Coastal Navigation

Instructor Manual

The national standard
of quality instruction
for and by sailing instructors

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SECTION 1

SHOREBASED TEACHING

Introduction

The most important single characteristic of a shorebased navigation instructor is that he or she should be an experienced yacht skipper. Navigation and pilotage learned exclusively in a classroom might be good for passing an examination based on multiple-choice questions, but it will avail students little if their instructor has only rarely put to sea. People who sail regularly understand when it is necessary to navigate formally and when it may not be. They know when a fix is vital and when taking one would expose the navigator unnecessarily to a potential bout of seasickness. They understand the reality of leeway and when it may prove insignificant. They are well aware of how accurate an Estimated Position is likely to be under varying circumstances and they can tell their students how it really *feels* to be in charge of a small sailboat unexpectedly engulfed in fog. Such instructors have also discovered in practice how a passage plan made with GPS in mind may require modification when it is found that the boat cannot lay the first waypoint plotted so meticulously the night before. It is realities such as these which a US SAILING Coastal Navigation Instructor should be teaching.

One of the main tasks of the practical "at-sea" instructor faced with a student who has completed a shore-based course, is to clarify the way navigation fits into the overall picture of sailing a yacht. Students, for the most part, have little skippering experience. Many, indeed, will have done hardly any sailing at all. It is therefore imperative that while you are teaching them in the classroom you continually remind both them and yourself that there is life beyond the navigation station.

Planning the Course

Before you begin running a course you should set a day aside to consider the whole syllabus in detail so that you can project the time requirement for teaching each part of it. A plan must be built around this and made available to students so that they can see how far they have progressed.

When working out how much you can teach in a session, you must bear in mind what you will give in the way of homework in the case of a night-school course, or private study if the course is to run "straight through" over a number of days. Marking private study exercises individually is very much a part of the technique of teaching, so always leave time for this in your plan.

Do not be disheartened by the amount of time it takes to write examples for your students to work through. If one of your exercises proves successful, as most of them will, you can save it and use it again next year.

The typical length of a night school session is 2 hours. Full-time courses can be more flexible in their time allotments, and instructors will make up their own overall timetables, but the one below might be typical for an evening class running over a winter period. The number of hours allocated is indicative of an average course.

As you read through this manual you will notice that the order of subjects does not entirely coincide with the plan below. There is no reason why it should do so in detail. Experience will show an individual instructor or school how the emphasis can be modified to suit their needs while fitting in with this loose recommendation.

Typical Program for a Coastal Navigation Evening Course
Sessions Timed from 1830 - 2030

The course is run in conjunction with the Coastal Navigation Student Book.

Lesson	Subjects Covered
1	Introduction to navigation -- The chart -- Symbols -- Scales and distance -- Basic lat/long position and direction
2	Exercises Aids to navigation, buoyage, lighthouses, etc. -- The dead reckoning position and leeway -- Basic course to steer
3	Exercises Inputs: Eyeball, Log, Fathometer/leadline, Steering compass
4	Chartwork exercises Tidal current -- The estimated position
5	Chartwork exercises The ship's log -- Position fixing
6	Fixing exercises Shaping a course with current and leeway -- One-hour legs, multi-hour legs and passages involving reversing tide Exercises
7	Tidal heights -- Theory -- Exercises
8	Tidal height exercises -- Tidal heights in practice
9	Electronic fixing aids -- Systems: Loran, GPS (transit) -- Accuracy -- Waypoints -- Cross-track error
10	Chartwork exercises to include lat/long positions and waypoint navigation -- Radar in theory -- Radar as a plotting tool
11	Coast Pilots -- Cruising guides -- Sources of up-to-date information: Navtex, Notices, etc. -- Chart corrections and exercises -- Living with uncorrected charts
12	Inshore Pilotage -- Pilotage plans
13	Pilotage exercises Creative reading of a chart -- Navigational strategy
14	Fog navigation without electronics Fog exercises -- Electronic aids in fog
15	Navigational realities -- Expected limits of accuracy -- Priorities -- Heavy weather pilotage -- Organizing your chart table
16	Passage Planning
17	Passage management without electronics
18	Passage management making sensible use of electronic aids -- The realities of modern smallcraft navigation
19 & 20	Examination papers

Planning a Lesson

It is crucial that the instructor knows exactly what is to be achieved during any particular lesson and that the teaching techniques to be employed have been thoroughly rehearsed. Together with a growing knowledge of the abilities of a particular class of students, this will ensure that the necessary information is imparted within the allotted time span.

