, where I set out to learn what I could about this curious beast, armed only with a diving mask, snorkel and fins, and the companionship of a good woman. What more could one ask for? I suppose I learned more about life and about myself on that isolated and wondrous island than I did about Oreaster, but that experience paved the way to further adventures and discoveries, and ultimately decided my career. By the way, I soon found that the shallow lagoons off Carriacou were full of octopuses that no one had ever studied, but once I had stars in my eyes I never looked back. Those years in the Caribbean, studying the life of a sea star, were among the best years of my life.

Sibuet, Myriam (Institut francais de recherche pour l'exploitation de la mer, Brest). I was struck, during my first voyage in 1969 for three months aboard the ship Jean Charcot, by the abundance of echinoderms in the trawls and especially their unusual, nearly elegant forms. It was of course the genus Deima that attracted me! A long time the photo of this species was at my door and the figure of Herrouard in 1902 illustrated the first page of my state thesis! This typically marine group has seemed to me from the beginning of my research on the abyssal biology a group well adapted to the conditions of extreme life in the depths of the abyss. The

morphological characters are very peculiar and curious in certain cases and answer to a form of adaptation. I have sought to interpret the mode of life and the adaptation to the great depths in considering the echinoderms and especially the holothuroids as a model zoological group. Later the studies made in collaboration on the nutrition of holothuroids have led me again to interpret the detritivore system in using the holothuroid species as a model.

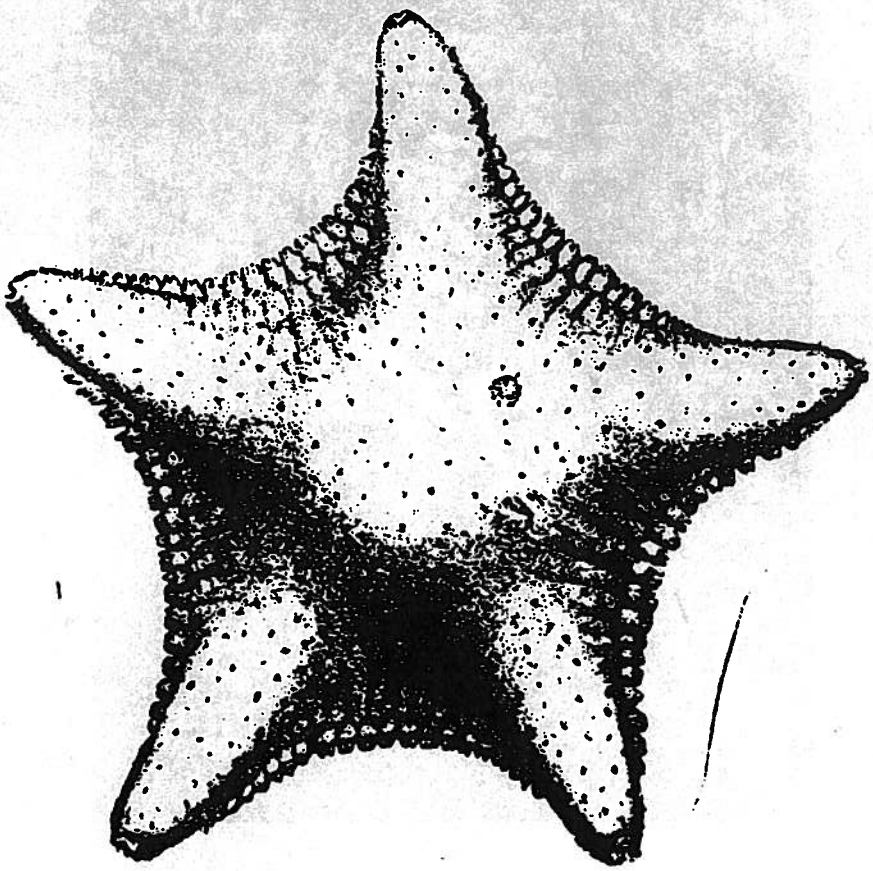
Woodley, Jeremy (Discovery Bay Marine Laboratory). When I was an undergraduate in the Zoology Department in Oxford, I attended a field course at the Millport marine Station. It was in the Easter vacation of, I think, 1959 and was attended by students from several other universities. We learned a lot and had a good time! Our visit overlapped with April Fool's Day when, I remember, the front gates of all the houses around Kames Bay were mysteriously interchanged. It was then that I learned how to bolt a door from the outside (on the inside) with a piece of string. One of my colleagues, excluded thus from his bedroom, borrowed. I regret to report that, when he took the ladder back, I wa secretly watching and slipped in and did it again!

Echinoderms? Oh, yes: we each had to choose a group of organisms to sort from communal collections, identify and display to the others. I chose brittle-stars because I thought they were pretty. Also something of a challenge because some of them looked rather similar. So it was that I first met those fascinating creatures, the burrowing amphiurids, dredged from the glutinous mud of the Firth of Clyde.

Later in my undergraduate career, I had a term of tutorials in vertebrate biology from David Nichols. Not surprisingly, we talked about echinoderms quite often, and he suggested that I stay on after graduation to work with him. I had been much influenced by Arthur Cain and the school of evolutionary ecology at Oxford, and my first thought was to find out more about the adaptive radiation of British brittle-stars. But that meant, not only finding out what they don, but how they do it, and one day David asked "How do brittle-star tube-feet work, anyway?@ We soon realized, not only that no-one knew the answer, but that the question had never really been asked. I resolved to try and answer it. Even before I graduated, I was back at Millport watching tube-feet and preserving brittle-stars for histology.

Even so, my career could have been in quite another field. I went on a University Expedition to British Guiana (as it then was), studying frogs and lizards in the rain fores of the Potaro River. I enjoyed working in the tropics, became fascinated by frogs, and actually secured a Brazilian Government Scholarship to continuye working with them, though it would have been for only one year. Had it been possible, in those distant days, to get support for a postgraduate project with fieldowrk overseas, I would now be a herpetologist! Funding was available to support projects at home, and I remember saying to myself that I would just knowck off this ittle project on brittle-star tube-feet, then go back to my real love, the study of tropical frogs. People do change, don't they?! Nonetheless, when I took my first real job, I moved to the

University of the West Indies in Jamaica because it offered research opportunities, not only on marine invertebrates, but on tropical frogs! As it turned out, they remained a hobby, and I moved deeper and deeper into the sea.



Bill

HOW I BEGAN TO STUDY ECHINODERMS ... Part 4.

