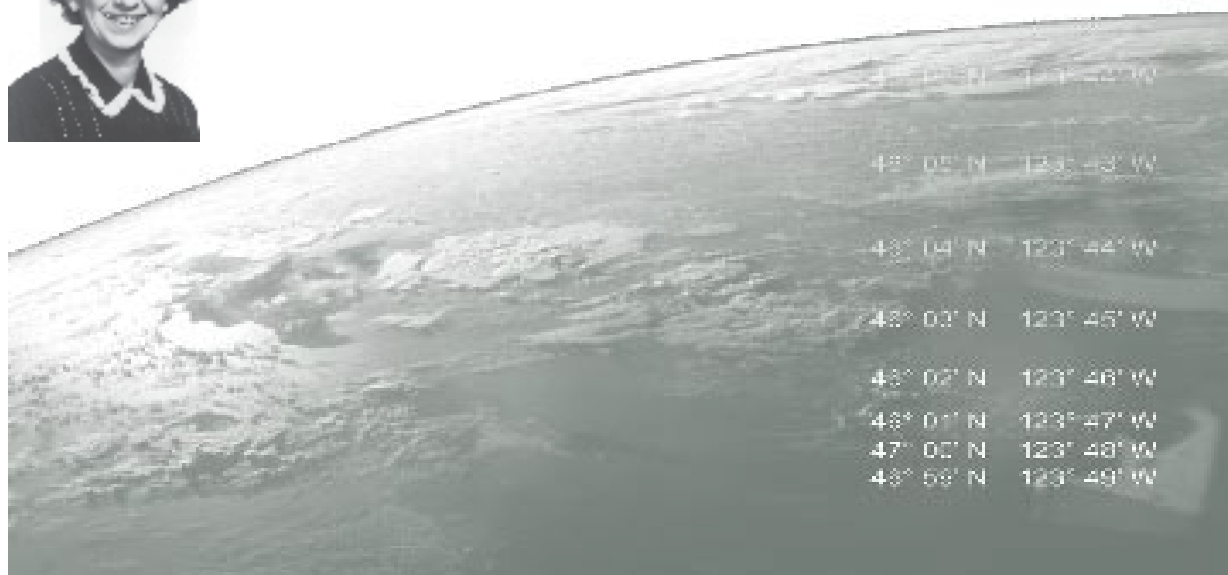




Racing against time

(mid 1975 – end 1976)

Irene K. Fischer



Between encouragers and repressors

In July 1975 there was an occasion to invite our old-time boss, Floyd Hough, back to TC (DMA Topographic Center, the successor of the old-time famous AMS) for a day of festivities. TC had installed a series of six portraits in the lobby, a “Gallery of Distinguished Civilian Employees,” and Hough had been chosen as one of these. A big luncheon was arranged in Hough’s honor, and several of his one-time employees, now in other agencies, joined us for this heart-warming reunion. After my return from Grenoble, Hough took great interest in my success there, like a proud father. Later in the fall, he went to the hospital to have a cataract removed, then had to return there with a broken hip—and that was just too much. He died 6 January 1976. Another warm experience lapsed into memory lane.

So did the friendly “Good morning” voice that greeted us in the elevator, suddenly become a mere memory? Many of us missed Nathan High, the chief elevator operator, when he had to retire upon reaching the mandatory retirement age. He knew his passengers, knew which floor they had to get off, and often saved me from getting off the wrong floor. He even remembered my husband and often inquired about him, which made me feel good. He had a pleasant, positive attitude towards life and accompanied the elevator ride with little, cheerful philosophical remarks that helped to relax the preoccupied faces around him, and sent them along to face the office day with a smile.

And such a warm smile was appreciated more and more, the less it seemed compatible with the assorted chicaneries of daily office life. You had

to learn to live with the fact that some people, unfortunately in a position of authority, would not respond on a technical or factual level; and be encouraged instead by the signs of support from the larger radius of the agency. You learned to distinguish between the repressors with their bureaucratic deputies and the encouragers. I managed to keep my perspective. After all, I was going to be here less than two more years before mandatory retirement, and there were several projects I wanted to finish before that—a race against time; I could not afford to lose time, energy, and enjoyment of this work by getting upset about things I could not change.

On the positive side, for example, there were just then a number of appreciative comments about several of my recent papers, with many requests for reprints, especially for the long review article, “The Figure of the Earth—Changes in Concept.” On the positive side also at that time was the nice gesture of the DMA award as “Outstanding Career Woman” which I and nine others (probably: let’s pick a round number of ten women) received in observance of 1975 as the International Women’s Year (so declared by the U.N. and by the President of the U.S.). Although it seemed a little odd that women’s achievements still needed a presidential decree to be specifically acknowledged as if these were something unexpected from a lesser species of mankind, the men did mean well.