Always leave time during a lesson, preferably at the beginning, to run through any homework which the students have brought in. Sometimes you can arrange to deal with this individually while the class is tackling an exercise within the structure of the current session. This type of personal attention is of the greatest value, because it enables you to keep in touch with each student and address any weaknesses as they develop.

Learning navigation is to some extent a sequential operation. Students who have failed to grasp the practical application of tidal current, for example, will waste everybody else's time as well as their own when you come to work on Estimated Position. So never forget to plan reviews of subjects already covered, both collectively with the class and individually to assist remedial students.

Outline the aims of a session at the outset, then ensure that formal presentations are assembled with an introduction, a treatment of the main subject matter, a summary, then a test if appropriate. Thirty minutes is more than enough for a straightforward talk. Keep your language plain and use no jargon that is not genuinely required. If you are introducing a technical term for the first time, explain it clearly and find a way of mentioning it again later. Do the same thing at the next session so that there will be no problems stemming from a misunderstanding of what you are talking about.

Try to structure lessons so as to include a variety of activities and teaching methods. Two hours listening to one person talk, however brilliantly, is too much for even academically active adults, especially while some of them are digesting their evening meal!

If you are operating by the water, lead the class down to the beach to take some real bearings. Find a convenient friendly motor yacht and borrow the wheelhouse to demonstrate a hooked-up radar set actually working. Even if you are in the heart of the mid-west, take what steps you can to achieve a balance between hands-on chartwork and theory lectures.

See to it that when you are stuck with a 2-hour session in the classroom, you plan a natural break. Have coffee served and make the most of the chance for some informal chatting with your students. One hour is the absolute maximum that you can expect to hold their attention without a break or change of some sort.

Shorebased Teaching Techniques

Competence and Enthusiasm

As a US SAILING Instructor, you have been rigorously assessed, so your competence to do the job for which you are qualified should be above suspicion. This does not mean that you stop learning, even at this level, at the termination of your Instructor Qualification Course. On the contrary, it is often said that you don't really learn to navigate until you have taught a number of courses. This is nothing short of the truth. Talking things through with intelligent students shows up any shortfall in your own armory very quickly indeed, and shortfalls there will almost certainly be, in the early stages at least.

Keep working up your own knowledge. Expand and reassess your expertise by taking every opportunity to make passages outside the cloistered environment of the sailing school. Sail with other experienced people and read up the latest thinking on the use of modern navigational aids. Just as a sailing instructor has a duty to understand state-of-the-art developments in rig and hull technology even if he or she personally prefers to operate a 1920's catboat, so the navigation tutor must have a complete grasp of today's navigational tools as they develop into the 21st century.

Despite your best endeavors, the time will certainly come when one of your students "catches you out." This is not a good feeling. Most of us experience first a sensation of weakness in the central abdomen, followed by a desire to prove ourselves right. This is natural enough, because nobody wants to be found wrong by a student with one week's learning, but you must resist the tendency at all costs.

When a student says to you, *"I don't understand that. Why isn't it done this way?"* Think hard about what has been said. If the answer is clear, then give it. If, on the other hand, you find yourself thinking, *"Hey, wait a minute. I don't have an adequate response. Maybe he's right."* *Reply honestly* at all costs. If you flannel now you will lose the student's respect and possibly that of the rest of the class as well.

If you really don't know the correct solution, tell the student that you will research it before the next session. You can always cover your tracks by explaining that this is not a situation that you have come across in practice, or some other genuine excuse for not knowing outright. Then make sure that you do find out, and never make the same mistake again. It was a nasty scenario, but you will survive.

When it comes to teaching the more complex concepts, such as tidal heights and their ramifications, you must be a complete master of the subject. If you are fumbling along, you have no chance of reducing the ideas to a concise, step-by-step form. Without such organized thought from you, the students will struggle and you will have failed them.

One of US SAILING's strengths is that it offers a national system with national standards. If your particular bay or estuary does not have tide, or your boat's compass does not suffer from deviation, you should not cast these subjects aside as irrelevant. They may be to you, but if your student charters in northern Maine next summer, or decides to sail to Europe five years down the line in his or her own steel ocean cruiser, you will have sold the student short if he or she is not in complete charge of *all* the techniques described in the course.

