

SEA URCHINS

I.

It was an early afternoon on a dry and sultry day in the last week of July, 1958. Two students sat on the edge of a metal frame cot in the small laboratory on the 3rd floor of the Marine Biological Laboratories in Woods Hole, Massachusetts. On a table next to the cot books were stacked at random. A heap of stenographic tablets, hard-covered loose-leaf notebooks, data-sheets and assorted papers of all shapes and sizes climbed upwards from the floor to a height of four feet.

"Hey Clyde , it's really great, us getting this chance to spend the summer here at the MBL, don't you think?"

" You bet, Jeff! You meet lots of famous scientists, that's for sure. Once in awhile you run into somebody working in your own field, even Nobel Prize winners who treat you like pals, just like ordinary human beings ! It's such a terrific place to do biology. Good beaches, lots of sunshine, a fantastic library: you can't beat that. "

The morning light entered the room through two large windows with low sills and bordered by dark frames. One stood at the far end of the cot; the other, set in the eastern face of the protruding southwest wing of the MBL building gave access to an unimpeded view of the limitless vistas of the Atlantic Ocean.

Cartons of beer cans were piled one on top of the other at the foot of the cot. The cover on the uppermost had been torn open. Two emptied beer cans had already gone into the trash basket, and two new ones were cradled on their stomachs. The churchkey lying on the drainboard to the sink had been tossed there less than ten minutes before.

Now they leaned their backs against the wall. It was Clyde Cytochrome's first day in the famous marine biological research station at Woods Hole, the village of scientists at the southernmost tip of Cape Cod. His research grant had been sponsored by his thesis advisor Dr Kurt Bergleson, professor in the biology department at Case Western University and a recognized authority on echinoderms. Bergleson was also on the faculty for the MBL summer school , and had so arranged things that his prize grad student would be there with him.

Jeff Benthic, still an undergraduate, had preceded Clyde in Woods Hole by a little less than a month. Now he was enrolled in the Invertebrate Zoology course being taught in the pair of frame buildings facing the main

entrance to the MBL on the street named, appropriately if with little imagination, MBL Street .

Jeff's enthusiasm matched his friend's :

" Hey, Clyde, you bet! It's just - out of sight, being up here! Anyway you can describe your research to me?"

"Sure." Clyde took a swig of beer and choked.

"I'm sorry. Take your time." About a minute passed before Clyde replied:

"Sea urchins ; obviously. That's why Bergleson wanted me here. Tube foot respiration in sea urchins. "

" Yea! That's some big field nowadays so they tell me. What's your take on respiration? Guess they gotta breathe, don't they, just like us?"

" Yea - sure - they do. I'll be studying respiration under conditions of more or less air, basically."

Jeff looked about the room:

"What's that humongous do-hickey over there by the wall?"

He indicated an assemblage of instruments, containers and accessories taking up most of the space of the wall separating the lab from the 3rd floor corridor. The light streaming across the room from the front window caused it to stand out in bold relief.

" My pride and joy, Jeff! Go on: take a good look at it. Better still, make a tour of inspection." As he stood up, Clyde continued talking : " It looks complicated, I admit. The fishtank has been prepared to reproduced as closely as possible the sea urchin's normal benthic environment, that is to say, sea water, sand and kelp under pressure. In the course of my experiments several basic gases in a pure state will be introduced in varying proportions and combinations. By manipulating pressure and temperature I'll be able to bring the global respiration of the population into stable equilibrium, then read the data off the different sorts of gauges surrounding the tank. It's simple, really. Think of it as somewhere between a frying pan and a pressure cooker."

"Yeah Clyde. Say, what's it called?"

"Oh", Clyde affected the stance of a modest individual ashamed of having to boast, " I've dubbed it the 'Cuisinart'."

The Cuisinart was a tank of the sort used to house pet goldfish. Its approximate dimensions, in feet, were 1.5 x 2 by 4. About three-quarters filled with water, its floor was seeded with pebbles, sand piles and nutrient seaweed. Six rubber hoses emerged through holes in its wooden cover, diverging to an equal number of tall gas

storage tanks standing upright against the side wall. The outermost hose was green and labeled Oxygen. Nitrogen was on the red hose going to the tank to its left. From right to left there followed, : yellow, Carbon Dioxide; brown, Hydrogen, blue, Ammonia; orange, Methane.

" 'How do sea urchins breathe? ' , Clyde intoned rhetorically, already mocking the gestures of the incipient professor: " That question is but a tiny scrap in the measureless storehouse of nature's undelivered secrets , " he scratched behind an ear, " yet innumerable monographs have been written on this one subject alone. There's lots of data around, all very inconclusive. No one else to my mind has ever proposed anything like my experiments. The boss - Doc Bergleson that is, likes my ideas. Man!" Clyde took a deep breath, " If you ask me, this is God's country !"

He strode to the window and paused to look out across Water Street. A handsome well-trimmed lawn runs parallel to a stone breakwater fronting the ocean. A couple was coming out from the US Wildlife and Fisheries buildings. Clyde gazed at them for a full two minutes as they strolled along the breakwater to the obelisk, a sundial set on a broad octagonal base, with green copper vanes inset in its cubical head, the whole surmounted by a spherical knob like the pom-pom on a knitted winter cap. The couple sat down on a bench beside the sundial. As they spoke they distributed bread crumbs to the gulls and pigeons. The sunlight reflected off the metal fastenings on the masts of the research ship Atlantis made him squint. Presently moored in the docks of the Woods Hole Oceanographic Institution, it had returned only a few days before from a month of sonar mapping of the Deep Scattering Layer in the Pacific, that ambulatory continent of marine organisms that rises and falls in a daily cycle.

Jeff continued to regard the Cuisinart with unstinting admiration. A hose hanging over the lip of the sink drained off the excess water in a continuous stream. Another maintained a constant flow of water into the tank, combining in proper proportions with the sea water cycling through a coiled transparent vinyl tube hooked to a pipe running alongside the wall.

Jeff beamed:

"I always knew you were mighty handy, Clyde. That's one ingenious contraption you got there. What're you going to do with it?"

Clyde didn't reply right away. Some questions require deliberation: "As you see, there's nothing happening right now..., normal atmospheric pressure, room

temperature, so forth and so on . Once I start introducing the batches of sea urchins - "

" What's the species?"

" *Stronglyocentrosus droebachiensis* : the longest taxonomic label in biological classification! You can just call them 'green sea urchins' . "

" Good. I like the other name better but I'll never remember it. I didn't mean to interrupt - go on."

" Once the organisms are introduced, the valves attached to these nozzles will regulate the rates at which the gases are being infiltrated into the fishtank. Notice this row of pressure gauges; they enable me to adjust their relative proportions. Don't think I haven't done my homework. Take a look at these tables." He picked up a stack of chemical charts from the floor.

" $PV = kT$ - and all that! Basic science every inch of the way! "

Clyde pointed to another hose on the side of the tank to which a rubber suction sack and a pump were attached. " I can reduce the overall pressure in the tank with this suction pump. Then, if I remove this ", he indicated a cork 6 inches in diameter plugging a hole on the wooden cover," all the gas flows out, and air at room temperature flows in . This apparatus should enable me to compile respiration statistics for various combinations of gases in differing proportions at any pressure desired. It's all hooked up to the Warburg respirometer. "

A metal table stood at the side of the tank closest to the door. Upon it stood the gleaming black box of an instrument case from which protruded a dozen 3-foot high lengths of glass tubing with rubber stoppers and valves, all secured within a metal frame.

" You did say something about raising and lowering the temperature. I'm not sure I understand how that's managed." Jeff finished off his beer and opened up another.

"It's right there, Jeff. That's my handle on $PV = kT$." Clyde directed his attention to an old-fashioned stove with four gas burners supporting a chassis on which the fishtank had been affixed by clamps and bolts.

" Holy smokes, Clyde! You'd better watch out!" Jeff gave a nervous laugh, " You don't want to boil all them respiring little critters before you've completed your experiment."

" Not to worry, Jeff... don't you worry about a thing! An adjustable thermostat is sitting on the floor of tank. An alarm goes off if the heat exceeds my specifications. " Clyde stroked the glass walls.