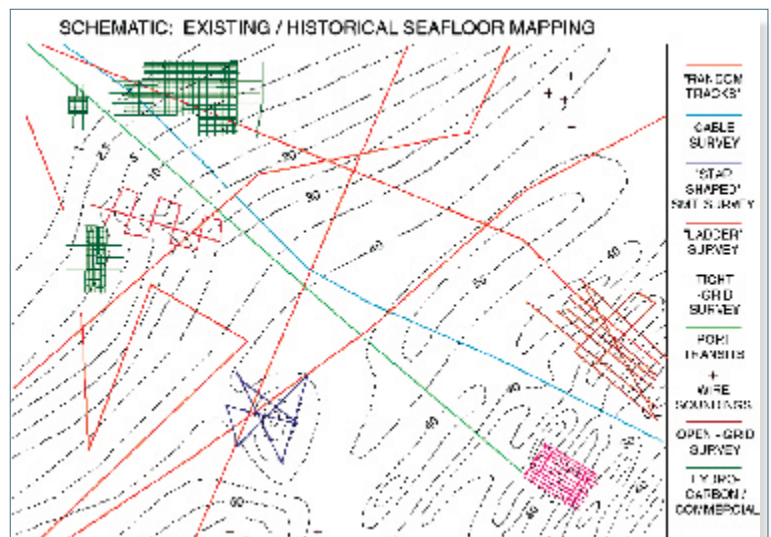
My concern with the sea level and ocean geoid problems had a strong supporter in Bob Gouker of the Advanced Technology Division who was satisfied with my monthly progress reports and provided long-term funding through renewed EAPAs (Engineering Application Project Assignments). I planned to pursue several strands of thought: one was to continue studying the conceptual assumptions in the debate between oceanographers and geodesists about the slope of mean sea level; another considered in fact that this quarrel was based on very few and relatively short available profiles. If one had more examples, particularly longer profiles, maybe one might see better.

It so happened that leveling data along the Pacific coast of South America were stored at our agency since the time our Inter-American Geodetic Survey assisted the South American

states with their leveling requirements. And the man involved in that assistance and familiar with these records and procedures was Jack Bray who had joined my branch some time earlier.

What a unique opportunity to contribute a very long meridional profile to the debate! I succeeded in getting Bray interested and appealed to his expertise in utilizing this unique treasure of data, not available anywhere else. In order to produce an example comparable to two previous profiles along the U.S. meridional coasts, Bray had to collect and analyze also the tide gauge data along the coast and study the effect of currents, winds, and a number of other factors affecting these measurements. While the sea level problem itself remained inconclusive due to the incompleteness and uncertainties of the available data at that stage, Bray made important observations and recommendations about the error analysis, the pitfalls of conventional adjustment procedures, and their avoidance when treating such long profiles.

Another strand in this problem complex was the



Data for ocean floor mapping [Source: www.nrl.navy.mil]

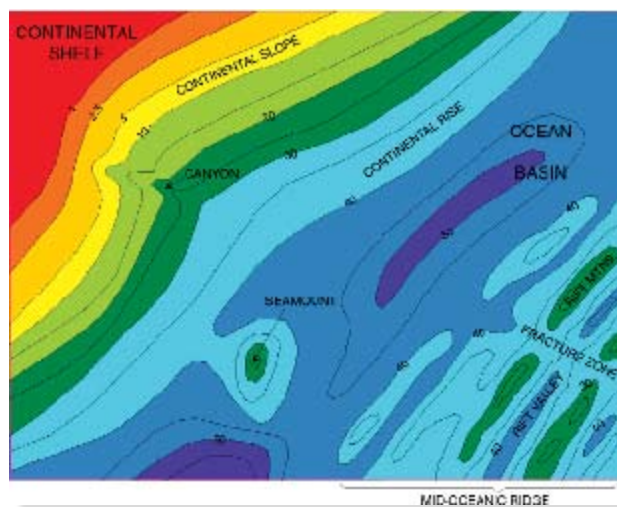
comparison of satellite-derived marine geoid profiles with terrestrially derived ones for verification. The bathymetrically derived deflections and geoid undulations in Kwajalein were specifically mentioned as TC tasks in the “GEOS-3 Exploitation Plan” of DMA, but here I had completed the terrestrial part of the comparison and yet there were no GEOS-3 data for Kwajalein in sight. (The designation GEOS-C had been changed to GEOS-3 after the launch.) We had a specially appointed

GEOS-3 representative who was to be the point of contact with the other agencies, went to all the periodic meetings, wrote and circulated reports about the agenda of the meetings, spent precious travel money for meetings across the country, but despite special requests he never seemed to succeed in getting data for Kwajalein, nor saw to it that the satellite would collect data when passing over Kwajalein, nor that there would be facilities in the Kwajalein region to receive those data, not to mention the need to monitor the flow of data through the processing channels. The sudden abundance of satellite data in some areas overwhelmed these multi-agency channels, and the increasing backlog of processing made it uncertain, when or whether at all specific, processed data could be expected. We asked for a specific search for our data. When nothing could be found, we prepared and submitted a time schedule for future possibilities for the satellite to collect Kwajalein data, but also that did not lead anywhere. We never did get these data.

Apples and oranges in the ocean

An invitation in January 1976, to participate in another sea-level conference at the University of Illinois at Urbana-Champaign, at the end of June, provided a focal point toward which to organize whatever I had gleaned from the oceanographic literature about the sea-level problem. Narendra Saxena who had invited the interdisciplinary “Conference on Geodetic Measurements in the Ocean” to Urbana, asked me to join the Marine Geodesy Committee that he chaired, and to be on the panel. Jack Bray’s study of the South American coastal profile would fit there, too. After the now usual difficulties to get permission to participate were mediated, the abstracts cleared and sent off, Bray and I settled down to prepare our contributions.