Since nobody ever got rich by teaching navigation, it must be assumed that you are in the business because you like it. This is a good start, because the students in your classroom are sufficiently committed to the subject to give up their leisure time and pay money to learn about it. There are as many ways of showing enthusiasm as there are instructors, but whatever form your own ardor takes, it is absolutely vital that you share it *and continue to do so* right through the course.

Remind yourself of this every time you walk into the classroom. If you are feeling low for personal reasons, you simply must put them out of your mind, just as an actor does. He steps onto the stage the evening his wife left him and a truck ran over his dog, gritting his teeth and muttering, *"The show must go on."* His audience sees only the same vivacious performance as he delivered the previous night when he won ten thousand dollars on a horse and his long-lost son returned home to embrace him. Admittedly, he has had years of training to handle such contingencies and you have not, but you'll get the idea.....

Adults in the Classroom

Your students will often be of varying ages and come from a mix of educational backgrounds. Do not assume that what seems to you to be the simplest arithmetic will come easily to everybody, and bear with them while you explain. There are after all more ways to heaven than being able to interpolate tidal data in one's head.

Spell out the sums, as the textbook has sometimes done. Never imagine because you have explained a knot to be one nautical mile per hour that everybody will instantly see without being told that a boat logging six knots will cover a mile and a half in fifteen minutes. You must find a way of making sure the whole class understands that this is so without patronizing the sharper mathematicians. How you achieve this will depend upon your own act as an instructor, but you should give it serious thought.

A typical 40-year-old may have had no formal learning for over twenty years, yet he or she may be a roaring success in business, or art, or in the sometimes degraded science of bringing up a family and keeping a home together. Such an individual will have been learning continuously ever since leaving high school, but much of the information will have been imbibed experientially rather than by listening to lectures. Fronting up to a lifetime of challenges and coming up with working solutions is how many of your students will have expanded their knowledge, and this self-education is the natural way for an adult to continue growing. If you have a young class, or one heavily seeded with academics, you

can safely lecture them, but in most cases your task will be better accomplished by putting across "bite-sized" chunks of information, then setting examples with carefully measured, achievable results.

You may find difficulty in persuading certain students to join in discussions and Question-and-Answer sessions. There are many reasons for this, but two of the commonest are a natural laziness arising from an assumption that you will simply instruct while they learn passively, as they might from a quasi-educational television program, and a reluctance to appear stupid in front of their peers.

Adults fear failure more than children do, and a reluctance to risk answering a general question is one of the results. Solving the problem may take a number of lessons, but your attitude will be vital. At all costs, be positive, even if people give wrong answers. If you smack them down, not only will your victims be hurt, any others who are experiencing misgivings about coming out into the open will think better of it as well.

Concentrate your mind on creating gentle ways of massaging the wrong answer into the right one without saying *"No."* For example, if a student suggests that a bearing is generally a superior source of LOP than a range, you might answer, *"That's an interesting point of view, and I can imagine circumstances when it might be so -- a huge lighthouse a mile away on a calm day would give you a great compass bearing. Things are different, though if the sea is rough, because the compass wobbles about.....etc."* And off you go, reminding everyone about the benefits of a range. You've had a perfect lead to restate your points; the problem with compass bearings has been brought out; the student who gave the dubious answer will certainly not forget what you are now saying, *but will be firmly on your side* because you praised his or her initial remark by finding a grain of truth in it.

It is all too common for a representative of any age group to catch himself or herself patronizing a group from a different one. The experienced are notorious for patronizing the young, while youth has its own special way of making its elders feel like "has-beens." Watch out for a patronizing style in your own presentation, and stamp it out, for there is no future in it.

Despite their keenness, older students are often less quick to pick up new ideas than their more youthful classmates, because the gap between broad interest in a subject and the ability to grasp its practical aspects tends to deepen as age advances. You probably will not find this where a mind is in training through constant "academic" extension in the workplace, but in cases where a student's lifestyle does not include specific learning and in-depth problem solving, you may have to work a little harder. Be patient, for none of us is growing any younger.

Oral Question-and-Answer Techniques

Questions from you answered by your students fulfill a number of needs:

- Because the technique requires direct input from the students it demands their active participation and thus expands their attention span, sometimes giving you a fresh platform for another 15-minute talk.

- Questions should be built into a lesson plan for three different purposes: they can be a direct teaching system, they can be used to stimulate a further avenue of learning, or they may offer both you and the students confirmation or otherwise that everything in the lesson so far has been understood.