" Golly gosh!" Jeff commented " It's just great being here! Say, can I get you another beer ?" Jeff lifted the church key from the drainboard and applied it to a new can . As he handed it over they raised a toast:

"Cheers! Here's to..." Clyde thought a moment ..." The Nobel Prize before I'm 30 !" He went on: " The boss is really impressed with my ideas. He's promised me that I won't have to place my name under his in the published reports; I can keep all the credit! With luck I should be finished by the end of the summer."

" Where're you going to publish?"

"We talked about that. Bergleson advised me to come out with a preview in Nature or Science, just to see if anyone else is doing something similar. We've reviewed the literature and didn't find anything. Of course you can never be sure. Then we're thinking of sending it to the physiology editor of Acta Echinodermata , Series Echinoidea . "

" I guess this is physiology, ain't it? I'm not even sure what the word means. I'm still stuck in first year course Invertebrate . Not doing too well I'm afraid."

" Aw, Jeff: I finished with the basics three years ago! That's kid stuff compared to what I'm doing now. Tell you one thing though: those introductory courses, they sure work you hard."

" They work you hard as a horse. "

"Yeah - A biologist has to love hard work."

" You come by the labs any time of the day or night and you find the lights on. 3 AM , 4 AM - biologists never stop! "

" No joke ! Oh, by the way: I didn't tell you, did I? This research has implications for space travel. "

" Nope. Hey Clyde, that sounds really amazing! What's it got to do with space travel?"

" The idea comes from a suggestion from Dr. Heinrich .You know him, don't you? He heads up the Astrophysics department at Case Western . He gave a public lecture last year - part of the 'Vistas of Science' series, and he told us that the atmospheres of Saturn and Jupiter contain mostly Ammonia. He doesn't think life can survive under such conditions, but it appears that no one's ever made the experiment. You see that tank standing by itself over in the corner? Look at the label."

Jeff turned over and inspected the tag on the blue hose:

" Real interesting."

" I won't be spending too much time on that one. I'm more interested in finding out things about Nitrogen and

Methane . Mom and Sis will be driving up from Ohio in a few days , and they're bringing an ultra-violet ray generator with them . After they get here I can begin work on some 'origins of life' experiments ."

" The Origins of Life! "

" Absolutely. You've heard of Urey's experiment, haven't you? No? Well, Harold Urey passed electric discharges through a vacuum-sealed test tube in which Methane, Water and Nitrogen were circulating. The whole set-up was placed under a powerful beam of ultra-violet light. Those were the presumed conditions when life made its first appearance on earth ."

" What happened next?"

"Some amino acids were produced. "

" As a matter of fact I have heard of that experiment. Wasn't there an article about it a few years ago in Scientific American? "

" Yes : 1956. So okay; I though it might be interesting to investigate whether sea urchins can survive under the conditions of Urey's experiment. "

" Why in God's name do you want to do that?" Jeff sputtered from a sudden intake of beer.

" Oh, I don't know. It's a common enough practice in science : looking at a problem from the other end of the telescope: How would life make out in the conditions under which life was created? Trust my Warburg to have all the answers!"

" Are you preparing an eyewitness account of how a green sea urchin dies a horrible death?"

Clyde chuckled , " Why not? I could even make up a separate data sheet for that one. Just preparing the data sheets for these experiments is going to involve an enormous amount of labor. For every gas there's going to be a whole set of related questions. For nitrogen : 'Does the sea urchin contract the bends? ' For carbon dioxide : 'Is there chlorophyll in sea urchins ? ' For oxygen : 'Why is the blood of the sea urchin white ? ' "

" I didn't know they had any blood. I've always thought it was sea water. Something called the 'water vascular system', isn't that right ? "

" It might very well be. However it's always good to retest an old hypothesis . For hydrogen: 'What happens to sea urchins as they approach the sun?' That's the space travel angle again. All of these things have practical applications. For ammonia : 'Can echinoderms live on Saturn and Jupiter? ' Finally for methane: 'The origins of life revisited ' . That's six papers right there.

Bringing in temperature, pressure and ultra-violet, I think we can contemplate something like a book in a few years: Recent Advances in the Study of Metabolic Processes in *Stronglyocentrosus droebachiensis*. Boy oh boy! " Clyde heaved a sigh of contentment, " Jeff, you can't begin to imagine how happy I am to be here!"

" Right on!"

" Yeah! Back in Woods Hole, doing cutting edge research!"

" Yessiry! It sure is beautiful here . Right smack on the tip of Cape Cod. Good swimming on Nobska and Stony Beach. Students, biologists, tourists, villagers ! You work all day till you drop, then head over to the Captain Kidd tavern by the drawbridge down on Water Street. That's where all the guys from the Oceanographic Institution hang out. Those guys can bang your ear all night long about hydrodynamics and weather maps. "

" Don't forget the Gulf Stream! But hey, man : they work for the Navy, strict 9 to 5 for them. We work day and night!"

" Yeah. They're just amateurs compared to us."

" Couldn't agree with you more, Jeff. We're the real scientists, over here at the MBL . Frankly I don't give those guys the time of day."

" Right, Clyde. And don't forget the parties we Invertebrates throw every night over on Stony Beach. Drinking and singing, and carrying on! Sometimes we just curl up in our blankets right there and sleep the night through. "

" It's a great life, Jeff, no doubt about it."

Jeff leaned his back against the wall and continue to muse:

" If you ask me, Woods Hole is the next best thing to Paradise . Famous scientists everywhere: Albert St. György lives out on the Point. I saw Otto Loewe on the street just yesterday afternoon. George Wald, Linus Pauling, George Gamov, Crick and Watson, they all pass through here. Somebody told me Julian Huxley's expected here later this summer."

"Didn't know that. Never read anything of his. "

" Me neither, but he's famous. I mean - uh - not like his brother."

" They've given him a desk in the library. He's supposed to be working on a book. I forget what it's about...." Jeff made an effort to try to remember what Julian Huxley's book was supposed to be about. "Well, they've always got famous people passing through here."

In this fashion did the afternoon slip away . The two students lounged about, their conversation filled with shop talk and banter, drinking more than was good for them. The consignment of sea urchins wasn't due until 4, and Clyde had nothing to do until it came. His room had been organized in preparation for a siege. The cartons at the foot of the bed held about forty cans of beer . Cheese, bread and salami were kept in a small refrigerator by the door. Books, appliances and a few suitcases stood underneath the cot. Once Clyde got to work, he did not want to be interrupted. A sign intended for his door leaned on the drainboard of the sink surrounded by rows of pipettes, measuring cups, syringes and flasks : "Important Work. Do Not Disturb" .

Scattered around the room lay debris, old newspapers, rope strands and slates of wood from the packing crates he'd shipped from Ohio. Science Fiction magazines and biology textbooks were strewn haphazardly about the floor.

The cot had been confiscated from the MBL dormitories. Clyde had no intention of staying there in the bunk assigned to him. Right here, the lab, that was home. Back in the 50's the student dorms of the Marine Biological Laboratories overflowed within the confined space of a refurbished whaling depot called the Candle House, massively constructed from huge granite blocks. One finds a single reference to Woods Hole in Moby Dick . Ancient odors of whale oil and blubber seemed to cling to the premises, the atmosphere scarcely improved by having as many as 50 students crowded into a single two-and-a-half story building. What with papers, books, decaying specimens , formaldehyde , people and laundry, the climate did not encourage one to linger . Clyde had acted very sensibly in making his move to the labs.

Quite apart from such considerations was the fact that experiments like the ones he was contemplating required a sustained investment in time. Working through the nights would be the norm , not the exception. It had not been through caprice that the lab was liberally supplied with food, beer, science fiction magazines and paperbacks . He needed to be alone. Dr. Bergleson had indicated that he would be dropping around sometime that evening. Clyde intended to see to it that his visit was short.

Starting at 4 that afternoon, with a possible break for dinner in the MBL cafeteria over on Albatross Street, the schedule he'd worked out called for work through the night and into most of the next day. His mother and sister were expected in two days , bringing the ultra-violet

apparatus and other supplies. The set of 'origins of life' experiments would fill up the next two days . What more could Science ask of him? He would probably collapse in their arms after that, but he would have laid the cornerstone for enduring fame.

As a follow-up he'd need a spell of lying out on the beaches, doing nothing for awhile. Then once more back nose to the grindstone: all nighters, collapse, rest, more work! It was the only way to accomplish anything in the field. Even as he spoke with Jeff Clyde was mentally outlining the previews to appear in Nature .