Since the discussions in Grenoble, I had read more and more of the oceanographic classical literature and I found the explanations, discussions of the problems, and the careful formulations by seminal oceanographers such as Bjerknes and Sandström, Defant, Sverdrup, and several others extremely helpful. To my ignorance as an oceanographic novice who had stuck out her neck in questioning contemporary oceanographic assumptions, it came as a revelation that these great oceanographers were on my side, or rather,



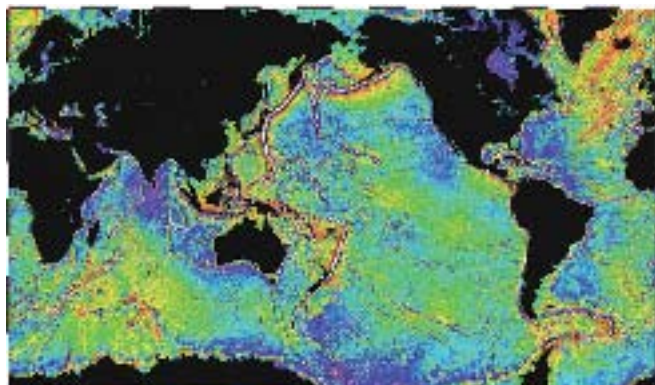
my critical hunch had stumbled into the right direction.

I would just use appropriate quotes to underline my arguments that the slopes of the mean sea level topography as determined by oceanographers versus geodesists are not directly comparable since (a) the mean sea level in the open ocean is not the same as the mean water level at a tide gauge which is subject to a number of local effects; (b) the reference surfaces against which the slopes are defined are not the same either; and (c) of course, that the two types of observations are made at different places, miles apart.

The literature, however, did not produce for me a direct quote about the odd equatorial bulge that I had noticed at first sight in these marine profiles. And yet, I still felt that here somewhere was the crux of the problem. Surprisingly, none of the several authors of marine profiles had seemed to notice this—to me—striking feature. Doggedly hunting for an explanation, I found several pieces of information that suddenly merged into a coherent picture. First of all I realized that the thrust and purpose of their investigations were quite different from those of geodesists—no wonder that the basics, adopted to achieve this purpose, were different.

The oceanographers study the mechanics of ocean currents, waves, etc. (sea level topography) and the interrelationships between density, salinity, temperature, and pressure in the ocean waters and the impact of meteorological and astronomic forces. The geoid as such is nowhere a primary object of interest as it is for geodesists who identify it with their basic concept of the “Figure of the Earth” and use it as the surface of departure for establishing elevations of the topography above and below. By contrast, the concept of departure for studying those oceanographic features is a

theoretical “standard ocean” which is by definition motionless, homogeneous throughout, of constant salinity, temperature, and atmospheric pressure, and with level isobaric surfaces. The interrelationships between changes in salinity, temperature, and water pressure at varying ocean depths were studied experimentally in the laboratory, expressed in empirical formulas, and tabulated in a number of detailed tables for practical use.



Free-air gravity, based on GEOSAT and ERS-1 Satellite Radar Altimetry (D. Sandwell and W. Smith) [Source: mp-www.nrl.navy.mil]

Reading about the excitements and achievements of oceanographic history since the beginning of the century, I learned that the currently used tables, still the same ones as first constructed in 1910, were based on 24 water samples taken from the surface of the ocean in 1902 during the international exploration of the northern European waters. In 1908, a single water sample taken at a 3,000 meter depth off the coast of Portugal had been added. Later criticism that these water samples may not be representative of the whole ocean did not succeed to incorporate modifications.

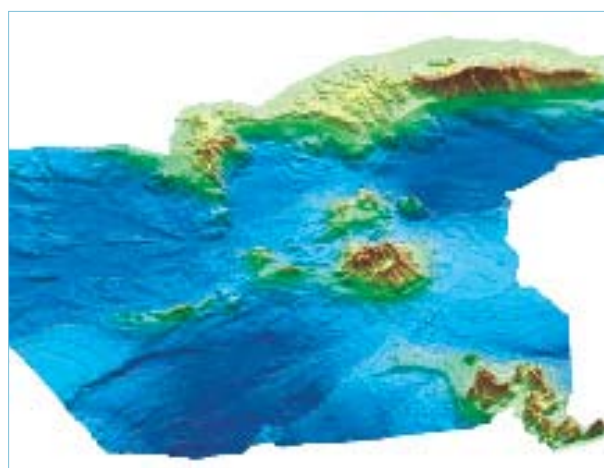
Similarly, Bjerknes, the author of the tables, was well aware (as apparently our friends in the current debate were not) that the variation in the intensity of gravity should be considered, but he had decided to use the simplification of a fixed value as good enough for the state of developments at his time (1910). He did, however, add correction terms in case more precision should be desired, but these corrections had been dropped in the current tables and current procedures.

Thus, I could see the pertinency of the standard ocean for the objects of study; and the oceanographic sea level profiles under debate as

deviations from that standard ocean—which had nothing to do with the geoid. These deviations were derived at particular stations, through the use of the tables, from the properties of the water column underneath each station down to a depth of 1,000 meters or 4,000 meters, depending on the author’s preference. There is no sideways connection between columns other than considering the foot of these linear columns to be at that same depth.

The question whether the pressure surface down there is level or not is not relevant for a single line column; it appears with their sideways connection through the constant depth—where it falls through the cracks of unproven belief or so far unsuccessful attempts to establish such a connection. Our oceanographic friends were thus correct in claiming that a refinement by introducing the latitude variation in gravity would be negligible for their type of computations. But I realized that this was so because these computations applied only to the individual linear column vertically below a station.