- There are two basic types of questions. **"Open" questions** require a broad thought process. They may have more than one answer, or they could demand the sort of complex response sometimes required in passage planning. **A "closed" question** has a simple, right or wrong answer, such as a magnetic heading deduced from a true course and variation.

Questions for Teaching -- Careful planning is required to frame a question in such a way as to elicit the response you are looking for. This will usually be the correct answer, assuming your intention is to work on the well-established basis that people who have deduced something for themselves are more likely to remember it than someone who has merely been told.

Occasionally, you might try being a little more creative. There are some circumstances when the obvious answer is the wrong one. In these cases, ask the question, be given the wrong answer, then put the matter to rights -- tactfully, of course. You don't want the honest soul who played into your hands to feel he or she has been "set up."

Most of the students who were not asked for the answer will realize that they would also have fallen for the trap, and therefore they will all be forearmed when they come to navigate in practice. In such circumstances it can be profitable to explain why you put the question as you did. Your students are not fools, and if you point out that the mistake made is a universally popular one, which is why you let them make it, they will be happy to forgive your subterfuge.

In this context it is important to distinguish the type of question outlined above and the "trick" question used "to make sure everyone is wide awake." It is generally a bad idea to use trick questions either in the classroom or at sea, because they undermine a student's confidence to answer any further queries you may set.

Questions To Stimulate Further Learning -- This approach uses a question to see whether or not your students have made the connection between today's lesson and a related one a week or two back. As the answer becomes apparent to them, you help to bring about the dawn of real navigational consciousness with the realization that the business of piloting a boat is more than a bunch of unrelated topics, it is the sum of a number of them used together. This in itself can encourage more serious students to revise on their own initiative.

Questions for Testing -- The purpose of such a question is to determine whether or not your people are "up to speed" so far. Framed successfully it can also raise students' confidence. As with all Question-and-Answers, this is a two-way process and the manner in which you handle yourself during these sessions can be axiomatic in your class bonding.

Never start a test question by saying, *"OK, Bert, I'm going to ask you to tell the others how to....."* In the first place, this can make Bert feel singled out for special persecution. It might even give him an inflated idea of his own importance. It is also less likely to produce a good answer because he will probably become nervous. Furthermore, the rest of the class will relax and mentally drift away, knowing they are off the hook for the time being. Instead, **pose** the question, **pause** while they *all* think about it, then **pounce** benevolently. *"Right. You've all had time to chew it over."* Now look round to see who has an answer or who is looking pointedly the other way. *"OK, Lola, you're in the hot spot."* (BIG SMILE) By now, the class should be on your side. They are also rooting for whoever gets the job, because you have made light of the way some of them are feeling, indicating that they have your sympathy.

If Lola hasn't a clue, reassure her and ask somebody else. Whatever you do, don't make her feel bad either by what you say or by your body language. A click of the tongue at the wrong moment can be enough to lose you a student and rob sailing of a possible convert.

Sometimes, there will be so many poor answers or silences that it is obvious the point has not gone home. This is because you didn't teach it well enough. Admit it. Tell them you're sorry and set about sorting out the problem. They will love you for it. If you chastise them they will know full well that it is you who was at fault and your bonding attempts are blown for lessons to come.

Up to a point, any student failure is a failure of the instructor, but you should not crucify yourself every time one of your class seems somewhat slow. You can only do so much and if one student is consistently holding back the class, you may need to talk to him or her privately, suggesting extra teaching or a broader course of home or evening study to help the student catch up. In extreme cases, your last resort may be to introduce the student to the secretary of the local golf club....

Questions from Students -- These come in two forms: relevant and irrelevant.

A ***relevant question*** will usually refer to what you are immediately teaching. Answer it. Another sort of relevant question may relate to a topic already covered which is pertinent to the current subject. A detail forgotten about Spring and Neap tides, for example, can make for difficulties during your tidal current lesson. Once again, answer the question as concisely as you can after first making sure that the questioner is the only one in trouble. If the haziness runs right across the class, you are lucky that somebody asked, because you clearly need a quick revision session.

Occasionally, a relevant question will concern matters not yet taught, in which case you might choose to explain that you will be coming to the matter three lessons down the line. If time permits and the answer will not confuse, there is always the option of giving a simplified response that will satisfy your questioner.