Feldman, Abby L. (University College, Galway). Studying Zoology as an undergrad in Trinity College Dublin, I became fascinated with echinoderms and cnidarians during a course of lectures given by Frank Jeal. When it came time to choose a supervisor for my final year project I grabbed him before anyone else did! He suggested I work with brittlestars. During my course of study I met up with Elizabeth Sides who had worked with *Ophiothrix fragilis* in Jamaica for 15 years. My association with both of these echinoderm people only served to install the feeling in me. The final straw, so to speak, occurred when my father convinced me to learn how to dive. Being terrified of the water this was no easy feat for me, but on my very first open water dive in Dalkey Sound, east coast of Ireland, the first thing I saw was a bed of brittlestars! I became so excited that I forgot to be afraid and since then, I have decided that there is nothing more interesting than an echinoderm. Or an Echinoderm scientist!!

Messing, Charles G. (NOVA University). I became fascinated with the great diversity of marine invertebrates sometime during college (having finally been convinced by parents and teachers that I could not make a living from dinosaurs--if they only knew about Jurassic Park), but had no real understanding of systematic research or on which group to concentrate. At the University of Miami's Institute of Marine Science (now RSMAS) in 1970 for graduate school, I gravitated to the invertebrate museum and came under Frederick M. Bayer's tutelage. I recall being made aware that the large R/V Gerda and Pillsbury crinoid collection needed working up. Bayer gave me several volumes of A.H. Clark's crinoid monograph and also used crinoid specimens in teaching me how to use a camera lucida. However, Gilbert Voss, then department chair, recommended that I work on the development and taxonomy of a large neotanaid crustacean from the Puerto Rico Trench for my master's thesis. I pursued this subject for about a year, finally discovering that someone had recently monographed the entire family; my own work had to await its publication, which kept getting put off. Seeking an alternative, I expanded a project on crinoid taxonomy for Bayer and Voss's Systematics of Invertebrates course into a thesis on comatulid crinoids of the Straits of Florida.

Zavodnik, Dušan (Center for Marine Research, Rudjer Bošković Institute, Rovinj, Croatia). Although born in a "continent" town, from childhood I felt an affinity to the sea and marine

creatures. But in the post-second-world-war times of poverty, I have had few opportunities to visit the Adriatic Sea. Luckily, due to kind gifts from some of my 'sea acquaintances', my collection of land flora exiccata, minerals, and land and fresh water mollusc shells became enriched by marine animals. At the age of fifteen, I held an open exhibition of my collections for the city community: about 150 specimens of marine molluscs and also, some corals, dried sea stars and sea urchins. By the end of my college studentship, because I lacked the money to cover train expenses, I undertook a cycle journey about 600 kilometers to visit and practice at the Institute of Oceanography and Fisheries at Split. There the assistant Mr. J. Hoenigman introduced me to zooplankton research which was also my occupation during the initial years of my University education. My scientific interest turned mostly to pelagic Copepod Crustaceans, and as well I have much enjoyed the skin and "hand-pump" diving. Thus it happened that I collected a beautiful female parasitic copepod Cancerilla tubulata with ovisacs attached on the oral side of a disk of a tiny brittle-star concealed in an algal thalus. I succeeded in identifying the creature as Amphipholis squamata. This event turned my major interest to echinoderms, to their taxonomy, ecology and distribution in the Adriatic Sea. In 1960, after my military service was over, I was engaged as an assistant at the Marine Biological Station at Rovinj, which continues to be my employer institution. But alas, in our small state, and in a small institute, it very soon became evident that an exclusive engagement in echinoderm studies is a mere illusion. The funds were available for other tasks and therefore I have had to do research in physiology of sardines, in morphology and ecology of small pelagic fish, in zooplankton, benthic communities studies, shellfish culture, pollution studies and even hydrography of the north Adriatic Sea. In the bulk of the "indispensable" i.e. first ranked tasks, echinoderms could be treated only as a hobby task - and regrettably, they remained to me a hobby until now. But it is true that continuous studies of shallow water benthic communities, especially by SCUBA diving always were excellent opportunities to collect immense quantities of by-the-way data on echinoderm diversity and their behavior and distribution patterns.

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HOW I BEGAN TO STUDY ECHINODERMS ... Part 5.

Makra, Athena (Martin Ryan Institute, UCG, Ireland). I grew up in Greece and so I had the chance, since I was a child, to explore and admire the wonders of the sea. Even though I was snorkeling for years, my first really scientific view of the marine life was at the second year of the University (Athens University, Biology Department), when I attended the lectures and field trips of Hydrobiology and Invertebrate Zoology. I then started becoming interested on working with marine invertebrates, but it wasn't easy to choose what kind of animals I wanted to study!

Then, after the 3rd year, I had the chance (through an ERASMUS programme)to visit MRI and do my final year thesis there. Under the supervision of Prof. B.F. Keegan I worked on Echinoderms (*Amphiura filiformis*, in Galway Bay) for the first time and I was fascinated! Now, I am back in Ireland, doing my Ph.D. on another ophiuroid, *Acrocnida brachiata*. I can say now that those animals are really fascinating and it is so interesting working on them. At the moment, I have just started working on their population dynamics and their microdistribution in Killary, but I am interested in many aspects of their biology and ecology, like their burrowing and feeding behaviour, regeneration rates, effect on the sediment and many more. Furthermore, since they are not so much studied in Greece, I believe that I will have the chance to do some really genuine research on them when I return!

********** ECHINODERMS IN LITERATURE **********

Oe, K. 1974. The Silent Cry. "The young man had an enormous round head, the broad, helmetlike curve of his forehead giving the whole head the appearance of being a continuation of the face. The cheekbones projecting outward on each side and the blunt, square chin reminded one of nothing so much as a sea urchin in human guise. ... She was quite obviously suspicious of the Sea Urchin for having conferred with Takashi in a low voice, resolutely ignoring us. ... In a strong breeze that blew aimlessly about the valley beneath a blue sky, the young men were kicking the football around in silence and with suffocating intensity of purpose. The Sea Urchin in particularly was dashing about desperately, a thick towel wound round the head that sat so incongruously large on his short trunk."

Kipling, R. 1912. Just So Stories. "In the sea, once upon a time, O my Best Beloved, there was a Whale, and he ate fishes. He ate the starfish, and the garfish, and the crab and the dab, and the plaice and the dace, and the skate and his mate, and the mackereel and the pickereel, and the really truly twirly-whirly eel." From: "How the Whale got his Throat"

Morgan, B. 1992. Random Passage. "Each morning the children searched the beach for driftwood, feathers, shells, smooth stones, star fish, and the bleached bones of small creatures washed up by the sea."