The surface of constant pressure at the foot of that column may or may not contain the foot of another column miles away, but may pass above or below it. In that case one would say that this equipressure surface was inclined, that is, not level. The assumption that it is level ignores the difference between the real ocean (where it may not be level) and the theoretical model of the standard ocean (where it is level by definition); it also



3-D perspective of the new bathymetry and morphology of the Kos-Yali-Nisyros-Tilos volcanic field, derived from a combination of surveys by SeaBeam 1180 and 2120 (National Center for Marine Research, Hellenikon). [Source: www.geowarn.ethz.ch]

ignores the efforts of several oceanographers to grapple with this unsolved problem.

For the controversy between geodesists and oceanographers, and for the puzzle of the equatorial bulges, all these pieces of information seemed to mean that the respective basic ideas of the geoid and the standard ocean were conceptually different, and that the various constant parameters of the latter, since they were adopted irrespective of geographic location, point to an inherently spherical model.

The geodesists occasionally also use a spherical model for the “Figure of the Earth” (the Earth minus its topography), but only as a rough first approximation. For more refinement they prefer an ellipsoidal model that incorporates into the model both the theoretical flattening effect of the Earth’s rotation and the measurable equatorial bulge. The standard ocean, by contrast, does not incorporate these features, and thus the bulges show.

Further refinements in geodetic capability of accurately measuring horizontal and vertical distances (which is a primary geodetic business) revealed the difference between this homogeneous, ellipsoidal model and the geoid, that is, the Figure of the Earth in the real world as molded by the effects of the existing irregular mass distribution. Thus, the geodetic description of the height of a station is separated into two parts: (1) the elevation of the station, say a hill top, above sea level (the geoid) as recorded, e.g., on a topographic map; (2) the height of the geoid above (or below) the ellipsoid model, as recorded on special geoid maps. It is important in geodesy to distinguish between these two parts like sorting apples from oranges. The leveling profiles along the U.S. coasts presented at the conference in Boulder constituted part (1), say oranges, the height of the mean water level at the tide gauges above or below the geoid. Part (2), the apples, would have come from, e.g., my geoidal map of North America if needed, which records the geoidal height above or below the ellipsoid used in North America. That was why I had been asked whether this information could help clear up the puzzle; it could



Source: www.ghostwriter-online.de

not, since the oceanographers insisted that their profiles of the sea topography (say the height of a current) were also part (1), oranges, and that they did not have nor need an ellipsoid.

Preparing now my contribution for the conference in Urbana, I had come a long way in questioning assumptions and studying the oceanographic literature; and I summarized my conclusions to the effect that the standard ocean was a spherical model; that it was roughly comparable to the spherical earth model in geodesy; that such models would produce profiles with systematic equatorial bulges; and that the oceanographic profiles were not referred to the geoid as claimed (not oranges) but to the standard ocean, and thus represented a mixed fruit basket of unseparated apples and oranges. I should have added some grapes to the oceanic fruit basket to indicate the difference between the (missing) ellipsoid and the spherical standard ocean.

It was great fun to present this paper in Urbana. It was published, as other conference papers, in “Marine Geodesy” (vol. 1, no. 1, 1977, 37-59), Saxena’s new International Journal of Ocean Surveys, Mapping, and Sensing. The people at NOAA, responsible for leveling in the United States, were pleased that my analysis proposed a solution to the puzzle other than blaming them for errors.

Bray’s study of the tide gauge and leveling pitfalls along the South American coast had also met with great interest in Urbana and elicited questions and discussions. It was published in Saxena’s Journal (*Marine Geodesy*, vol. 1, no. 2, 1977, 177-197).

Write as ghost but not as author

A new experience was to try some ghostwriting which I had never done before. The upcoming 25-year celebration of teaching geodesy at The Ohio State University took the form of a symposium with the theme “The Changing World of Geodetic Science,” October 1976, and our Commanding Officer, Col. W.R. Cordova, a graduate from there, was invited to present a paper on “New Concepts in Geodetic Instrumentation,” covering the past and future 25 years. I was asked to write this paper for him. I tried to imagine what I would say addressing my university as an honored guest speaker ten years after graduation, though with his background. Although my style in speaking and writing was surely different from his, I must

have hit it right, because he was delighted. My department chief liked my humorous address and the condensed overview of the technical developments, and insisted that I give a full-blown performance to the department. Cordova showed his pleasure by having the whole speech printed in the *Topocomment* (Oct. 76).

Pleased with my beginner's luck as a ghostwriter, I agreed to a second such request. Obie Williams, Technical Director at DMA, was invited to talk at the same symposium about the much debated uneasy question, "Does Geodesy Have A Future?" and he asked me to write a draft—of course with a positive answer. Of course, what else could you say at an anniversary celebration of a school for geodesists? It naturally had to be a pep talk and I tried to make it convincing. The reason for the general uneasiness about such a question came from the fact that the ancient quest to determine the size and shape of the Earth, the major goal of geodetic ingenuity for several thousands of years, has been met and fulfilled suddenly in our own time while it had seemed only a few decades ago to be an almost endless scientific hunting ground where every question answered opened up a number of new questions and new enterprises. Now, due to the new techniques (the theme of the symposium), further inquiries about this subject were just a question of increased accuracy with improved tools and sufficient funding – no really exciting, scientific surprises. Sure, the primary geodetic enterprise, the meaning of distances and directions, was still there and it profited from the new tools, but it was considered a humble service compared to the adventurous inquiry and lofty philosophical wonder about our planet.