Irrelevant questions are usually a total distraction for you and the rest of the class. Dispose of them as humanely as you can. They may offer an opportunity for you to spin a *quick* yarn about your amazing experiences at sea and so increase our own "street credibility," but this is a dangerous course to embark upon and you should keep such responses to a minimum. It is better to allow your private life to filter through to individuals during informal chats in natural breaks. They will pass the "scoop" around quietly and your name will go up lights far more surely than if you had tried to nail it there for yourself.

If an individual develops a habit of asking irrelevant questions, or otherwise contrives to be the nuisance of the class, do not be too sudden in your actions. It can take a few lessons for some people to realize that they are not making themselves popular, and in the meantime it is more than likely that one of the fellow students will tip them off. If the tendency does not fade away, have a quiet word. The student is almost certainly seeking attention. If this does not work, put him/her down firmly but kindly in front of his/her peers. Be assured that they will be on your side.

Keep Students Informed of Their Progress

Encourage continuous communication with all your students on an individual basis so that you can not only judge their progress, but can keep them advised of your assessments. It is important for them to know how they are doing.

Visual Aids

When it comes to absorbing information, the brain prefers visual stimulus to anything else. Analysis indicates that in a learning situation, 75% of what goes in is taken visually, 15% by ear, and 10% by the rest. Visual teaching aids are therefore of the utmost importance. In this respect, everything is fine for the on-board instructor who is surrounded by the boat and the sea; the visually impoverished classroom teacher must be more creative.

Visual distractions are as arresting to the eye as properly constituted aids, so you must take steps to arrange your classroom environment to avoid them. Similarly, once a visual aid has out-run its usefulness, place it to one side, or it too may become a distraction.

Keep visual aids as simple as possible lest their very complexity become a distraction. Decide precisely what you want the aid to say, make sure it says it, *and no more.*

Time the moment when you reveal your aid, and do so in as dramatic a way as you reasonably can. It will be remembered more clearly if linked in the mind to some event or other highlight of the lesson.

Involve your students in the use of the visual aid if possible. A question about plotting, for example, might be dealt with by asking the student up to draw his or her query on the overhead projector. If you are using real instruments hooked up to transducers, as you might in your friendly powerboat's wheelhouse, invite a student to twiddle the knobs, rather than hogging the job yourself.

Types of Visual Aid:

- **The blackboard** is still hard to beat for explaining something quickly, and a good, big one is useful so long as you are aware of its limitations. Using it requires practice. Remember that you will turn your back to the class while writing on it and that it is hard to talk while doing so. Blackboard diagrams and figures cannot be stored and the medium is not generally successful for detailed work. On the other hand, it can readily be seen by the whole class.

- The more modern **penboard**, though often smaller, has the same benefits and drawbacks, while the **flip chart** has the advantage of your being able to pre-draw a number of useful diagrams.

- **Overhead projectors** (OHPs) are of tremendous value. If you have never used one, start now, and get plenty of groundwork in before you face the students. You can prepare acetates up front, draw on them in advance if it helps, and produce special effects by overlaying one upon another. Colors may be used to highlight salient points, and the whole presentation can be managed in daylight so that you never lose eye contact with your class. Sometimes, even a list of headings on the OHP can concentrate the mind, but do not try to put up too many words at once. Words in themselves are not true visual aids and a page of small print can degenerate into a distraction. Don't talk to the OHP screen or to the projector. Always remind yourself to speak to the class.

- **35mm slide transparencies** can bring reality into the classroom. A photograph of a real green buoy, for example, is far more useful than all the diagrams in the book. Think creatively about how to use slides, but don't overdo it in terms of lesson time because you will have to dim the lights and so give everybody an ideal opportunity for a snooze. Edit ruthlessly and resist any desire to give a "magic lantern show" of your last cruise. If in doubt, heave it out!

  When showing slides, it helps to turn up the room lights every now and again to make a series of points. This will break up the dream sequence and keeps both you and the students on your toes.

- **Videos** must be checked thoroughly by you before you show them, unless you made them yourself. There are many detail differences in teaching techniques and plotting conventions. The last thing you want is for your authority to be undermined by your visual aid.

  Whenever you use a video, always hold a tutorial on its contents immediately after it is finished so as to answer any queries and to align yourself with it in your students' minds. The change of voice and delivery method can do nothing but good, but only so long as you have chosen the right video!

- **Real-life items**, such as a hand-held GPS receiver or a trailing log spinner should be passed round the class, not merely held up for inspection. Beware, though. If you give somebody something to hold, he'll go on looking at it rather than concentrating on your lesson, so don't leave redundant visual aids circulating after they have served their time.