Jeff stood up:

" Okay Clyde - I've got to be going. Sure wish I could spend more time with you here: I'd really like to be here when you pop those spiny creatures into the Cuisinart."

Clyde glanced at his wristwatch : "It's only 1:30. You've got to go already?"

" Yes; afraid so. Invertebrate class in half an hour and I'm not prepared for it. I wish you luck. You're pretty young to crack open the vaults of Nature's secrets, but you're the kind of guy who can do it."

He paused : " Actually, I've changed my mind; it's a waste of time to study. If I flunk, well - too bad. I can make it up next year. I'm going to get some of that sea breeze before class. "

" Wait; I'm coming with you." Clyde took his jacket off the door, and together they took the elevator to the street floor and out into the daylight.

II.

" Put them ... right here. No No CarefulThere ...That's right! Good! Just leave them where they are. Thank you."

The two 10 gallon bottles, their sides covered by strips of black masking tape for protection against sunlight, were rolled into the room. Each was filled with a hundred sea urchins. Delivered at the MBL's basement level and carried up on the freight elevator, they had been wheeled to the lab on a trolley through the 3rd floor corridors .

The delivery man was short, dressed in faded jeans and a tee shirt. Tough muscles on his exposed arms bulged like taut rope. On a squat neck was positioned a gourd shaped head, its skin grizzled from oceanic weathering and exposure. His face, if not particularly intelligent, was friendly and expressive. He

pulled a large , dirty rag from his pants pocket and wiped his brow:

" You know, fellow? Let me tell you something: I heard them things was poisonous! Am I right? I wouldn't touch them spines if I was you! "

" Not at all!", Clyde laughed " Here, would you like a can of beer?" He opened a can and passed it over. Reaching into one of the bottles he pulled out a black ball of wriggling spines:

" You must have read something about *Diadema antillarum* . You don't want to run into him in the dark. His spines are a foot long! See? These are perfectly harmless. I'm holding him by the spines, but he doesn't do a thing to me. Here - you hold him."

The delivery man jumped away by reflex instinct:

" Hey no! Not me! Yes, I will have a can of beer." Clyde invited him to sit down in the one chair in the lab while he sat on the cot.

" I'm not going to take no chance like that! You scientists don't care what happens to you. You don't care what if your research kills you! I've lived on the Cape all my life and I've seen it happen. Me, hey! I look after number one . Thank you brother, but no! Say, " , his eyes roamed about the room,

"Get a load'uh that! This is a real nice set-up you got here! What's that fancy doodah you got sittin' over there in the corner?"

Goggle-eyed with fascination he walked over to the Cuisinart .

"Nothing much. It's my experimental apparatus. "

" Your experimental wazzis ?"

" Apparatus. That's a fancy word for machine. Doodah is okay too. It's for my research. I'm sorry, " Clyde glanced at his watch, " I know you'd like to stay and watch what I'm doing but I can't allow myself to be disturbed while I'm working. "

" That's okay, fellow. I don't know nothing about this modern science anyways! It frightens the hell out of me sometimes. Long as you believes in Jesus Christ, that's all that matters. What's your opinion?"

" I haven't got one. I'm a biologist. Biology doesn't deal with such questions."

"Biologist, huh? Like humans coming from monkeys? Stuff like that? "

" You've got it." Clyde was beginning to wish he would leave. Fortunately he changed the subject:

" Say, whad'ya think of the atomic bomb? You're not working on that, are you?"

" Close enough: Space travel."

"Space travel, huh? I gotta hand it to you , you're up there with the heavies! It ain't Top Secret, is it?"

" Well... yes and no. Nobody's supposed to know about it my papers are published in the journals." With a sad shake of the head Clyde confessed : " I've told too many people already, I'm afraid."

" Oh yea? In that case you better watch it or'n the F.B.I. 'll get on your tail. I've been around for a long time and I've seen it happen! . Don't you worry I'm not gonna tell nobody ! Space travel, huh? That's between you and me and them little bottled-up buggers. I keeps my mouth shut about what don't concern me nothin' . Don't you let nobody come around snoopin' though, or before you know it you'll be on television before a Congressional committee, wantin' to know whether your mother was some kinda Communist! I'd keep my head under my hat if I was you!"

" I'm not worried about that." Smiling, Clyde drummed on his empty can of beer , " My work doesn't have anything to do with national defense. "

" No? I'm glad to hear it. Well, I hate to be going but I got to be going. Thanks for that can of beer. And I wish you luck!"

" No trouble - no trouble at all! Wait a week and come again. So long! "

III.

The delivery man left, leaving the door open behind him. Clyde deftly closed it, then walked to the front of the fish tank. He stood before it in absent-minded reverie debating what he ought to be doing next:

" Let's see." he mused, partly aloud and partly to himself:

" We've got lots of hard figuring to do, don't we? 200 sea urchins. How many experiments ? Seven? Don't forget the control group. That makes eight . Oh ... nearly forgot the ultra-violet. Nine . A batch just in case. Something always goes wrong. Ten.. ...10 into 200? That's 20 sea urchins per experimentWill the tank hold that many?"

Clyde examined the fish tank and nodded ,

"Looks okay. How many experiments did I say? Eight? Nine? Ten? " He picked up some scrap paper from his work table, " Should I use a stenographic tablet, lab notebook or a loose-leaf binder ? I'm not sure.... What did I say the problem was ? Oh yes ... Stenographic tablet or notebook?Maybe I ought to go down to the supply store in the basement and buy me a few of those professional

looking computation notebooks, you know the kind used by investigators to write down data, make graphs, with brown covers and strong bindings.....I'd better lie down and think about that

He lay on the cot with his back propped against the wall. Picking up a science fiction magazine, he started writing on the back of it.

" How many did I say ? Ten? Twenty? That's right: ten groups of twenty urchins makes 200 give or take a few, some might not make it.....

One thing I know for sure, each experiment has to have a separate data sheet . Ten experiments makes ten sheets. That's it! "

He jumped off the cot and strode to the work table:

" One of these will do." Clyde picked a stenographic tablet off the top of the pile. With a large black felt magic pen he wrote

INVENTORY

on its pasteboard cover. For a few seconds he stared at the word in some perplexity. Then he crossed it out. Underneath he wrote

SEA URCHIN INVENTORY .

This also was studied from a number of different vantages. Then it too was crossed out.

" No, that's not right." he muttered. Crossing out SEA URCHIN INVENTORY , he wrote , simply ,

INVENTORY

underneath it. Now the cover was filled with crossed-out words . Clyde swore:

" Damn! I'll have to use another tablet!". He put the first one down then picked up a second. This in its turn was labeled INVENTORY .

" But I can't just throw away the first one - it hasn't even been touched. I'll use it for making calculations....How confused can you get!Just bad organization...Well, I'm still learning. The truth is I'm very well organized, but it may not be in the manner appropriate to this investigation..... Let's see... What was I saying?" He looked down at the tablet still gripped in his hand:

" 'Inventory' ... Okay. Now, below that." He wrote :

SEA URCHIN EXPERIMENT

Clyde crossed out the word EXPERIMENT and changed the second line to:

EXPERIMENTS WITH SEA URCHINS —~~EXPERIMENT~~

"Damnation!" he cursed under this breath " All I had to do was put an 'S ' at the end of 'Experiment' . When you do something wrong, it's better to do the whole thing all over again. Persistence : you get that drilled into you. Uh..... What's this? Oh yes ...". He read again:

INVENTORY

EXPERIMENTS WITH SEA URCHINS ~~EXPERIMENT~~

"I don't like that crossed out word ... Crossed out words look really bad. Future generations reading these lab notebooks might think I was some kind of amateur..... Too many corrections just look bad Gotta go on...The date? 'July 25th , 1958 ' ... At least I've got that straight. Now for my name :

CLYDE CYTOCHROME

" Say.... Should I include my thesis advisor's name? .. I don't know" He drained off the remains of his beer, " What've I got? " :

INVENTORY

EXPERIMENTS WITH SEA URCHINS ~~EXPERIMENT~~

JULY 25th 1957

CLYDE CYTOCHROME

"Crap ! I'm wasting valuable time, reading this stuff over and over again! This disorganization is driving me up the wall ! Am I in some kind of rut, or what? Oh yes: ' Inventory' .. ' Experiments with Sea Urchins ' 'Experiment' That crossed out word doesn't seem so bad anymore..... July 25th , 1958...'Clyde Cytochrome' ... Hmmm..... Yes I will put in the bosses name in .. 'Dr. Knut Bergleson' ... ' Case Western University' (?) ... No, that's not right."