-- contributed by J.M. Lawrence

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HOW I BEGAN TO STUDY ECHINODERMS ... Part 6.

Freeman, Steven M. - (The University of North Wales).

"The Star Shaped Disc"

As an undergraduate I spent one year working as a Naturalist on the west coast of Florida. Not being a native to these parts my first experience wading the shallows off Key Island was not one I'll forget easily! It wasn't the feeling of fish brushing against my skin, a reaction I thought provoked by the novelty of my pale legs, it was the curious lump under my foot. A closer examination revealed, to my amazement, a finely patterned star on the under side of an animal shaped like a disc.

Following this informal introduction to the sand dollar I soon became fascinated with all aspects of echinoderm life. At the end of my stay in the United States I returned to England, with my new found passion, to finish my studies. Shortly after graduating, I secured a scholarship to do a PhD at the University of North Wales. Now I spend my days dedicated to continuing this fascination, but with other members of the Asteroid family.

McClintock, James B. (The University of Alabama at Birmingham). As an incoming freshman at the University of California at Santa Cruz in the mid 1970's, my interests leaned towards English Literature. However, soon thereafter an intense and provocative Introductory Biology course presented simultaneously by three professors turned the tide, and I knew I had found my niche in the field of Biology. In my Junior year I had a marvelous opportunity to enroll in a ten-week Marine Invertebrate Course at Bodega Marine Laboratory, on the rocky coastline of northern California. Although the group of organisms that the course focused on changed each year, I was fortunate enough to come along at the exact time that Echinoderms made their debut as a course topic! For the next ten weeks, my fellow students and I were immersed in lectures on Echinoderm Biology. Moreover, each of us conducted hands on research on some aspect of echinoderm physiology, behavior, ecology, etc. The course had such a profound effect on the students involved that it really does not surprise me to look back 20 years and see that a number of the students in this course have successful careers working with echinoderms (for example Scott Smiley and Tim Pennington to name a few). The course also brought me together for the first time with John Pearse, who was, and remains, a guiding force in my professional career and echinoderm studies.

John Pearse invited me to work in his laboratory during the senior year of my undergraduate career. I conducted a senior thesis on the growth of the echinoid *Strongylocentrotus purpuratus* in contrasting habitats of the rocky intertidal. My interests in echinoderms grew and following the advice of John Pearse, I applied to conduct my graduate studies in the laboratory of John Lawrence at the University of South Florida. Here, I found a dynamic environment where I was guided by a leader in the field of Echinoderm Biology and surrounded by fellow students engaged in studying diverse aspects of echinoderm biology, encompassing echinoderm phylogeny, physiology, and ecology. In 1983, John Lawrence invited me to work on aspects of echinoderm reproduction on the subantarctic island of Kerguelen. This experience laid the foundation for six subsequent trips to the Antarctic sponsored by the NSF to study echinoderm reproduction, nutrition, chemical ecology and population biology. My antarctic work included a Postdoctoral Fellowship with John Pearse, investigating aspects of larval and reproductive biology in echinoderms at McMurdo Sound.

Now an Associate Professor at the University of Alabama at Birmingham, my graduate students and I have continued with studies of echinoderms. My Advanced Invertebrate Zoology course focuses specifically on the Echinodermata, providing students a rare opportunity to spend an entire semester studying this group. It has been fun to share my enthusiasm for echinoderms with both undergraduate and graduate students. And it is through my students that I find myself rediscovering the unique nature of this fascinating group of animals.

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Number 22 1997

HOW I BEGAN TO STUDY ECHINODERMS ... PART 7.

Rowe, Frank W.E. - (Goldbrook Boarding Kennels, Hoxne, Suffolk, U.K.)

For someone born under the astrological sign 'Pisces' (!!) and who lived his childhood by the sea on the north cornish coast, an early interest in echinoderms might have been expected! Such was NOT the case, for distant memories of school party visits to the shore were ones of an attitude of sheer boredom!!! This was all to change when I was invited to join the Zoology Department of the Natural History Museum in London as assistant to a certain Miss A.M. Clark. Duly, on Monday, October 3rd, 1960, I arrived in the echinoderm section. However, it was not until the next day (Ailsa worked on a Saturday instead of a Monday!) that I was to meet the person who was to instigate and inspire my career in echinoderm studies! But not even that yet! For, I recall my first job was to incorporate (write into a register and label - all good quill and ink stuff!) a collection of Antarctic ascidians (Ailsa was also responsible for these collections) and subsequently to spend a short time with Dr. Robin Millar (Millport, Scotland) learning the basics of ascidian identification! In the meanwhile, back at the camp, Ailsa decided we should prepare a monograph of the shallow-water echinoderms of the Indo-west Pacific region. I was set the tasks of searching the literature and tabulating the records and preparing the section covering the generic keys for the Holothuroidea. Concurrent curation duties included relabelling (by hand) the complete echinoderm collection. It was through this very basic duty that I became so familiar with, and fascinated by, firstly the shape and varied form of the living classes (even the holothurians!!) and then the scientific names associated with them. I recall, even now, my first echinoderm identification when I found a flat, pentagonal starfish in the bottom of a jar of holothurian specimens collected from Sri Lanka (then Ceylon)! Ailsa encouraged me to identify the specimen, which I did correctly as <u>Asterina sarasini</u>! So, through the encouragement and guidance of Ailsa Clark my career seemingly had become set!

My next great pleasure was in meeting, by correspondence, Dave Pawson, with whom I was then to write my first descriptive holothurian paper and who became such a supportive and continuing influence on my career and, more especially, such a firm friend.

At about the same time I resigned from the N.H.M. to complete my first and second degrees (my PhD thesis being one on sponge biology!!), though never losing touch with the echinoderm section (e.g. Review of the Holothuroidea). Next came a short period at

the Royal Albert Memorial Museum in Exeter and the privilege of examining Percy Sladen's collection (e.g. Report on Sladen Collection) as well as enjoying the company of David and Anne Nichols. This post was meant to last at least 3 years, but was cut short following the offer of a research post in the Australian Museum in Sydney, which later I joined in January, 1974.