Personal Performance

Room Layout -- Give this subject all the thought it deserves. Ensure that the workplace is well lit and ventilated. If only one wall has windows, you should be facing it, with the students' backs to the light, unless you can arrange for the light to come from one side. Never teach with your own back to the light.

Do what you can to make students comfortable, each with a decent desk that can take a large chart. If this proves impractical, at least be certain that all desks can accommodate a folded NOS or full small-craft chart.

Try to turn down any offers of a room next door to a primitive music class specializing in Voodoo dancing. The noise will be unhelpful.

Stance and Mannerisms -- For much of the time you are teaching, you will be moving around the room dealing with individual queries and operating visual aids. When you are talking formally, pay attention to where and how you stand. Don't hide behind your desk, make an active decision about how formal you should be, but don't overdo formality. A lectern may make you feel safe, but it introduces a barrier between you and the class, whereas perching on the edge of your desk is friendly but could be taken as too casual. Think about your students, your own age and general demeanor, then form a policy on what sort of position to take up.

Beware of speech and body language mannerisms. It is difficult to check up on your own performance in this respect, but it can make or break your success as an instructor. It is all to easy to fall into a speech habit such as ending every other sentence with, *"Right?"* or *"OK?"* There are many others; all are highly distracting.

Almost every untrained public speaker develops irritating mannerisms, body movements such as finger-drumming, fiddling with keys in the pocket, or kicking a leg while seated. Search yours out and eradicate them.

Ideally, ask a friend to sit in on one of your sessions to watch your act. Accepting what is said afterwards will take real discipline, but do not try to self-justify. You have asked another's opinion. Take it on the chin like an adult and you have an opportunity to improve your performance beyond recognition. Your students won't know you the following week.

Dress -- This may be the first thing about you that is noticed. In some ways, your turn-out is the key to your character. Although sailing is an active sport, you are not at sea when running a shorebased course. If you dress down too far you will offend students who have made an effort over their rig, though pink pants and blazer will generally be over the top. You cannot go far wrong by setting a smart casual style, but if you are in a city location and your students are coming after work you may have to up-grade. A good rule of thumb is to be as well turned out as your best-groomed student. That way, you should upset nobody unless, of course, you forgot to take a shower. However outdoor a person you are, there is nothing like an hour or two in a stuffy classroom for generating body odor. Guard against it!

Maintain Two-way Communication -- Without this, your lessons become impersonal lectures and will fail, at least in part. Use eye contact frequently, and with every member of the class at least once per session. Do not talk towards the curtains or to the pretty girl or cool guy strutting past the open window. If you are conversing with a student, during a chartwork session perhaps, never let your gaze stray to a more interesting student at the next desk but two. This is a social mistake seen mainly at cocktail parties. It has no place in the classroom. Neither has leering at members of the opposite sex, even if the "come-on" is unmistakable.

Watch your class carefully at all times to assess their level of interest in your lesson. If you see them flagging, *do something* to wake them up. What this is will depend on your personality and the circumstances, but it could be anything from a change of pace in your speech to a more radical answer such as taking the students outside with their compasses. You might simply call a coffee break.

Never lecture or teach wearing dark glasses. It is extremely rude because your students are excluded from intimacy with your eyes. They do not know where you are looking or what you are thinking, and they have those rights.

Learn your students' names early on. If you aren't naturally good at this, and few of us are, then make up a seating plan with all the Christian names on it. Keep this on your desk and utilize it to the full. Use students' names every time you talk with them and, if you think you may still make mistakes, explain your problem and ask them to remind you if you get one wrong. That way, embarrassment can be averted.

Humor -- If you are a natural humorist, by all means go for the occasional joke, but remember that not even Bob Hope could have played a full navigation course for laughs. If you are not adept as a stand-up comic, don't even try to be funny. You only need fail twice to lose your audience for good. Ask any out-of-work comedian.

Never extract a laugh at a student's expense, and under no circumstances use sarcasm or other forms of humiliation. Everyone in the room will hate you for it.

Punctuality -- Do not be late for a lesson, whatever the excuse. A number of busy people have taken precious time out of their day to be there. For you to be ten minutes late is to imply that you are more important than they are. This is simply unacceptable.

If you are not the sort of person who is naturally punctual, do not say to yourself, *"My lesson starts at 1830, it takes me a quarter of an hour to drive to the school, so I'll leave at 1815."* Always aim to be at your class at least 15 minutes before the start of the lesson.