He crossed it out and wrote

MBL WOODS HOLE , MA .

" But looking at it another way I am enrolled at Case Western... . It's paying for my grant and equipment . Well, what should I do? What's the right thing? ... All right, All right! Okay already! I'll put them both down."

Next to ' Woods Hole , MA' , he rewrote 'Case Western University, Ohio'

" That still doesn't look right. Hell! Why am I wasting my time on this nonsense! Nothing must stand in the way of scientific progress! "

With an angry imperious swipe he crossed out both ' Woods Hole, MA' and 'Case Western University, Ohio' .

" No address! Nothing! Just the date. Everybody knows this is Woods Hole, anyway. Time for a review, just to check if I've got it all down..... BLAST! ", he threw the tablet against the wall, retrieved it and sat down :

"Take it easy ... I won't get anywhere by losing my temper... Okay, okay but let's get it over with quickly, There's too much to do. What have we got here?" :

INVENTORY

EXPERIMENTS WITH SEA URCHINS ~~EXPERIMENT~~

JULY 25th 1957

CLYDE CYTOCHROME

Dr. KNUT BERGLESON

" I should write 'Sponsor' after ... no, before .. 'Dr. Bergleson'... it has to be before:

SPONSOR, DR. BERGLESON

~~CASE WESTERN UNIVERSITY~~

~~WOODS HOLE, MA~~

~~CASE WESTERN UNIVERSITY, OHIO~~

" Pretty damn sloppy, if you ask me. Boy, what a mess! At least that phase is over. "

Clyde was trembling. He wiped away the sweat pouring down his face.

" Hey; I worked pretty damned hard, didn't I ! I deserve another can of beer." Opening one, he picked up a box of crackers and a Science Fiction magazine from the floor and lay back on his cot.

III.

" I've got time enough to read one short story. Just one. This looks pretty good : "What Do You Do In A Jam ? " Who's the author? It doesn't say. Oh yes: Izzy Azimuth! He's a top-notch sci-fi writer. I like all his stuff. Got to put aside this high pressure research for a bit, pull up my feet, and relax. "

He removed his shoes, propped the pillow up against the wall and opened the magazine. In a short time he was completely engrossed in his reading:

"Hey: this is one really great story! There's this Martian monster, body of an insect - one thousand times earth size - intellect of a simian ape. The creature is a regression from advanced beings from past eons, whose science was a million years ahead of ours. It's a giant arthropod, really. Anyway, it's immobilized a space ship from the planet Earth between its six legs .. not badAll the crew members, the ones it hasn't eaten, are

being held as prisoners. The creature wants the astronauts to teach its species our science, so they can set out once again to conquer the universe, which is what they'd started to do ages ago, before the earthquake depopulated the planet and the disease destroyed their intelligence..... Azimuth never writes cheap stuff ... No ray guns or anti-gravity or time machines ... No Venusian maidens, Saturnian torture chambers or Ganymedeian prisons... none of that obvious, cornball stuff ! ! You sure read a lot of trash in these magazines, let me tell you...

Uh-Oh! There's a complication !"

Excited, Clyde pulled himself up to a sitting position: " The disease is contagious ... The captain of the spaceship has hidden the true nature of the emergency from the rest of the crew to spare them the horror of it. Now he's more worried that they might catch the disease than he is of anything else. That includes death , torture , or becoming the Martians' slaves..... What's he got up his sleeve? ... Apparently the captain's playing with some idea that hasn't occurred to anyone else.....Say, this is a pretty long story Oh boy! Oh yes! Damned ingenious, too.... Azimuth to the rescue ... He hypnotizes the giant insect with the spaceship's searchlights ! Don't quite see how he manages to do that; the light beam can't be any bigger than a pencil to such a huge fly Azimuth gets around that one tooThere are a hundred facets in the fly's compound eye....Interference patterns... Hey! Did you ever hear of a cross-eyed fly?Well, the spaceship escapes from old cross-eyes anyway....."

Clyde sat up, put the magazine away, and briefly pondered the surprising outcome of the tale,

"... That was a great story... time to get back to work! "

Clyde jumped off the cot to a standing position. Too abruptly: waves of dizziness assailed him.

" Wow! Have I been drinking, or have I been drinking? Six cans ? Or seven? I don't remember anymore. Well, I've had enough. I'm sober at least." He picked up the steno tablet :

" What's this ? Oh yes , ' Inventory ' ... Seems okay. The time has come to begin sketching outlines for all the experiments. That's the only way to deal with the confusion."

He flipped open the tablet : " What're we talking about here?" On the first page, in bold letters he wrote:

TOTAL NUMBER OF SEA URCHINS : 200

... I could just as well have written # ...go on...

1st exp ____ 20

2nd exp ____ 20

3rd exp ____ 20

.

.

.

9th exp ____ 20

10th exp ____ 20

Total Number ____ 200

" All I have to do is cross them off as I go along....." He hesitated, dissatisfied : "... I see what's wrong: am I sure I'll want to use the same number for each one of them? Something might come up. Animals do die, I might change my ideas about how to do this thing Okay already! "

He tore out the first page and began afresh:

" ' Total Number of Sea Urchins - 200' ... Oh damn ; I forgot to write # instead... Well, let it go :

1st exp ____ 20

2nd exp ____ 20

3rd exp ____ 20

.

.

.

9th exp ____ 20

" Boy!", he laughed, taking a deep breath : " I sure am glad I didn't write ' 10th exp ' . But I have to remember what the 9th is about . "

Putting the tablet aside, Clyde bent over to relieve his throbbing headache. After a few minutes he sat up : " Oh yes ... Boy, I was worried for a moment ! The origins of life ." He continued writing:

' Amount Left Over (?)

TOTAL 200

" Then again I'm not sure I'll have the whole 200 when I'm finished... All right! There goes another one!" He tore out the page and hurled it across the lab, " Hell on earth! Blast it!! I can't stand it anymore! I've got to get out! I need a walk!" Once again he wrote

NUMBER OF SEA URCHINS

" '#' and 'NUMBER' mean the same thing. Okay! I'll cross it out!"

NUMBER OF SEA URCHINS

" You should have crossed out the word 'Number' , you boob ! Oh boy ... ". He sat down, limp and exhausted.

"Let me get just this page finished, then I'll have to go out for a swim. I also need a can of beer...Too much nervous tension building up ..."

He scrawled across the page:

1st exp ____ 20 " Same mistake ! " 1st exp ____ 20

2nd exp ____ 20 " Another ! " 2nd exp ____ 20

3rd exp ____

.

.

.

9th exp ____

" No tenth experiment! No total! No nothing! My stomach's sick as hell! I need to piss like crazy ! I've got to get out of here!" He threw the tablet up at the ceiling. It bounced across the room and landed in the water gushing into the sink from the fish tank.

" Let me out of here!"

Clyde wobbled about the room to the door and ran down the hall,

" Let me out of here!"

IV

Clyde spent the remainder of the afternoon on Stony Beach. Instead of returning to his lab he went back to the Candle House for a brief nap. Upon awakening he walked over to the MBL cafeteria which, at that time, was located down the road from the US Wildlife and Fisheries Service on Albatross Street. 1 After dinner he strolled up the walkway past the tennis courts, back to the entrance to the Lillie Laboratory, the larger of the two buildings making up the MBL . A low staircase of two 3-step ranges introduces a pair of solid doorways. At their crests rise semi- circular arches casting a protective shade over transom windows, gracefully decorated with wooden slats . Just above these stands a ledge with the name LILLIE carved in the ugly block letters one sees in most MBL official graffiti .This ledge supports a pair of bulky Doric pillars, on which there is another ledge with the incised message:

The small lobby is located just before the principal lecture hall, the information

LILLIE AUDITORIUM

painted above its doors. Clyde had arranged to meet here with Jeff before going in together to attend that evening's lecture. Its title was : On the Electrical Stimulation of Squid Eggs . About the subject he knew nothing; about the lecturer he knew only that he was young and, by some people, presumed brilliant.