Fifteen years, and a certain Xyloplax later, I decided to more or less hang up my podia for a quieter life running a dog kennel!!! Well, even that ambition has been partially thwarted! Early on in our time here I was walking our two dogs across an adjacent ploughed field only to find - you have guessed it? - an internal mould of an Echinocorys staring up at me from the plough (well-known for Cretaceous fossils). Even my long suffering wife, Mary, has conceded I cannot be released from my commitment to the Echinodermata, even in the midst of the East Anglian countryside!!!

I continue to identify small collections of specimens and photographs, when time permits, and continue my interest in the echinoderm scene whenever and wherever possible. I have so many colleagues and friends, made along the way, to thank for making my career such a happy, exciting and even now continuing one. Echinoderms are indeed the most fascinating creatures and the most rewarding to study and I feel very fortunate to have been involved!

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Abigail M. Moore (Hull University, U.K.)

Well it really all began by chance. I discovered coral reefs in Florida a few years ago, and instantly fell deeply in love... after a trip to the Red Sea, my (now ex-) husband didn't want to go on another coral reef holiday, so in Sept 1995 I joined an Operation Wallacea Expedition, as I really wanted to learn more. There I really loved the practical survey work, and I saw that it was possible to do what I had always dreamed of, and actually work in such an environment. When I was offered the opportunity to do an MSc (in Global Biodiversity, Monitoring and Conservation), with the project of surveying the Holothurians of the area where I had been on expedition, which is now the Wakatobi Marine National Park, I jumped at it immediately. Then I had to learn how to do it... All I knew about holothurians at this stage was how to recognise a few common species from the field guide we were using. I have since learned enough to know I cannot hope to learn more than a fraction of the available knowledge, and that even what is known is only scratching the surface of what there is to know about these fascinating

creatures. I have had a lot of help from Dr. Claude Massin of the IRSNB and Sven Uthicke, curently at AIMS. I don't know whether I shall continue in this field after the MSc is completed, but certainly I have developed an enduring interest in holothurians, and I shall always be keeping my eye open for them even when doing other work or even just relaxing in the water. I am never so happy as when in, on, under or by the sea... As well as the MSc course, I have now become a SCUBA instructor (PADI and BSAC) and will soon have my Yachtmaster Commercial Endorsment... so I should be able to find some work in a coral reef area. Eventually I would like to consider a PhD, if I can find funding for a suitable project.

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Materia-Rowland, Christine (Dept. of Environment and Land Management, Coastal and Marine Program, Hobart, Tasmania)

In 1986 I was undertaking a Bachelor of Applied Science Degree in Melbourne, Australia and was introduced to Mark O'Loughlin via a mutual friend. Mark assisted me with a minor research paper by providing a valuable critique of the work. I was invited to join him on a field excursion to a small Bay on Phillip Island in Victoria. It was on this first trip that we collected specimens of the cucumariid Staurothyone inconspicua which was brooding juveniles. From there I began attending Museum of Victoria volunteer work days where I spent my time curating the echinoderm collection. My interest and intrigue in these animals developed and we began making monthly trips to the Island to collect further specimens. Ten years and two children on since that first field trip I have collected thousands of specimens for the research collections of the Museum. I continue to work periodically on the group finding them incredibly interesting and diverse. I am grateful to Mark for the opportunities he provided in those early days and for where it has taken me.

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Susan Hottenrott (George Washington University, Washington D.C., Smithsonian Institution, Washington D.C.)

My father, whose training is in physics, often wonders aloud to me how I could possibly study such slimy creatures. I wish I could express how rewarding it is to work with echinoderms, and how most aren't particularly slimy at all! But alas, my poor father is also still trying to get my mother to dispose of the numerous bags of seashells I collected as a child during our

summer vacations in Maryland. I don't think he is prepared to hear about the wonderful world of echinoderms just yet.

When I am asked how I got started in this field, I have to think back to the oyster and clam shells I hunted for at the beach when I was little: the bigger, the better. Ultimately I searched for tiny little gastropods in shell hash. I often looked at the other kids (still picking up those big clam shells) and silently laughed at them for what they were overlooking. I am grateful that I was never forced to experience what it was like to have to leave my collection behind like so many other children. My parents let me take them all home, where they sit to this day.

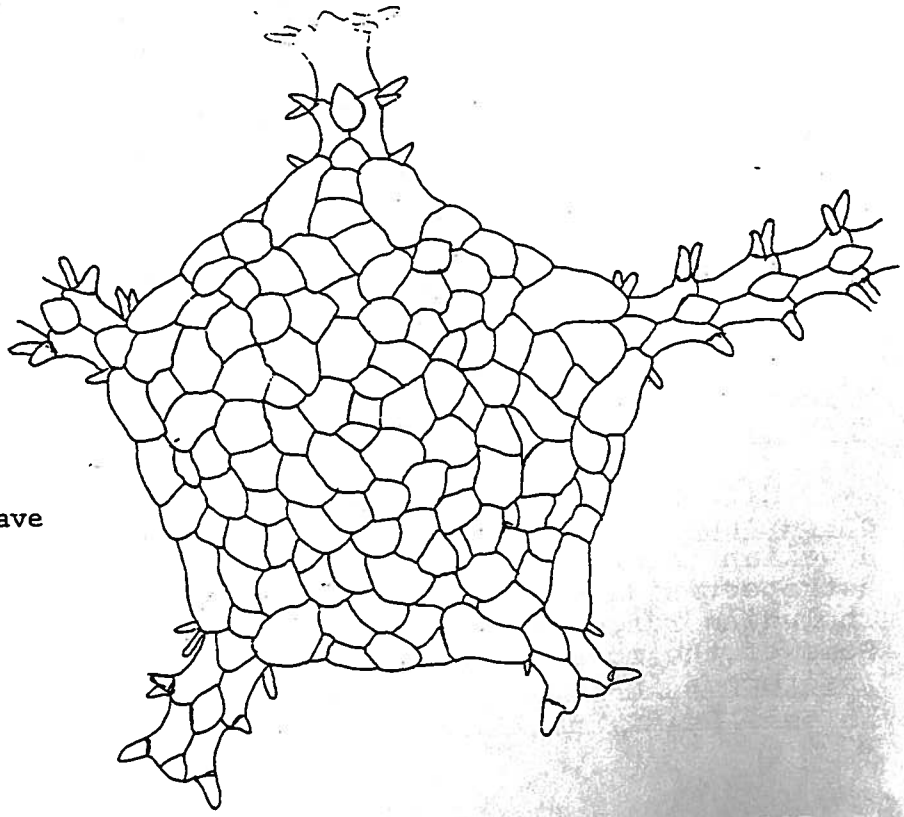
During the school year I would continue with my scientific endeavors. I passed through a number of phases, not (unfortunately) recalled in a glorious list of publications, but in the titles of my elementary school science fair projects: "Fungi in My Backyard" was a favorite of the judges. Of course, I defined my backyard a bit broadly and had my mother drive me around to other backyards in which I had eyed some huge fungus growing on a tree as I passed by on the school bus. In contrast, "Fossils of Dutchess County, New York" featured a number of fine brachiopods, collected solely from my front yard (quite the incomplete fossil record).