If there are visual aids, etc. to set up, be at your classroom with time to spare so that you have finished your preparations 15 minutes before the start of the lesson.

This "15-minute rule" will give you at least some time for the inconvenient contingencies in life.

Cynicism -- There is a natural tendency for all professionals dealing with the public to go through a period of cynicism. This is brought about by a perceived stupidity in those who do not spend their life perfecting skills the specialist has managed to master. The results of this are plain to see. The gas station attendant thinks the driver who chooses to have him check the oil is a fool incapable of doing it for himself; the chandlery salesman assumes that you do not know how to apply paint to your yacht; the bus driver treats you with contempt because you were too busy to find the correct change before climbing

aboard his bus, and the sailing instructor sniggers with his mates because a person (who may have skills of his own that the instructor could not begin to grasp) is a little slow to find the groove helming to windward. Be aware of this tendency and DO NOT LET IT HAPPEN TO YOU in or out of the classroom. If you see it developing in any of your colleagues, tell them about it, because it is unacceptable in any form.

End Lessons On a Positive Note -- Ensure that everyone has taken in the main points of the session, then find a way of projecting onward. That way, your students will feel they have had good value from this lesson and will go away looking forward to the next.

SECTION 2

COASTAL NAVIGATION COURSE HIGHLIGHTS

Introduction

This section consists largely of specific hints to make teaching the Coastal Navigation course easier. It is understood that navigation will be taught on board as well as in the classroom, so while this book is essentially pitched towards the shorebased instructor, points will also be made that should prove useful to hands-on instructors at sea with their students.

The sequence will more or less follow the chapters in the Coastal Navigation Student Book. This order of teaching the whole business of piloting has been shown to work well, but it is not "cast in stone." If conditions or circumstances experienced by individual schools or instructors render it less than ideal, there is no reason why the subjects should not be dealt with in an order more suitable to the locality.

Some topics in the syllabus require a modest amount of rote learning. Buoyage is an example. It is best dealt with by introducing it early on and spending a few minutes on it each lesson.

Subjects demanding in-depth understanding, such as course to steer, EP and tidal heights, will need careful planning both in terms of your teaching strategy and also for the preparation of a considerable amount of private study questions.

Private Study Questions and Exercises

Many students start out on a navigation course believing that it will be primarily about chartwork. This is at least partly true and it would be a shame to disappoint them. The multiple-choice question is, of course, a useful teaching aid as well as a means of cross-checking a student's comprehension of a concept or specific point. It is limited, however, in that it is not the most effective means of testing or building plotting skills. Neither is it ideal for working on tactical overviews. The instructor must therefore work hard on creating chartwork exercises.

A simple EP worked up from course steered, distance run and a one hour set-and-drift vector is another easy plot. Start off by giving the current as a simple speed and direction. Later, you could ask the class to look up the current for a given hour in a suitable current table or tidal current atlas. Later still, introduce leeway, etc.

All plotting propositions should be thoroughly backed up by worked examples on the chart. You will never know whether or not a student has really understood the running fix until one has been correctly plotted from first principles.

Later in the course, you can set examples of passage plans involving awkward decisions concerning such items as Traffic Separation Schemes, to which there may be no single correct answer. See what the class comes up with and take time to discuss the results with each student individually.

There will be further indications of ways to create exercises in the coming sections of this book, not only on plotting, but also on such questions as tidal heights, sources of LOP and inshore pilotage.

Student Equipment

In order to take part in a US SAILING Coastal Navigation course, students will require dividers, a plotter or parallel rulers, a soft pencil of the grade 2B or similar (with a means of sharpening it) and an eraser. Schools should be equipped with a few examples of all the above, and certainly should carry a stock of proper pencils. Any student who is serious enough to have signed up for a course ought to have their own basic instruments.

The course instructor will probably have preferences for the type of plotter or parallel rulers to be used, the size and form of dividers, etc. This should be indicated in pre-course material so that students have time to equip themselves before they arrive on Day 1.

Chapter 1 -- Introduction to Navigation

Despite anything you may have heard to the contrary, navigation is a straightforward business. It is built around two simple questions: "Where am I now?" and "How do I safely get from here to where I want to go?"

The above quote from the Student Book, set in your own words, is as good a start as you can make to a navigation course, once everyone has introduced themselves and you have stated the aims. The aims are to give the class all the theoretical knowledge they need to pilot a boat or yacht in all but oceanic conditions.