A pair of tables stands on each of the edges of the lobby. During the summer these may hold sample copies of recent publications by scientific publishers like McGraw-Hill, Addison-Wesley, Prentice-Hall and so on. Before sitting down on one of a pair of low dark mahogany - stained benches, Clyde lifted a copy of a recent publication from by McGraw-Hill from one of the tables , a treatise entitled: *Cyclical Breeding Patterns in Nematode Populations of Central America* . It was only sheer idleness that impelled him to leaf through its 967 pages, with sporadic flipping back and forth through the index for signs of familiar names or references.

In general Clyde was contemptuous of such narrowly focused research. It is however common practice among scholars to relieve boredom by the perusal of a boring book. Jeff finally showed up. The book was returned to its display table and they entered the lecture hall. Already filled to capacity, yet they were able to find seats near the back, where they could converse in whispers without disturbing their neighbors.

"What's he going to talk about, Jeff? I only glanced at the notice."

" You know - I'm not sure? The guy is brilliant, no doubt about that. He practically runs the Biophysics unit in the Marine Research Institute at UC San Diego in La Jolla . He's built his reputation on delivering electric shocks to cultures of deep sea organisms' eggs. I actually went to the library this afternoon and looked up one of his papers. Frankly, I didn't understand a word of it. He's a lot more than just a biophysicist you know."

" Oh? What else does he do?"

" He's also got a Ph.D. in Electrical Engineering. Though technically a biophysicist he's done some impressive work in embryology. Seems to me I've heard he plays jazz piano in night clubs. They're all related, of course. That is, except for the night clubs."

" In science, Jeff, everything is related to everything else. You can't do cosmology without worrying about angiosperms."

" That's stretching it a bit, don't you think, Clyde?"

" Maybe. But everybody is going high tech. Mark my word. I was even considering requisitioning a spectrophotometer from Case Western before coming out here. I figured I had enough to do already. There always comes a point at which you've got to admit to yourself there's something you don't know."

" I'm not there yet, Clyde. Maybe that's because I don't know anything."

- You can say that again! - Clyde smirked to himself. Aloud he replied:

" Just keep coming to these lectures, Jeff. You learn an awful lot that way. It just sort of seeps through."

" 'Suppose you're right. I don't enjoy going to lectures I don't understand. Clyde - do you know anything about squid eggs?"

" Nothing in particular. Maybe he'll teach us something."

They turned their attention to the stage. The speaker, professor Seymour Brine walked onto the stage before the audience had fully quieted down and launched into a rapid-fire discourse:

" Five years ago, in the summer of 1952 - " High-pitched screeches from the speaker system blocked out his voice. After a student technician came onto the stage and adjusted the microphone for feedback, Brine began again:

" In the past five years there has been notable work done in advancing our understanding of the havoc wrought by the electrical , chemical and radiative abuse of the eggs of diverse species at various stages along the embryonic cycle . In matters of radioactive insult the salamander has been the favored animal. We now know a great deal about salamandric mutation, transmutation, regeneration, the effects of massive doses of radioactivity on its' primary and secondary sexual characteristics, its' coordination, balance, eating-habits, mating, intelligence, and so forth and so on.

"To paraphrase most of the conclusions in this field, the more juice you put into the beast , the more anomalies you can expect to find coming out at the other end. Gentlemen! We are in the business of manufacturing freaks of nature.

Any of you present in the audience this evening who's spent as much time as I have zapping squid eggs with

electric shocks will understand me when I say that the work is very frustrating and the rewards few and far between."

(Laughter, cries of assent from the audience)

" I don't consider its methods terribly original. All one needs is some sort of equipment that manufactures high voltage discharges of electricity. Turn up the juice, watch the voltmeter, sacrifice the eggs, then study the effects under an electron microscope. Secretaries and librarians could do a much better job of it. Little more is involved than recording and transcribing data. It does however provide many opportunities for grad students churning out Ph.D. theses."

" When's he going to start talking about his own research, Jeff?"

" He's coming to that."

" Last summer here in Woods Hole I rejected all the standard methodologies in this field. I had to rethink everything from scratch."

" That's a real scientist for you!" Clyde exclaimed, " Strike out on your own and hang the consequences - that's scientific progress !"

" Routine procedures for zapping squid egg cultures with enormous voltages had always left an unpleasant taste in my mouth. In my opinion they are nothing more than disguised sadism. The people who do that sort of thing are second cousins to the sorts who write to prison wardens asking for permission to witness executions."

Clyde felt an upsurge of panic; in a moment he was going to be sick.

" The focus of my research for the past twenty years has been on the polarization of the squid egg, that is to say, the polarization of the lighter and heavier polar bodies. Since these always arise after fertilization, my lecture should have properly been entitled: ' Electromagnetic Stimulation of the Fertilized Squid Egg ' . In any case everybody knows what I'm talking about. This course of inquiry led me by a natural path to the study of the magnetic poles of the egg ; if it has any. Don't scoff until you've thought about it - why shouldn't an egg have a magnetic field? Consider this: The solar system has a magnetic field. The sun has a magnetic field. The earth has a magnetic field. The egg ... well, the egg wouldn't even exist if it wasn't for the solar system, the sun and the earth! It's a plausible hypothesis, you must grant me that much. Real progress in science, one must never forget, is made by asking the right questions.

"Finding the magnetic poles was another matter altogether. Imagine trying to inject a compass into a squid egg then searching the little pointer!" A torrent of raucous laughter swept the auditorium. Clyde listened with unrelenting fascination:

" Practical considerations eliminated compasses from our list of options. Bar magnets, vanishingly small electric fields, iron filings: we tried them all! Nothing washed. It took a year for our instrumentation to achieve its final form. A magnetic field is produced by the passage of electricity through a wire coil. This coil is wrapped around a long cylindrical drum. The electrical field itself is created by the rapid rotation of the drum in the manner of the rotors of a power plant generator. The drum is 20 feet long, widening at its mouth to a radius of 10 feet, then tapering to a small instrument packed box at the far end.

The drum still exists: you'll find it in the basement of this building. We left it here last summer because it was too cumbersome to take back with us to California. Yesterday while preparing my lecture notes it occurred to me to go down there and make a tour of inspection. The drum was in the exact spot and position in which we'd left it! The janitor who looks after that part of the building told us he'd been saving it just in case we came back to claim it. He was very apologetic as he confessed that he sometimes crawls into the drum at night and uses it as a bedroom. He lives north of Hyannis, and it's often inconvenient to travel that distance late at night. Of course I made him a present of it on the spot. Admire the ingenuity of Man!"

Before going on, Brine paused for a moment in tribute to such ingenuity:

" The drum and coil were attached to a spindle hooked onto a powerful motor that rotated them at a top speed of 10,273 revolutions per minute. I don't remember why we chose that upper limit. A current was thereby induced via the agency of hundreds of little metal whisk-brooms. The technology is fairly complicated and there's no need to go into it here. Then we souped it up to 20,000 volts. You'll be seeing the results in a moment. The box at the far end supported a devilish arrangement of mirrors, with a deftly placed camera in their midst. Pictures could thereby be taken at any speed."

" Hey, Clyde, that sounds like real stuff, doesn't it?"

" Yeah Jeff, you better believe it : real science. Not like most of the research you hear about, where some

cranky old professor throws together a few test-tube racks , shakes some amino acids in them, then writes a paper on the color changes per shake, or something like that."

" Yes sir; this is the real thing ." While they were whispering back and forth Brine was occupied in pulling a strange looking object out of a wooden case.

" We called this the - uh - 'gun' . "

Brine held up a 3 foot long metal rod. A tube jutting from its middle was fashioned to slide into a wooden stand affixed to the floor. One end of the rod had been outfitted with a trigger. The other branched out into the form of a spatula , roughly the shape and size of a Petri dish.

" Descriptions of the gun's construction and modus operandi fill 8 pages of the June 1956 issue of the Ballistics Bulletin. It's designed to shoot culture dishes into the maw of the revolving drum. This meant that the eggs would not have to be killed before subjugation to our experiment. An unpleasant trade-off had to be accepted : an accumulation of large amounts of broken glass at the far end. This couldn't be helped: it was essential that the fertilized eggs be kept alive. Dead eggs may lose their magnetic fields.