It is no surprise to me or my family that I have pursued an interest in systematic biology. The only question for me was what kind of creature would catch my eye for good. That moment came while I was on a summer course offered at the George Washington University entitled 'Tropical Marine Biology on the Island of San Salvador, Bahamas.' We had an unusual half day free from work. Our options were either to go to the beach or into a cave which, though marine, had a terrestrial entrance about half a mile inland. The cave, home to numerous bats, was cold, dark and had a guano based food web ("you'll never get it out of your clothes"). I weighed my options and headed straight for the beach to snorkel and add a few specimens to my shell collection. Soon after, two of the instructors of the course came hurriedly down the path with a small vial and cries of "look what we found!" It was a tiny white brittle star. I looked at this specimen back in the lab along with the other students before it began to autonomize and was preserved. No one had any clue what it was, and it was particularly unusual since extensive studies of the cave had never before revealed the presence of ophiuroids. I became quite interested in the prospect of working on identifying the ophiuroid as an independent study project for the upcoming semester.

When I returned to Washington D.C., the professor, Bob Knowlton, took me over to meet Dave Pawson at NMNH. Dave invited me to work at the museum and use the collections to try and identify the specimen. To this day, no one ever has. I have been back to

the cave once to search for additional specimens, but with no luck (the class, incidentally, will be offered next summer and I will hunt once again). But the experience at the museum was all I needed to find my niche. I worked on a cladistic analysis of the scolopendrina group of Ophiocoma during my senior year. I am now a Ph.D. student at George Washington University, which in the few years since I received my B.S. has inaugurated an excellent graduate program in systematic biology. I work at NMNH on the deep sea ophiuroid genera Ophiomusium and Ophiosphalma, as well as other genera in the Ophiolepididae. I plan a revision of Ophiomusium and Ophiosphalma, plus a cladistic analysis of the genera and of the family. I am interested in the evolution of these deep sea forms, which have also been identified as possible cases of progenesis. A phylogeny will allow me to investigate these theories.

Thanks to an NSF Dissertation Improvement Grant, I have been traveling to many collections around the world in search of key specimens. I have been able to finally put faces with some of the names listed in this newsletter, and that has been as enjoyable as finding the specimens (perhaps only a systematist knows how enjoyable that actually is!). Many thanks to all of you (a list would be far too long) who have helped me sort through your collections and who have loaned material to me. It will be invaluable for my study.



unknown Ophiurinae
from Bahamian cave

- Susan Hottenrott

November 23 1998

☆ HOW I BEGAN TO STUDY ECHINODERMS. ☆
PART 8.

John Lucas, James Cook University, Australia

I began to study echinoderms due to a villain.

My story goes back to the late 60s and early 70s when I was a new lecturer at James Cook University in northern Queensland. My PhD at University of Western Australia had been on various aspects of the biology of an insignificant group of spider crabs. It involved experimental studies on their ecophysiology. Thus, when I was appointed to JCU in 1968, I went there with plans to research crustaceans of the Great Barrier Reef. My plans were soon dashed. It was only possible to get out to the reefs nearest to Townsville by a 3 hour boat trip and these boat trips were organised by a shell-collectors' club. The trips only went out in winter months on days of spring low tides (to enable the shell-collectors to walk on the reef at low tide) and they only went out in calm weather. I waited through months of cancelled trips, due to bad weather, before I got out to the Great Barrier Reef. The coral reef community that I saw was overwhelming in beauty and complexity. It did not seem possible to take any component and research it in a sensible fashion. Thus, I gave up the idea of working on crustaceans of the GBR and looked to working on the intertidal crabs of the local mangroves (more than 40 crab species).

Then along came *Acanthaster planci*, the Crown-of-thorns starfish, "eating its way southwards" along the GBR in the late 60s. The late Dr Robert Endean, who was always prepared to give a strong opinion, stirred up public concern through the media. There was sufficient public concern about this villainous starfishes' threat to the GBR that Queensland government funds were made available for research into its ecology and coral damage. By chance, I became involved in a minor way with the Queensland government group that was researching the starfish. Although the larvae of *Acanthaster* were totally different to those of the crustaceans that I had previously worked with, I offered to have a go at rearing these larvae and was successful. There they were: tiny 5-armed starfish that subsequently grew and added arms.

Federal government funding was allocated for research on *Acanthaster* and I had a head start in the competition for funding with my experience of researching the early lifecycle. I then started from the hypothesis that the high fecundity of this starfish is the source of "plagues" in combination with environmental factors that strongly influence the survival of the initial tens of millions of eggs and larvae. Hence I engaged in a series of laboratory studies on the lifecycle of *Acanthaster* and environmental factors influencing the various stages. The problem of

access to the GBR was solved through obtaining enough funding to hire a small fast boat to go out to the reef according to my needs for starfish. The problem of identifying a manageable research topic was solved by the villain.

Ultimately, I teamed up with the eminent echinodermologist, Dr. Chuck Birkeland of University of Guam, to produced a book, "*Acanthaster planci*: Major Management Problem of Coral Reefs", CRC Press. We complemented each other's interests, in that Chuck's interests were primarily in field studies while mine were primarily in laboratory studies. Unfortunately, the book did not become an international best seller (probably its price ensured that it was strictly in the category of a library purchase).

The Crown-of-thorns starfish is still a "villain" in the destruction that it causes to many coral reefs in the Indo-Pacific region. We now know a lot about its biology and ecology, but there are still fundamental questions about the "plagues" that remain unanswered. These big questions are now in hands of the newer generation of coral reef ecologists and echinodermologists.

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Ram Mohan M.K. (MRC of CMFRI, Tamilnadu, India).