In German geodesy the distinction is even made in the names "lower geodesy" versus "higher geodesy." And now, there was insult added to the injury: while typical geodetic services including information about the Earth's gravity field could be enhanced in scientific value by serving the scientific goals of geophysics and geodynamics, even extending them to the Moon and all planets, the scientists of these fields were doing these chores themselves without realizing they were trespassing. So there was a question of delineating disciplines and defending one's turf, to assure participation in the scientific adventures of the future. The paper was a determined defense of the turf, characterizing the typically geodetic services as a ubiquitous, never ending necessity. Williams liked

the paper, wrote me a gracious thank-you letter, and acknowledged my name in the publication in the Proceedings.

A related paper, written under my own name, however, ran into totally unexpected and unreasonable difficulties. It had grown out of current discussions of whether the newly growing marine geodesy was an entirely new interdisciplinary field or part of geodesy, whether its proper name should be marine geodesy, and what its specific scope should be. Saxena, originator and editor-in-chief of the new journal "Marine Geodesy," clearly endorsed this name by so naming the journal. He asked me for references from the literature where a definition of geodesy included the ocean floor. From my work on various historical papers I saw marine geodesy conceptually as always having been a natural part of geodesy, with the difference that only now there was the economic incentive of harvesting the resources in the ocean; and only now one could develop the techniques to do so and apply the typically geodetic services in the difficult ocean medium. This was impossible 2,000 years ago, even 50 years ago. Saxena invited me to write this up as an article for his journal.

When I submitted the paper, entitled: "Marine Geodesy: A New Discipline or the Modern Realization of an Ancient Endeavor?" (*Marine Geodesy*, vol. 1, no. 1, 1977, 165-175) for clearance, I had to wait three weeks before I was told that it would not be cleared. Not be cleared? Why not?—Well, such type of paper was not within the agency's publication plans. But this department chief showed common sense and a capability of making a decision: he agreed that I could treat this paper as a private effort (which it was after all) and send it out immediately without clearance, provided I took off the agency byline. This I was glad to do since my name as an author was well known and did not need the agency byline anymore; the omission would only make the agency look peculiar. Sure enough, when in due time the galley proofs arrived, the agency's name had been filled in and I had to correct it out once more. The publisher called me long distance to assure that this was not a mistake and he shook his head by telephone when told the reason. "Any other agency would be proud to have such an article written," was his comment.

But in some respects my agency was much more benign. In September 1976, I received a phone

call and, a few days later, an official letter from the National Civil Service League (NCSL) that I had been selected for their Career Service Award, as the only one from the whole Defense Department. I then learned that the NCSL was an organization of private citizens who “honor excellence in public service” by asking heads of Federal agencies to nominate outstanding career employees, and then choosing ten for their prestigious award every year. It was the first time that my agency had an awardee and they were extremely pleased. I believe, it was friendly Dewey Pegler, our Technical Director, who had initiated my nomination. A little while earlier I had already received letters of congratulations from all the channel steps for having been selected as the DMA nominee. Now, upon the news of the award itself, a pleased staff meeting had been

called at DMA Headquarters, so I was told, to plan publicity and arrange for my escorts to the festivity at the Smithsonian Institution; and there were again congratulations from all sides. A very special, coincidental yet memorable feature at this festivity was the presence of another awardee, the former astronaut Michael Collins who

had walked in space and been on the Apollo 11 flight to the Moon.



Source: www.jsc.nasa.gov

The beauty of the ocean floor

*“He had bought a large map representing the sea,
Without the least vestige of land;
And the crew were much pleased when they found it to be
A map they could all understand.
Other maps are such shapes, with their islands and capes.
But we’ve got our brave Captain to thank
(So the crew would protest) and that he’s brought us
the best—A perfect and absolute blank.”*

[Lewis Carroll: The Hunting of the Shark]

Experiencing the vastness and sameness of the open ocean surface from a ship or from the open beach, one can well empathize with Lewis Carroll’s crew. And it is easy and natural to transfer this impressive sameness to the interior of the huge water masses and to the ocean bottom underneath. It is only in this century that modern technology has taught us otherwise.

In antiquity, the need to test the depth of the sea near the shore for precaution against navigational

mishaps was originally met by a pole (shown in an Egyptian carving of 1500 B.C.) and later by the lead-and-line technique (mentioned by Herodotus in the 5th century B.C. as an established procedure) which was good enough for two and a half millennia. It took World War I and its need of locating enemy submarines to develop sonar methods. The technological breakthrough of echo sounding replaced the time-honored lead-and-line procedure and gave us continuous profile lines of ocean depth along the track of a moving ship, in lieu of sparse, isolated depth measurements for each of which the ship had to be stopped. This led to systematic exploring and charting of the ocean floor and a startling discovery. All of a sudden, the notion of a smooth ocean bed, smoothed by continuously accumulating debris, was shattered by the realization of great variations in depth: from narrow and deep trenches to isolated seamounts and to continuous systems of mid-ocean ridges.

By mid-century, one had an over-all picture of the major ocean trenches, ridges, plateaus, and basins. In the 1960s, the National Geographic Society produced a series of beautiful, colored maps of the ocean floor, based essentially on the bathymetric studies of the Lamont Geological Observatory, artistically augmented and dramatically enhanced to give a stunning painting of the ocean bottom topography, which by far surpasses whatever the most impressive land topography has to offer. At least I was very much impressed and awe-struck.