The eggs could not however be expected to survive collision with the walls of the box . This was not a problem, since the superb engineering that went into the installation of the camera guaranteed the capture of images of the spinning culture dish while yet in flight.

" The photographs in this next slide." , he signaled the operator,

" have been enlarged 100 times. In them the orientations of the polar bodies are clearly seen . I will interpret the data in a moment . But first : a brief pause, to honor the rapid advance of science in our time, along with all the brilliant discoveries and inventions that have brought Electrical Engineering! Electrodynamics! Electro-magnetism! Electronics! Photography! Embryology! Optics! Mechanical Engineering! Metallurgy and Ballistics! together in a single experiment. "

The chaos of a thunderstorm would have been drowned out by the waves of adulatory applause that swept over the auditorium. Another slide flashed onto the screen as the room was plunged into darkness.

" This is a picture of the experimental apparatus." Brine indicated its salient features with a blackboard pointer:

" The mouth of the siphon points in the direction of the south magnetic pole; likewise, the far end points to the north magnetic pole. The rotation of the drum is

counter-clockwise. You can see the motor off to the left. Because of the telescopic sighting device on the gun stand, we were able to aim dead center into the box at the far end.

It was not possible to predict the exact moment when the culture dish entered the box. Instead, the camera was set to take exposures at the rate of 50 frames per second from half a minute before the dish of eggs entered the drum until half a minute or so after crashing. The next slide please."

A graph flashed onto the screen.

"The line on this graph portrays the total magnetic force acting on the flying dish at greater and lesser speeds of the dish, that is, the x-axis, in terms of greater and lesser angular momenta of the rotating drum, that is to say, the y-axis."

"Isn't there a mistake somewhere, Jeff?"

"Why no, Clyde. Where do you see a mistake?"

"Well: if one axis gives the acceleration of the drum, and the other gives the velocity of the dish, where is the axis giving the effective magnetic force on the squid eggs?"

"I don't think that matters, Clyde. He's big in his field, so he must know what he's talking about. If it doesn't make any sense now, it will later on. I don't see anything wrong myself. Let's just listen: he's showing the next slide."

A split-second exposure of a flying Petri dish jumped onto the screen.

"Here we see the dish with its magnetically oriented squid eggs flying through the instrument box. In the next slide we show a millimeter square section of the former slide enlarged 50 times. As indicated by the arrows, the eggs are all oriented in a North-South direction. The heavier pole usually points north, whereas the lighter pole, that little black mark, almost always points south. After examining hundreds of such photographs, we applied a variety of standard statistical measures until we found one that uncovered a tendency for the heavier polar body to assume a northern orientation, of about 7%. This must be considered statistically significant. We were thus led to the conclusion that the heavier pole, being attracted to the north, has a south magnetization, while the lighter pole has a north magnetization. The final slide", he pointed to the screen, "shows the debris of several shattered Petri dishes inside the box. That broken glass really doesn't look so bad after all, does it? Now for some concluding remarks."

Blinking eyes re-adjusted as the lights were turned on

" Certain questions remain. Influencing our results to an extent, that is, predisposing them in a certain way, one might say, is the fact that the heavy polar body was at the heavier end of the egg, while the light polar body was at the lighter end. Ignoring the effects of friction may have been an unwarranted over-simplification. That will be the subject of our next series of experiments.

All the same, I encourage everyone here to contemplate the far-reaching consequences of these findings. It is not going to far to say that the very future of biology as a science is at stake. The relationship of magnetism to life has perplexed scientists since the 16th century. What indeed is this relationship? How? Why? When? Since the magnetic field is at right angles to the electric field, so, perhaps life itself is at right angles to who can say? Who dares say?! What depths of horror lie at the heart of the living phenomenon? What unsuspected grandeur? What black cloud hovers over our existence? Life triumphant! Life ever onwards! Eternally mysterious! The biologist's quarry, repulsive of his boldest assaults, stubbornly resisting extermination ! And with these thoughts, I leave you."

Brine quit the stage amidst deafening applause.

V.

As Clyde re-entered the lab he was immobilized by a feeling of despair:

" I can't bear to look at it beer cans all over the place... piles of paper all over the floor...sci-fi magazines everywhere underfoot ... This place was cleaned up when I started work this morning." He began putting the room back into shape.

" Going to that lecture was a good idea. Now I'm all fired up with ideas ... There, that's better..... Where was I this afternoon just before I walked out.... " He picked up the stenographic tablet that had been left open to dry on his work table,

" Oh yes... ' Inventory' . I've already done the first page, haven't I ? ... What's it look like? Okay. I don't like it, but it'll do . So, what next?" He sat down on his bed and lowered his head into his hands . He had absolutely no idea of what he should do next.

" Let's shape up that next experiment, how about it? ... Use the loose-leaf notebook for that one..." The sight of the steno tablet filled him with loathing. He slammed it

onto the worktable and pulled a blue loose-leaf binder out from a box under the cot:

" What's happening? Yes! Oxygen, for the first one."

As a kind of commentary on his decision, Clyde stood up and took a long, healthy breath. " ... To be followed by combinations of oxygen with nitrogen..... What proportions should I use ? Don't know: how do they occur naturally ? nitrogen 20% , oxygen 80% . That's my control experiment. Altogether 5 experiments: nitrogen 0% 20% 40% 60% 80% 100% Oops! I meant six. Okay... Just do the same for all the other gases. How many? Count ... oxygen and carbon dioxide, 6 ; oxygen and ammonia, 6 ; oxygen and nitrogen , 6 ; oxygen and methane, 6 That's 30 experiments to begin with and I haven't even begun to exhaust the combinations. Anyway I may want to mix them all up , 3,4 ,5, 6 of them together! It's obvious, isn't it? Just use the most significant mixtures , out of a total of" , he did some calculations

" 73 possibilities , without getting into mixing their proportions , which puts the number into the many thousands!... No reason to get upset ...My problem is, therefore, to reduce this mess to no more than 20 or 30 experiments Start with the 6 pure gases, naturally , at increasing pressures.. Then oxygen, carbon dioxide, and nitrogen .. Hell! What did I say the proportions were ? Something like this....." :

	OXYGEN	CARBON DIOXIDE	NITROGEN
	0	20	80
	0	40	60
	0	60	40
	0	80	20
	0	100	0
	20	0	80

etc.....

Hey! That's 25 right there, even before we start thinking about varying the temperature , pressure, volume Damnation! ' Why does nature overwhelm us with its complexity? 'I need a can of beer....."

As Clyde sat there debating the most efficient course of action, who should walk in but Dr. Knut Bergleson!

VI

" Oh , hi boss ! I've been waiting for you. Come in. Here, have a can of beer."

" Clyde, how are you? We expect great things from you, you know. Yessir! We're really counting on you, my boy! Show me what you've been up to. What've you done?"

"Dr. Bergleson - "

" No excuses now! You've got to show me everything. Down to the fine tuning, is it ? Ha, ha! All the pipes in C, are they? Yes, I will have a can of beer. Thank you, my boy. Clyde, I want to confess something to you..." Though balding and prominently bulged around the middle, Bergleson normally radiated an aura of vigorous health . Now he suddenly appeared old and worn:

" You're really like a son to me." He removed his glasses and dried his eyes,
" My son never wanted to have anything to do with science. He thinks it's all his old dad's nonsense. Ah me " , he made a gesture of disparagement, it not being clear who or what was being disparaged, " Stewart drives a Cadillac ; wears nothing but Brooks Brothers suits! Custom tailored shirts! If that's all he wants out of life, he's welcome to it.

"I've never had any talent for business. Research has been my passion all my life! Did you know, Clyde: I got my start right here in Woods Hole, just like you're doing? I still remember the title of my first published paper." He leaned his head back and intoned: "'The Effects of Epinephrine on the Circadian Rhythm of the North Atlantic Crayfish.'". It was a presumptuous paper for sure: title and all! I'm glad to see you've chosen simple names for yours. Not that I'm not still very proud of that first paper. How I slaved to get that written! Ah me .. " He mopped his brow , then replaced his handkerchief in his pants pocket.

" Say, young man. That's a mighty good beer you've got. What's it called?"

" Jack's Guts . It's a local brew, from a place near Menemsha on Martha's Vineyards . It's real cheap, too."