After completing the course work of my Ph.D. program, I was fortunate to be put under Dr. D.B. James, the eminent Echinoderm specialist, to work on Echinoderms. At that time I had very limited knowledge of echinoderms, particularly confined to starfishes. Later we were asked to give two credit seminars as a part of our program, for which I selected the topics on holothurian resources and reproductive biology of some holothurians seen in India. While preparing for these seminars I had a fair amount of reading on not only holothuroids but also echinoderms in general. Slowly but steadily I developed an interest in the group. At CMFRI, Cochin and also during my brief stay at Tuticorin, I came across a good deal of literature, which gave me more insight into the characteristics of echinoderms, particularly taxonomy, diversity and reproductive features. At present I am doing my research on reproductive biology of holothurians. There is only one word which comes to mind when I think of echinoderms - 'Namasthe' (the Indian equivalent for Salute).

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Payikat Sahadevan Asha. (T.R.C. of CMFRI, Tuticorin, India).

During my post-graduation, I was not having much idea on sea cucumbers. After that I got through the Agriculture Research Service as a scientist in C.M.F.R.I. I was in Fisheries Environmental Management Division and was very much eager to know about the projects allotted to me. After one month I got the transfer along with the projects allotted. I was surprised to know that I have to work under an eminent Senior Scientist Dr. D.B. James. I was very much enthusiastic to collect much information about sea cucumbers. After my preliminary discussion with Dr. James, I came to know that my knowledge is very poor, and I have to work a lot. When I started working, I could understand that the echinoderm - sea cucumber is an interesting animal group both economically and experimentally and it is the responsibility of all to conserve them as a scavenger of marine environment.

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Robert Singletary (University of Bridgeport, Connecticut)

In the late 60's I was a new graduate stuedent in Hilary Moore's laboratory. At that time the research focus was on the autoecology ofthe animals that made up the benthic community of Biscayne Bay. While many of the animals in the community had been studied, no one had tackled the most abundant animals, the brittle stars. Therefore, I naively decided that would be a fruitful research area. I soon found out why these animals were avoided, the brittle part of their name was their most impressive characteristic. It seemed that all you had to do was look at these animals and they would break apart. Additionally, we were in Miami, Florida, within easy reach of coral reefs, and the animals I chose to study lived in the muddy bottoms of turbid Biscayne Bay. Still the research was rewarding, and I was able to visit the reefs to obtain comparative information. I also learned what fascinating animals echinoderms are and I continue to marvel at them.

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Number 24 1999

How I began studying Echinoderms - Part 9.

Karim Mezali (ISMAL - Aquaculture Lab, Tipaza-Algeria)

I am an Algerian student researcher preparing doctoral thesis. My main research subject is the systematics and ecology of some Mediterranean "sea cucumbers". However, this kind of research is seldom undertaken in Algeria, and I'm the only researcher working in this area, so it is very difficult indeed to conduct very well my research work.

The **abstract** of my last **magister thesis**:

Few studies have been undertaken on the biology and the ecology of holothurians. In Algeria these studies are particularly few indeed. To make up this lack, a detailed study is carried out on the systematic, the biology, the distribution and the population dynamics of five holothurians species namely *Holothuria tubulosa, Holothuria polii, Holothuria forskali, Holothuria sanctori* and *Holothuria stellati.* A particular attention has been reserved to the micro-distribution of these species in the *Posidonia oceanica* meadow.

This study was done in one shallow-water area in the Sidi-Fredj peninsula, situated at about 20 km West of Algiers, which covers a surface of 500m2 and a depth of between -0.5 and -3m. The sampling was done by scuba diving during two periods: the first period extending from June 1994 to December 1994, was destructive. It consists of mensurations and sampling of five batch composed of (115) *H. tubulosa*, (108) *H. polii*, (89) *H. forskali*, (88) *H. sanctori* and (46) *H. stellati*, and this for studying the biometrics relations. The second period not destructive, consists of counting and measuring, extend on one annual cycle, from March 1995 to February 1996, for the aim of studying the structure and dynamic of each holothurian populations.

By this study, we have defined systematically each holothurian species. The census established showed a clear dominance of *H. tubulosa* et *H. polii*. The biometrics analysis revealed one allometric relation between the contracted length and the body weight. The numerous young holothurians recorded on the fall period, result of the sexual reproduction; the reduced number of juveniles in the winter period should result from the viviparity of the adults. The micro-distribution of the holothurians in the studied area, shows that *H. tubulosa, H. polii* and *H. stellati* have a random distribution in the *Posidonia oceanica* sea grass, whereas *H. forskali* and *H.sanctori* confine themselves in the "tombants de matte" and between boulders. The growth parameters, the recruitment month and the age have been estimated only for *H. tubulosa, H. polii* and *H. sanctori*.

The data obtained in this study was compared to those obtained in others Mediterranean and tropical stations.

KEYS WORDS: aspidochirote holothurians, Posidonia oceanica sea grass, algerian basin, micro-distribution, spicules, contracted length, growth parameters, longevity, recruitment, biomass.

Number 25 2000

☆☆☆ HOW I BEGAN STUDYING ECHINODERMS ☆☆☆

PART 10

Elisa Maldonado - UCLA

It all began at 3 a.m. on June 21, 1997, when I met Gordon Hendler for the first time at the gates of the PG&E Nuclear Power Plant. Gordon had planned this VERY early morning venture as the prologue to the summer portion of the Museum Research Apprenticeship Program (MRAP) at the Los Angeles County Natural History Museum. I knew little about brittle stars, except for the fact that when *Ophioderma panamense* is involved in a righting-race against *Asterina miniata* and *Strongylocentrotus franciscanus*, the large brittle star is always sure to win. I learned this while volunteering summers at the Cabrillo Marine Aquarium in San Pedro, California, where I would take bets from captivated five-year-olds on which echinoderm could flip over the fastest.

When I read the brittle star project description, which included the early morning collecting trip, I was smitten by the prospect of a summer adventure. Gordon said he wanted to see what we were made of, and boy did he mean what he said! Not only did our tasks include climbing down a vertical cliff on a rickety wooden ladder with only headlamps to light our way, but we also had to use these headlamps to search among algae holdfasts for brittle stars no bigger than a pencil eraser. My fellow MRAPer, Jessica Denton, and I were quite happy with our findings…until Gordon let us know that we had found only one specimen of the elusive species that was to be our summer research project.

Plan B was put into action, and Jessica and I began the search for baby *Ophiomastix annulosa* within the reproductive pouches of adult *Ophiocoma scolopendrina*. It was so exciting to find a tiny red-spotted arm protruding from slits on a midnight black disk. I was hooked. I continued coming into the museum in my senior year of high school, spending afternoons and days off searching for baby *Ophiomastix*. Needless to say, brittle stars and marine biology had me so captivated that I have continued working in Gordon's lab to this very day.