In the 1970s when I worked on the Kwajalein project, demonstrating how bathymetric charts could be turned into highly useful geodetic information about deflections of the vertical and geoidal undulations, I read with much more than routine interest several articles about newly developed and further planned methods to collect consistent detailed depth information. Such collections were being stepped up in response to military as well as geophysical requirements. The essence of various kinds of such new instrumentation lay in the capability of side-looking sonars in multi-beam arrangements to sweep the areas on both sides of the moving ship out to more than two miles. Such blanket coverage was obviously a big step forward in compiling bathymetric charts. I wished I had had such charts for Kwajalein; or, since that was past, it would be nice to have them even now for testing how much I would have gained in accuracy. More important, I would like

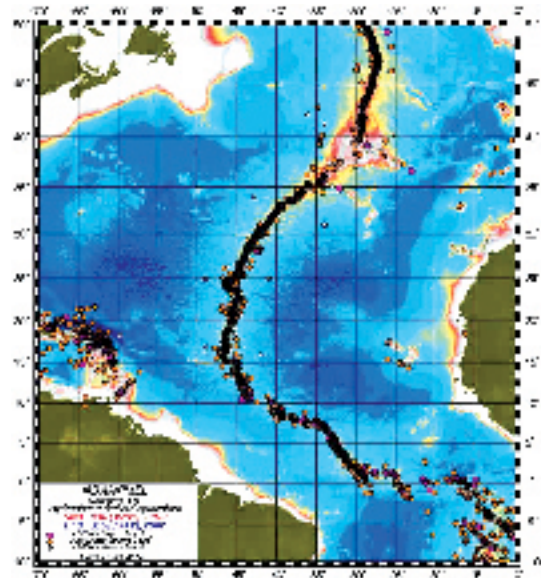
to have such charts for a second test area somewhere in the middle of the ocean.

At the ACSM 1974 Fall Convention where I had presented a detailed report on my Kwajalein work, there was a fascinating paper by William Lear of the U.S. Naval Oceanographic Office (NOO) about the implication of such new techniques to small seamounts, and the computerized processing from data collection to finished contoured bathymetric charts with unbelievable detail at any scale. From the discussion I gathered that there would be “wall to wall coverage” of the ocean floor, and I asked, of course, whether I could have such charts for Kwajalein or other regions. The chairman who had given me a particularly friendly and generous introduction before my own presentation, said: “For you and your well known work, Mrs. Fischer, I am sure they’ll make them available.” He was overoptimistic, however. When I sent a request to NOO for such charts in certain regions, I could not get any, not even with the help of an official liaison. It was not quite clear to me then whether “not-available” meant “not existing” or “not given out.”

Then, in fall 1975, I suddenly was in luck. *The Journal of Geophysical Research* (JGR) carried an article on a section of the Mid-Atlantic Ridge (MAR) at 26° north latitude, with a sharp reproduction of a detailed bathymetric map. It was made from a very dense survey, from narrow-beam echo-sounding profiles along tracks only a few kilometers apart, augmented by underwater stereo-photographs. Depth contours were given at 200 meter intervals and at 100 meters for the central part. It seemed like the answer to my prayers: a detailed central part across a conspicuous feature such as the top of the ridge, and a surrounding area – except that the latter should have been much larger for my computational requirements. I would start with what I had here, get formulas and procedures ready, see what these would lead to, and worry about supplementing the extent of the surrounding coverage later. To begin with, the map needed to be blown up considerably to allow reading and tabulating the content in a grid of 5 by 5 minutes of arc and even 2½ by 2½ minutes in the center.

The Mid-Atlantic Ridge is part of a huge system of underwater ridges running along the middle of the oceans, as shown so impressively on the National Geographic charts. According to the current plate theory, materials well up here from

the Earth’s interior, rejuvenating the crustal plates which spread out from here to either side, and are subducted into the interior again in another region. The focus of the journal article was thus on the crest of the ridge, about 2,000 meters under water, and particularly on the very narrow, deep



Acoustic monitoring on the Mid-Atlantic Ridge.
[Source: www.pmel.noaa.gov]

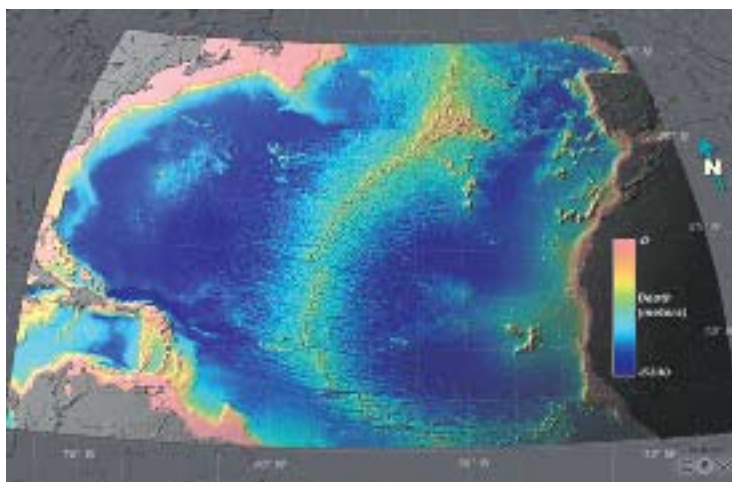
rift valley that splits the crest along its axis, reaching down almost another 2,000 meters. A cross section would show the ridge as if it were a 5 to 6 km high, very craggy mountain with an incision at the top, and nearly symmetrical, much dissected slopes spreading out on either side for more than ten longitude degrees before reaching the deep ocean bottom. The little map, however, covered less than 1½ by 1½ degrees and thus included very little of the mountain slopes. For our purpose of deriving from it geodetic information at the ocean surface 2,000 meters and more above, the sudden cut-off of the data introduced a falsifying effect (truncation error) as if there were a quadratic prism 1½ degrees wide and about 3 km high; it masked the variations on the top including the rift valley, which were further attenuated through the distance up to the ocean surface above. Would it not be nice to have the whole mountain feature, not just the rift valley, which in its narrowness was not very conspicuous among the multitude of the other crags?