" Fair enough. Never let it be said that a student of mine ever had bad taste in anything." Bergleson turned the can slowly in the light of the ceiling lamp, " Only it's a little warm. When you find time, unpack those cartons and put the cans in the refrigerator..... That reminds me. I see you've hooked up the Warburg ."

Bergleson stood up and ambled over to the Cuisinart. He lifted the wooden lid and peered inside the fish tank:

" Make sure you keep the cork in tight, or you'll ruin everything."

He examined the apparatus carefully, humming to himself. Then he turned around to face Clyde:

" There was something I wanted to ask you Oh yes : I didn't notice any heat source. You wanted to make some

temperature experiments, didn't you? I remember your saying something to that effect. "

" Yep. It's right there. " Clyde proudly pointed to the gas range beneath the tank.

" Wha - what's that??!"

" That's my heat source . Don't you like it?"

" Don't I like it? Why, I'm at a loss for words! It's utterly incredible! What do you want to do, fry them? What's for dinner, folks? Shall we have Entrecote *Phyllacantus parvispinus* ? Perhaps a garnish of *Asthenosoma intermedium* ? Make sure the chef doesn't try to slip you some *Toxopneustes pileolus* ! Oh the poor dears!"

" Boss...it was the best thing I could come up with on such short notice", Clyde faltered, helplessly, " It's ingenious, don't you think?"

" Don't make any temperature experiments! Leave that part out! And whatever you do, I don't want you using that gas range!"

" All right, but - "

" I'm coming back tomorrow , Clyde. I hope, for your sake, to see things in better shape. Take that thing to the dump! I don't want you ruining everything! Okay, I've got to go now. " Bergleson opened the door,

" Clyde, I expect better from you . Don't use that gas range !"

He walked out, slamming the door behind him.

Depression descended over Clyde's spirit in thick blankets of gloom. He drained off the remnant of beer. Chewing idly on a leftover sandwich, he thought through the situation:

" It took a lot of work, bolting the fishtank onto the gas range. I don't think the boss fully appreciates the effort it's cost me....." Clyde's expression registered defiance, " All right, I'll use it but he won't know about it. It's too late in the game to change everything. But, Jesus Christ! Sometimes I think the boss is no different from a cop! You never know when he takes it into his head to act up....What's he expect from me? I'm just a first year grad student in biology, trying to find a way for myself, really, just trying to find myself like anybody else my age!" He emitted something between a sigh and a belch:

" I need to sit down and rest, after what I've just been through" , he reached for the loose-leaf binder and a pen , " Where are we, by the way?....

Oh yes.... now I remember.. I'm looking for 20 to 30 significant experiments out of thousands...No, I've done it

all wrong ... just 73..... it all depends on how you look at it... I think I said the first one requires a 25-place table... That's too much. Maybe, maybe not. I don't know." He tore out the page from the binder and crumpled it in his hand preparatory to throwing it across the room . Almost immediately he unfolded it and flattened it on the table:

" Damn it all to hell! Crap! I needed that ! Why can't I get anything off the ground ? It's all very simple , really. Just make a selection out of the 25. How many? 5? All right. That's final! Thank God! That's settled! All right ... How many ... Just five ... Write that down before you forget it ! Which five? .. No problem with the first three. Here you go:

Oxygen	Carbon Dioxide	Nitrogen
00	100	
0100	0	
100	0	0

" What about the other two... Should we make it six. No ! Just five!! All right! Six then! It's horrible being a perfectionist! Best write the whole thing out:

Oxygen	Carbon Dioxide	Nitrogen
0	0	100
0	100	0
100	0	0
0	50	50
50	0	50
50	50	0

Actually, that's already six experiments. And I'm certainly going to need 3 more... Make it nine then... but not ten ! That's the limit! ' The integer $n < 10$ ' , like the mathematicians say... Okee-dokeewhat are the other three? ... Damn! I've already used up four sheets of paper and torn out three. Maybe the complete table needs to be written out all over again on another page... Damn! Damn! Damn! I could have done all this computation this morning, instead of wasting time chewing the fat with Jeff. He'll never make it as a scientist. " , he shook his head in commiseration, " Hasn't got what it takes, I'm afraid..."

Oxygen	Carbon Dioxide	Nitrogen
0	0	100
0	100	0
0	50	50
50	50	0
0	0	50

20	40	40
40	40	20
40	20	40

" Good enough. Finally :

CONTROL 80 2 18

" Hey! " he held the table at arm's length, admiring his penmanship: "That's really clever! It's over and done with, thank God. Now at last I can turn to the origins of life. That work may even get me the Nobel Prize! What'm I gonna need ? .. ultra-violet light for that one... but that's the most interesting experiment anyway, so it's worth the extra complication:

Water	Methane	Nitrogen
20	40	40
40	20	40
40	40	20

"... No. Something 's wrong here. That 40% water... it's too small. Okay. Looks like I've got to make another table." Clyde's cursing had roared into the infra-red. He stood up and wobbled about the room. Then he reached for another can of beer:

" You know something? : I've forgotten all the details of Urey's experiment. I don't even remember how the results were interpreted."

He seated himself at his work table. For 15 minutes he tried to recall the basic features of Urey's 'origins of life' experiment. He gave up, shaking his head:

" There's no hope for it.... I have to head over to the library and dig up that article from the Scientific American... right in the middle of all this intensive labor !" As he stood up again he cried aloud:

" Everything's on hold!"

As he scanned the chart of the oxygen experiments he allowed himself a brief descent into pessimism: " And I haven't even begun thinking about the others. Hundreds of charts just like this one will have to be done before I'm finished! I won't have a scrap of blank paper left by morning. Not counting the origins of life! And space travel! What have I gotten myself into?"

He picked up the new can of beer, an untouched steno tablet and a few ball-point pens.

" Off to the library! Sooner or later I'm going to have to digest all the literature. There are lots of holes in my reading, and it'll take years to catch up on what's current in the field. I can't think about that now, my

mind's cluttered up enough as it is. " Closing the door behind him he headed down the corridor.

VII

When Clyde entered the deserted library it was 2 A.M. The library's two reading rooms and 3 floors of stacks take up half the space of the Lillie building. For the rest of Woods Hole's scientific community (the Oceanographic Institute, the US Wildlife and Fisheries, the Geodetic Service and so forth) the MBL library is its most valued resource. Until recently its four stories of stacks were at their disposal 24 hours a day .2

The informal reference room holds two round tables about 6 feet in diameter, with space around each of them for about four chairs. Predictably the decor, including the upholstery, the carpet and the floor to ceiling window curtains (garnished with prints of marine plants and organisms), is seaweed green. Four high backed chairs and a sofa take up the central section of the room. A few portraits of former MBL directors hang on the walls.

The far more spacious reading room , approximately 50 by 20 feet, has been magnificently designed for serious work in comfort. Entering it one immediately notices the circuit of magazine racks around 3 of the 4 walls, holding well over a thousand professional journals. Nine round polished wood tables sweep across the room, each large enough to accommodate 6 or more persons. Salmon-tinted carpets muffle footsteps . The 7 great windows, covered by white shades and framed by regal hydrangea-printed green curtains, open up the western and northern containing walls to bright sunlight, air and, at night, the sea - saturated freshness of an inky sky .

From inside the reading room one enters the stacks through a door to the right. Before they were replaced by computers, the indexed card catalogues were located near this entrance. Clyde strode over to them and pulled out a drawer at random. He held it in his hand, mutely gazing, inert and in total perplexity:

" What did I say I'm looking for ...Linus Pauling? (Pardon me , I mean Urey) . I've forgotten his last name, (I mean his first name) A real scientist would be looking up Urey's original papers through the journals....I'll do that later, when I compile the bibliography Hell with it for now , I've got too much to worry aboutWhat's the first thing that comes into my mind? Of course!", he snapped his fingers, " the origins of life ! Should I browse under Origins ? Or Life ? Why not both?"

Under the keyword Life he found nothing, not all that strange for a biology library, 'life' being the ultimate taboo word in that field. Under Origins he discovered a reference to an article written by the Nobel prize winner George Wald in 1956, then reprinted in a compilation of Scientific American articles on the origins of life controversy.

"That's good enough. It's bound to contain references to Linus Pauling's - (I mean Urey's! - Damn! What planet am I on?) original papers."