I assume every echinoderm biologist has spent a little time studying each group before settling on their animal of choice. Sure Gordon would have loved for me to focus all of my attention on ophiuroids for the rest of my life, but I needed to get out and explore the echinoderm world! So, this past summer I headed to Washington D.C. to work with Dave Pawson as part of the Research Training Program at the National Museum of Natural History. I studied the ecology of deep-sea feather stars, a group of animals I had previously been unfamiliar with. I returned to Los Angeles in good spirits, excited by all the new things I had learned about feather stars and sea cucumbers (after a crash course on their ecology and spicule identification). I have also become excited about deep-sea research, which has shown me new avenues that I never dreamed possible!

Echinoderms blow my mind. It's so amazing how animals that appear to be so simple can have such complex lifestyles, and play just as important a role in the world's oceans as any other marine organism. No one can say that arm regeneration and starfish stomach feeding habits are not cool! I am now a third-year marine biology major at UCLA, and I plan on enrolling in a Ph.D. program in three years. Provided that nothing else catches my attention (which hasn't happened yet), I hope to continue studying the ecology of echinoderms in graduate school (and maybe for the rest of my life?? It could happen!).

Alexandr Yevdokimov / Vladivostok, Russia

I was born in Vladivostok, Russia November 1, 1969, graduated Vladivostok Medical University as a physician in 1995. I was interested in academic science more then to be a practitioner and spent a lot of time for the intent study of embryology at the Department of Histology and Embryology, Vladivostok Medical University. I studied early ontogenesis and objects of my studying were mainly *Strongylocentrotus intermedius* and *Strongylocentrotus nudus*. I continued my research after I graduated Medical University together with colleagues from TINRO-Pacific Research Fishery Center (Vladivostok). We made publication in1996 (Seasonal characteristics of spermatogenesis *Strongylocentrotus intermedius*) /Evdokimov V./Yevdokimov A., Russian Research Institute of Fishering Journal, (March.1996.N1286-px96.) Couple years I was far from studying Echinodermata.

Now I am working as Japanese language interpreter (and translator) for a small JointVenture Company (Russia-Japan). We work with Anadara Broughtoni, Spisula Sachalinensis and Carbiculidae. I am interested in reproduction and ecology problems. Our Japanese partners have constant interest in *Strongylocentrotus intermedius* and *Strongylocentrotus nudus*.

This year I am going to continue my education. It will probably be a post-graduate course in Biology (Echinodermata). I am interested in studying effects of visible light on ontogenesis .I am presently studying effects of visible light (520 nm and 720 nm) on reproduction and ontogenesis of *Strongylocentrotus intermedius* and *Strongylocentrotus nudus*.

I will be very thankful if I can get contacts with specialists in Echinodermata and ecologists.
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Jacob Dafni / Eilat, Israel

It was 1979, when I was looking for a subject for a PhD study. Fifteen years earlier I studied the effect of pollution on an invertebrate community species diversity, in order to assess and suggest using this method to quantify the over-all effect of pollution (without the necessity to determine the level of the individual pollutants). The most polluted site was a shallow UW slope opposite a combined power station with a desalination plant. The pollutants were thermo-haline sea water with frequent occurrence of heavy metals and organophosphates in these waters. This time I was

astonished by the sight of hundreds of sea-urchins - up to 2/3 of *Tripneustes gratilla* population - that were highly deformed - their H/D ratio reached 1.0-1.5 compared to the normal ratio - 0.55. It was obvious that these pollutants are to blame, but the mechanism was unexplained. I took the challenge and started to record the phenomenon and try to make sense out of this. Later, I found only 2 km from the first site, in an artificial estuary, to which local hotels dumped their wastewater, a second type of deformity - 3/4 of the most affected population of *T.g. elatensis* (n. ssp.) were flatter (H/D < 0.5), very often with deep concave apex, resting upon Aristotle's lantern top. Literature survey revealed that such proportions of abnormal tests in sea-urchins were never recorded elsewhere.

Preliminary observations in the deformed tests suggested that whatever the pollutant was, it twisted a highly symmetrical equilibrium that governs the morphogenesis of echinoid test, which is basically genetic, but I felt that environment -- in the form of external pressure translated through the force applied by the tubefeet and other contractile and elastic tissues - mesenterial threads, collagen fibers etc. - affects the final shape.

This study which lasted for 5 years was exhilarating for me: it demonstrated to me the marvelous symmetry of these animals' morphogenesis. Try to imagine a sea urchin with 4 ambulacra and a lantern made of 5 jaws - obviously pinched at an early stage. What is the regulative forces that are responsible to the highly tetramerous symmetry it shows. I hypothesized that it is done by a biomechanical equilibrium. I gathered much circumstantial evidence, and I also tested D'Arcy Thompson's (early 20th century) hypothesis that regular echinoids which grow on sand (with less ambulacral pull) tend to be rounder (have a higher H/D ratio) than those living on hard substrate, and lo, - I had managed to establish it. I concluded my study by publishing a "Biomechanical Model for the Morphogenesis of the Echinoid Test" with possible implications to its phylogeny, which was hailed by some, others were more sceptic. I find it encouraging that some students took the hypothesis and tested the model experimentally. My last echinoderm paper is from 1992 (a comprehensive list of my papers can be found in my web-site **www.come.to/jacob-dafni** - Come and visit).

To make a long story short, I was overwhelmed by the mechanical aspects of these animals' behavior - that use hydraulic forces to move, an unconventional coordination system to regulate the pull of the tubefeet, and moves to a desired direction - aided by light although they have no eyesight - simultaneously holding firmly in other directions. I was no less inspired by the rare specimens of echinodermologists I have met in conferences - cheerful, friendly, and cooperative.

Unfortunately, I was too old at that time to start an echinoderm career, and I have drifted to other fields. Presently, upon my retirement, I am willing to actively take part or otherwise cooperate in ongoing studies that involve Red Sea echinoderms - taxonomy, skeletogenesis, field studies etc.