I turned again to the Navy for extensions of my data, and this time they came through: in spring

1976, they sent me a newly compiled bathymetric chart, still in the manuscript stage, that contained in its center the little area of the map we were already working with. The dimensions of the map sheet were the standard 6° in latitude and 10° in longitude, and thus covered a good part of the mountain feature. It was contoured at 200 meter intervals and showed spot values to the meter at extreme points. Although it had not been made with the new technique, and some areas were covered less densely than others, on the whole it was a far cry from the old spot value charts I had to make do with for Kwajalein.

We decided to read and tabulate its content at the same detail of the 5 by 5 minute grid. For easier reading of the maze of contours that seemed to have no rhyme or reason, I began to outline the major contours, every 1,000 meters, in color. We were richly rewarded when out of the maze gradually a pattern emerged. The color scheme brought out an unbelievably dissected landscape of jagged mountain blocks, separated by deep canyons at right angles to the slightly NNE direction of the crest and rift valley. Blocks of the same height are larger in horizontal extent when nearer to the crest and diminish with increasing distance as if they had moved away, and were cut up in the process until dissolved. The deep ocean bottom at the sides was coming in towards the center in these deep canyons like overlong fingers.

Lewis Carroll's crew would never have dreamed of so much exciting variety way beneath the vast blank they saw on the ocean surface. Even less would they have cared to know of what's going on beneath the deepest ocean bottom? But scientists do care about the oddest things. Way back in the first half of this century, the Dutch geophysicist F.A. Vening Meinesz and others made gravity measurements in a submarine in an ambitious attempt to decipher these messages of what's happening underneath. And way back at the start of my own geodetic career in 1952-53, I had listened to doubts about the validity and reliability of such measurements, and had contributed a study in the Western Mediterranean Sea dispelling that doubt. Now I came full circle, happy to find a few of Vening Meinesz' gravity measurements within the area of my map sheet. Could they serve as guides



The hydrothermal system where North America and Europe once used to be connected. Due to sea floor spreading over the millenia, they are now 3000 miles apart . [Source: www.lostcity.washington.edu]

in lieu of the land-based observed deflections of the vertical in Kwajalein and tell me what it's like below the ridge? Vening Meinesz thought there must be some isostatic compensation under the ridge. Somewhat to the north of our area, unfortunately not within it, there had been two scientific cruises producing two transoceanic gravimetric and bathymetric profiles, from which scientists of the Lamont Geological Observatory had deduced that there was indeed some isostatic compensation under the ridge; and they had constructed some tentative suboceanic density models to account for the discrepancy between the observed gravity and that calculated from the bathymetry. Could I use this information as a starter and modify it to fit my area? It meant that, unlike the Kwajalein work, I would have to concentrate on gravity first in order to establish a reasonable density model, and derive later from that the deflections and geoidal heights. I asked the Navy for two more of those remarkable bathymetric sheets, the ones adjacent to mine to the east and west, which would enable me to squeeze out a little more information about the underworld from these sparse and precious Vening Meinesz messages.

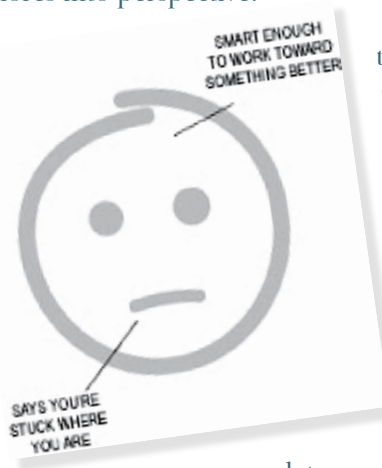
In September 1976, Phil Wyatt, my senior programmer, was suddenly transferred out of the department into Staff, leaving the Mid-Atlantic Ridge project at a rather critical stage. He had been incorporating the Navy's map sheet, as read and tabulated by Willie Nelsen, into the data collection for the electronic computer, augmenting the first data set from the little map I had found in

the JGR. He did not have much time but, conscientious as he always was, offered to show his successor how he had set up things and to help where and when he could. Both the successor and Willie Nelsen, however, were detailed to the classified area a little while later, and that was that. What to do? I was very busy with the theoretical aspects of the project, and I urgently needed an experienced programmer to compute the various options I was setting up for analysis and further planning, and finally to compute the results. At this stage, a new person did not need to learn much about the background and intricacies of this whole project; as long as he had computer skills, I would tell him exactly what I wanted done. So I went on the lookout for a programmer-computer who might be underutilized and dissatisfied somewhere else (so many were) and could be persuaded to work for me. The one thing I could always offer was interesting work under well organized and pleasant working conditions. Contrary to some managers' viewpoint, many people don't like being underutilized, and they respond beautifully to well-planned guidance, encouragement, and appreciation. I was lucky again this time. I did get two people willing to help me out: John Brady in November and Paul Berdy in December. They were both godsend.