The book was quickly located. He yanked out another 10 on related topics and re-entered the brightly illuminated reading room. Sitting down at a table near an opened casement, he began outlining the article by George Wald.

".....Fascinating, that's the only word for it ... Statistical models for the factors operative at the time of the appearance of living forms on this planet 'more likely' as against 'less likely' I don't know a thing about statistics except that I hate it..... I do like graphs, but not when there are so many numbers attached to them..... Louisiana a likely site for the beginning of life Marshy, sandy bayous..... What if I throw mud into the fish tank? That should do it. A good scientist knows how to improvise Weak cloud cover, ultra-violet light pouring in from all sides.. Thunder, Lightning ...Methane ... Nitrogen..... I'M GOING TO DO THIS EXPERIMENT TONIGHT ! TONIGHT ! It'll take too long to sort through the thousands of options in my other experiments. Anyway, this is the most important of all of them !... Plenty of time to worry about the others later... You can only do one thing at a time.... But, what about the ultra-violet? Mom won't be arriving for another two days..... Stuff the ultra-violet; the gas range is good enough. And that's that! "

He cradled the pile of books in his arms and started out the door.

"These are going back to the lab with me..... maybe I ought to fill out the filing cards, it'll just take a minute... On second thought... Boy do I hate to fill out library cards! I lose patience, and it takes forever....I make so many mistakes filling out library cards, then the librarians say they can't read my writing.....Why bother? ... Return the books when you've finished with them.That's why I avoid libraries.....You'll find very few scientists in libraries, they're all in their labs..... Yes, but suppose somebody else needs them in the meantime?.... I can't be worried about that; I've got a job to do!"

Clyde stumbled out the door and down the corridor, his arms and hands encumbered by books, papers and the unfinished can of beer.

VIII

He walked the length of the corridor and up to the 3rd floor. Upon arrival at his lab he posted the 'Important Work. Do Not Disturb' sign outside the door. The ceiling light was switched off and replaced by the dim illumination of a small desk lamp. Then he locked himself in.

"Now, where am I?... Oh yes... Hell , I never did get those proportions....They must be somewhere in these books.... on't bother to look them up right now, it'll just distract me I'm going to do this experiment! Get it over with! And that's that !! ... I can't spend the rest of my life haggling over petty details . Everything's terribly cluttered up already. Between you, me, and the local population of horseshoe crabs , any old proportions will do..... Any advance is a good advance ...How about 40, 40, 20.....? " He reached out for a scrap of paper and hastily scribbled a new chart:

Water	Methane	Nitrogen	Heat
(Range)			
40%	20%	40%	
100 ° F			

" At last! Now for 20 little squiggly urchins!" Clyde reached into one of the jars and pulled out a handful and dropped them into a large bowl

" I'll never use them all anyway; why not take forty? One step at a time another beer ." With trembling fingers he opened a new can and guzzled its contents at a fearsome rate. Then he scooped up another 20 urchins.

" I've got to control my nerves, otherwise I won't get anything done.... Wait a minute.... I can't bear the thought of dropping living creatures into ice cold water! First heat up the tank ."

Clyde struck a match. The glow in the semi- darkness highlighted his haggard features " ' He fumbled for a match' " , just like the sci-fi stories. They're all crap , if you ask me. Come on."

Fragile flames danced over the two front burners of the gas range. Slowly Clyde picked up the sea urchins, one at a time , and dropped them into the saline waters of the fishtank. Closing the lid, he plugged in the cork and squeezed it until it was as tight as he could make it.

" Open the valves. Full steam ahead! " Faint streams of Methane and Nitrogen could be seen invading the interior of the tank. As they bubbled into the water he earnestly watched the gauges on the compression tanks, the nozzles and the various instruments.

" There'll be some computations to do later. You know : $PV = kT$, etcetera.... What's k by the way? ... That's Physical Chemistry, not my field. Don't get sidetracked. "

The thermostat was supposed to work but didn't. Nothing happened until the heated water began giving off bubbles. Then he quickly turned off the two burners and stopped the flow of the two gases.

" All I need to do now is wait 15 minutes, read off the figures on the respirometer and call it a night. Good!" He heaved a sigh of relief , " I didn't know it would be so easy. I'll write down the figures later, then calculate the proportions from the amounts left in the gas tanks."

Clyde lay back on his cot and rested his head on the pillow.

"It must really be something to be a great scientist. " He closed his eyes and fell asleep instantly . When he awoke again it was 6 AM. He sprang off the cot:

" Check the instruments, pronto! What's the reading on the Warburg? " He studied the long glass tubes and read the dials. They registered: nothing. He peered into the tank. Desperately he tapped the walls. Nothing happened.

All the sea urchins were dead.

IX

An article with accompanying photograph appeared on the front page of the Falmouth Enterprise of July 29th, 1958 . It revealed that on the evening of the previous day Clyde Cytochrome , a 22-year old graduate student at Case Western University engaged in research at the Marine Biological Laboratories in Woods Hole , had been discovered in his lab, lying in a coma. An ambulance rushed him to the emergency room of the Cape Cod Hospital in Hyannis. His condition was reported as being stable, however he had not yet regained consciousness. The doctor in charge stated that Cytochrome had succumbed to toxic alcohol overdose sometime between 10 AM and noon. Dr. Knut Bergleson, eminent zoologist at Case Western and Cytochrome's thesis advisor, could give no reason for this grim turn of events.

More than 40 empty beer cans were counted. The student's laboratory was described as being in a terrible

disarray, with beer cans, papers, glassware, specimens, instruments and electronic equipment scattered every which way. Fragments of shattered glass tubing looked as if they had been wrenched from their supports and broken across his knee.

Scraps of paper ripped out from steno tablets and loose-leaf binders littered the room. They were thickly written over with ludicrous doodles, charts, mathematical calculations and random notations. Apart from some suggested connection with physiology, not a single one of the scientists at the MBL could make any sense out of them. Science Fiction magazines and paperbacks were also thrown about at random. Bergleson surmised that such junk literature may have exacerbated the depression of a young man he described as his 'prized student' .

Bergleson stated that he'd visited with Cytochrome the night before, and had found the room orderly and in good condition . The reporter was skeptical: scientists, he observed, live in a dream world peculiar to themselves, and what is neat and tidy to them need not be neat and tidy to anyone else. In his opinion Cytochrome had been hiding out there for months, terrified, afraid to step out of his refuge from the world.

A large water cooler bottle and the remnants of another were found on the premises. Bergleson identified them as the containers designed to hold the sea urchins ("spiny animals like little porcupines") used in Cytochrome's research. The first was empty and had been smashed against the wall , the second was still filled with about a hundred of these peculiar creatures. According to Bergleson they were all dead. They should have been dropped into salt water immediately upon arrival. They'd all suffocated within a few hours after delivery. Bergleson admitted that he'd been so shocked when he'd learned what Cytochrome intended to do with his gas range that he'd not noticed this detail.

The missing sea urchins were soon discovered clogging up an odd Rube Goldberg apparatus bustling with pipes, hoses, gauges and valves. Most of its accessories were busted. It was believed that in his delirium Cytochrome had dumped the whole bottle of sea urchins into the tank , then turned the valves and burners on and off at random. At the peak of his frenzy he'd drunk himself into oblivion because (it was surmised by a senior investigator under guarantees of anonymity) he believed he'd permanently ruined his future chances for tenure at any name university

.

Bergleson confided that he was both confused and depressed from what had happened. He described Cytochrome as a promising scientist, full of ideas, a little wild of course, but that was because he was very young, or so he'd thought all along. He'd expected great things from him. Now he wasn't so sure. He'd decided to adopt a wait-and-see policy.

Cytochrome's buddy, Jeff Benthic, also a student enrolled at the MBL summer school , testified that he was mystified by the mishap that had befallen his friend. He'd always thought of Clyde as the calmest, most collected , most ambitious person he'd ever known. Jeff was summed up by the reporter as someone commonly found in the scientific world, bug-eyed and horn-rimmed, the 'typical nerd' .

The article concluded with a brief description of Woods Hole, reaffirming its international fame as a marine biological research center , and reminding readers that it is the docking terminal for ferries to Martha's Vineyards. As a vacation venue in its own right it came highly recommended .