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☆☆☆ How I Began Studying Echinoderms. Part 11. ☆☆☆

Casey Burns - Wind Instrument Maker and Occasional Paleontologist

My 8th grade science fair project of extracting fossil pollen from coal caught the attention of the local science museum in Portland, which ran a science research center for high school students. The paleo wing was run by David Taylor, who suggested that I pursue my interest in the nearby marine Keasey Formation. We visited the legendary Mist crinoid locality - my first exposure to crinoids - and I was immediately hooked and fascinated. Thus, instead of attending sock-hops and football games, I spent my high school afternoons and weekends obsessed, crawling all over NW Oregon looking for echinoderm fossils, or working at an S. S. White sandblaster that threatened to give me chronic bronchitus! Summers all of us headed to the Hancock Field Station in Eastern Oregon where we dug up large Eocene vertebrates (boring....), and enjoyed the 60's a few years late. Hancock became the center of our universe and community. Everyone called me "Crinoid".

My college advisors frankly told me there was no point in continuing my echinoderm obsession. I should have gone elsewhere, but at PSU, a geology student was basically trained to find oil for the oil companies (not what I wanted to pursue, especially as a militant bicyclist!), so I went after other interests in and out of school and eventually created a career as a self employed maker of wind instruments, such as wooden flutes and unusual species of bagpipe. My paleontology interests waned, especially as I moved farther away from NW Oregon. During that time, unfortunately, the Mist locality was more or less illegally mined for commercial purposes - I should have been paying more attention - and any thoughts of returning to this fascination seemed remote.

Eventually, my family and I moved outside of Seattle. A few years later, a group called the Northwest Paleontological Association formed and met at the Burke Museum at UW. I quickly found myself involved as the Association's newletter editor. Through field trips, contacts and access to the Burke's underbelly as a volunteer, I began to explore western Washington's paleontology avocationally, as well as re-exploring NW Oregon's. One day, while examining a Keasey Formation locality that had produced a largish (20cm) isopod, my wife Nancy stumbled upon a very nicely preserved spatangoid. Further collecting produced several more.

Liz Nesbitt, curator of invertebrate paleo at the Burke, suggested that I contact her friend Rich Mooi at CAS, who kindly took me under his wing to study these together, and to provide me with some necessary guidance and instruction. This was just the beginning, and was the rekindling of my fascination with these wonderful echinoderms. Since then, we have been working on several fronts together, and have enjoyed several great moments of wit, repartee and friendship. Our first paper, "An Overview of the Eocene - Oligocene Echinoderm Faunas of the Pacific NW", is currently in press.

I very much enjoy this experience of riding the fence as an avocational paleontologist, working with fellow amateur collectors who have provided me with several important specimens (all of which will end up in appropriate repositories!) or assisted in the field, and with professional paleontologists and biologists who graciously recognize the passion, value and legitimacy of my activities.

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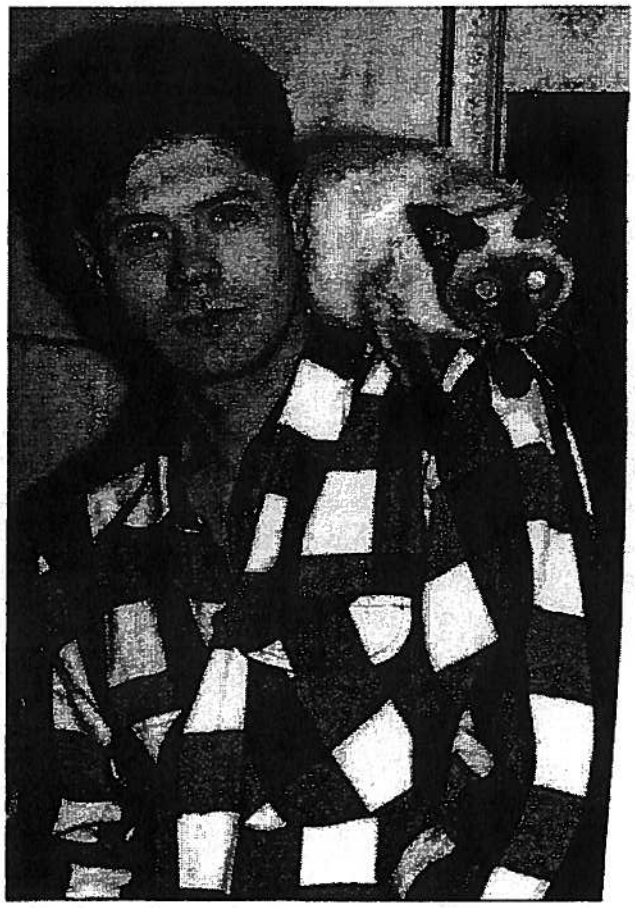
Grigory Winter, lecturer of Cherepovets branch office of Russian Academy of Education University; post graduate student of the faculty of Geology of Saint-Petersburg University.



This picture was taken a month after the windfall of a new Echinodermata in Cherepovets (with the favorite cat Susanna on the shoulder).

I was born in the year 1969 in the Russian Far East, in Vladivostock-city. My parents are famous in Russia philologists and did a lot to provoke my interest in natural history. The first collection of minerals and rocks was presented to me before my going to school. In the year 1982 my family went to European part of Russia to the steel city of Cherepovets. By this time the collection of rocks and minerals become bigger and included some fossils. In the year 1987 I entered Vologda State Pedagogical University, the faculty of Natural Geography, where I studied paleontology and geology for 5 years, specializing in geology of the Northern European part of Russia. In the year 1993 I began to work at Cherepovets State University at the chair of natural history and ecology. At this time I described several rocks and minerals unknown in Vologda region. In 1996 I made my main windfall in the historic center of Cherepovets at the bank of river – the representative of unknown species of Ophiocistia class. In year 1997 I began to work at Cherepovets branch office of Russian Academy of Education University where larger possibilities for

creative work were given. Working there I take post graduate courses at the faculty of Geology of Saint-Petersburg State University.

Due to poor investigation of Vologda region the sphere of my interest is very wide and includes many questions in geology and paleontology.

The spheres of the interest:

- description of not investigated semiprecious rocks and minerals
- founding and description of rare representatives of sea fauna of Carbon
- reconstruction of the found fossils (team-work with Mr. Roman Fedorov - the head of Cherepovets University Biological & Ecological laboratory)
- investigation of the modern relief of Vologda region forming process due to plate-tectonical model of construction of lithosphere (taking Severnie Uvali Hills – the largest hills of the North of European part of Russis as example)
- analyses of the mould of the forefoot of Notosaur found in Cherepovets in the summer of 2001.
- studying of phylogenetic table of Echinodermata due to the windfall of Augustina winteri

The results of my researches are published in the bulletins of the scientific works of Cherepovets scientists and in the report of regional geological department. At the end of 2001 year a special brochure "Conception research of Severnie Uvali Hills" was published in the local State University (Cherepovets).

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