I quickly distinguished the different capabilities and inclinations of these two men and assigned jobs accordingly. Brady got busy on the computer and eventually we were both happy and proud with his achievement of a huge clean set of data to play with: the center sheet with the finely read middle part across the rift valley contained 12,204 items, and each of the two side sheets had 8,640 items, together a little less than 30,000 items. You do learn to appreciate the electronic computer! In earlier times one would not even have planned to tackle a computation job with so much detailed information. Brady computed from it the gravity field of the region in five fairly evenly spaced latitude profiles, with and without compensation from a number of suboceanic density models that I was designing and testing. Because of the great longitudinal extent of these profiles he subdivided them to suit the time limits on individual research computer runs, kept track of their multitudes, and stored the information in an orderly, readily accessible fashion. I would graph the solutions for analysis and modifications. Both of us enjoyed the looks of these graphs as they grew under our eyes from our continued purposeful industry.

In the meantime, Paul Berdy helped me to squeeze the ten Vening Meinesz pendulum stations in our area for whatever clues they might hold for the suboceanic density conditions. It was obvious that there must be considerable compensation also in our area, since the observed values were much, much lower than the ones which Brady had computed from the rocks above the 6 km reference of ocean depth alone. Thus, below that depth there must be less dense rocks than assumed as a uniform theoretical reference (particularly beneath the high crest of the ridge), so that the deficiency below would make up for the load of the ridge above, to produce the observed values. I had to construct some density model that would do that. Eventually, I adopted a model that seemed to do the job, and it was incorporated into Brady's profiles for the whole area.

Happily ensconced in technical work, with the satisfaction of having things purr along once again, the vagaries of the current administrative world to which I also belonged, did not really disturb me so much anymore beyond a constant wonder about the difference of the two worlds in which I moved within the same working day. In an almost schizophrenic switch between them I contemplated the sterility and pettiness of the one while there were these beautiful marbles to play with in the other. I had learned long ago to put the administrative chores into perspective.



There were the periodic and overlapping housekeeping reports (multiple versions of the same information), evaluations, schedules, forecasts (all to fill the files), federalese

updates and name changes with different alphabet letters, updates of work objectives and manpower needs (pro forma paper games with changes made arbitrarily along the way elsewhere), listings for higher officials (which they could have found in the files already), travel and training needs (which did not mean they were honored), nonsensical estimates of future savings

Fischer, p. 48, col. 2

Trimble acquires XYZs of GPS, Inc. assets

Trimble (NASDAQ: TRMB) acquired in February intellectual property assets from the privately held XYZs of GPS, Inc. of Dickerson, Maryland, in an all-cash transaction. The XYZs of GPS is the developer of the real-time Global Navigation Satellite System (GNSS) reference station and of integrity monitoring and dynamic positioning software for meter, decimeter and centimeter applications.

The purchase of The XYZs of GPS intellectual property is expected to extend Trimble's product portfolio of infrastructure solutions by providing software that enhances differential GNSS correction systems used in marine aides to navigation, surveying, civil engineering, hydrography, mapping, and GIS and scientific applications.

Dr. Benjamin W. Remondi, president and CEO, and staff of The XYZs of GPS will join Trimble as part of the transaction.

"Dr. Remondi has been a pioneer in the development of GNSS positioning and its applications. We are extremely pleased to welcome him and his team to Trimble. We believe that The XYZs of GPS software will greatly enhance our infrastructure solutions which are becoming increasingly critical for high-precision applications," said Jürgen Kliem, general manager of Trimble's Survey Division.

The assets acquired from The XYZs of GPS, Inc. will be reported as part of Trimble's Engineering and Construction business segment.

Certain statements made in this press release are forward looking statements within the meaning of Section 27A of the Securities Act of 1933 and Section 21E of the Securities Exchange Act of 1934, and are made pursuant to the safe harbor provisions of the Securities Litigation Reform Act of 1995.

Corrigendum

The listing of FIG Commissions on p. 14 of *ACSM Bulletin* 219 did not include Commissions 3 and 4. They are:

Commission 3—Spatial Information Management (Chuck Pearson, ACSM Delegate)

Commission 4—Hydrography (Jerry Mills, ACSM Delegate)

(compared to what?), show business to impress someone (that at least was artistic and fun), etc., etc. I knew it was important and sometimes useful to be there and play ball, but I had also learned to return the ball quickly and pragmatically, with the little finger of my left hand, so to speak.

Most importantly, I had adopted a sort of selective memory which made me respond to and remember the cordial conversations and cooperation of so many people, while shutting out the shenanigans of "the little ogres" and their messengers of understudies, except for a cool analysis to help me decide my next move. I would not let them infringe on my joy of life. Yet, I kept musing why office life had changed so much from the good old days in AMS when, at least within the department, all seemed to play together and managers were leaders and professional colleagues, while now the kids played in different corners with distrust between them. Was it an aberration now and the normal state then, or was the present the normal state as the habitual disparagers of government workers are wont to claim, and was it an exceptional state of affairs then which I had been fortunate to witness and had mistaken for the norm?

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