It will be well worth while to consider the whole of the introductory passage in the book, because it is carefully designed to motivate students while setting their minds at ease. Ever since the Portuguese pilots in the Age of Discovery, navigators have made capital out of projecting their trade as a "black art" open to only a few initiates. It was professionally important for those early navigators to create this myth, and the generations who have followed them have done nothing to dissipate it. Your immediate task is to fly in the face of tradition and blow this nonsense out of the water in the opening moments of your course.

Spend a quarter of an hour or so talking casually about navigation, using each anecdote to further defuse the students' nerves and apprehensions.

Remember what has been said in the early part of this book about adults in the classroom. Bear in mind their probable hang-ups and use this brief session to do what you can to reassure them that the course will not only be useful, it will also be highly satisfying and can actually be fun as well.

Chapter 2 -- The Chart and Basic Chartwork

The Mercator Projection

With an average class it rarely pays to dwell on the theory of chart projections. The purpose of the session is to ensure that comprehension of the "two-dimensional image of a three-dimensional reality" has taken place.

One way to achieve this while putting across the concepts of Lat/Long at the same time is to devise a spherical visual aid. In lieu of something more technical, a segmented, multicolored child's beach ball is an acceptable indicator of the meridians coming together at the poles. Move on from that to an OHP display which you have pre-drawn and you have the lesson in the bag.

The textbook illustration indicating the source of the Mercator projection should prove adequate to help you explain how the chart has been formed. Once you have covered the "straight-line, shortest distance" principle of the Mercator chart, it can be interesting to show students a Gnomonic chart of your local ocean, indicating to them how the meridians converge on such a projection at this scale, and how a straight line across the ocean changes course every few degrees of easting or westing. After that insight into the wonders of the world, they will be well pleased to return to Mercator's view of things and plot their courses in straight lines.

Plotting Positions

Now is the time to issue students with their first chart. If you are by the sea and your local waters are well supplied with features, both man-made and natural, give them a quick briefing, then take them outside and let them orient their charts and begin recognizing realities right from the outset. Make full use of Chart #1. This technique will have the spin-off benefit of waking up the class by a change of scene in case your Lat/Long presentation has induced a somnolent condition.

If you have no sea close by, do your best in the classroom.

Involve students at a hands-on level straight away by getting them to measure distances on the chart with their dividers. It is useful to issue two charts of differing scales to ensure that the message has been taken in.

Plotting Lat/Long positions is fun and helps accustom the class to their instruments and the chart. Giving several of these can be productive, especially if after inviting them to plot a number of positions, you turn some upside down, by asking, "What is the position of the Grumbler bell buoy?"

Standard Mistakes

- It is understandable that a person who writes English, French, Russian, or any other language based on the classics will expect numbers to rise from left to right across a page, because that is the way everything is written. Arabs do not suffer from this illusion, but we westerners are stuck with it. The result for the navigator is that it is natural to expect the degrees and minutes of longitude to rise (increase) from left to right across the chart. In west longitude, of course, they do not. They rise from right to left as the longitude extends towards the setting Sun from Greenwich. Nearly everybody makes at least one such mistake in their lives. It can have catastrophic consequences. Instructors must ensure that students never fall into this well set trap by explaining its presence, why it occurs and perhaps by recounting (or even inventing) an anecdote in which they nearly lost their ship as a result of forgetting.
- Spell out that distance is measured down the *side* of the chart, then check next week by a couple of simple exercises that the class has remembered.
- The conventions for writing down minutes and decimals of a minute can cause some initial confusion in students who do not have a scientific background of any sort. Make sure this is clearly understood.

Direction

The purpose of this session is to teach the general concept of direction expressed in angular terms, not to promote the idea of plotting in True or Magnetic. Since you are dealing with first principles, it will be clearer to talk about degrees True, merely mentioning the magnetic compass rose in passing, so as not to create any complication at this early stage.

The theory of direction should be easy enough to put across, but it will be best consolidated by a number of exercises which also introduce the ideas of courses and bearings. Possibly the most important thing is to make sure that everyone can use their plotters and/or parallel rulers by the end of the lesson. This will leave students with some feeling of achievement as well as the impression that they have seriously come to grips with the chart.

If there is time, you could set one or two exercises of the type, *"What is the course and distance from Peacehaven harbor mouth to Beetling Head buoy?"*

For the reasons stated in the textbook, it is now almost unheard of for a European yachtsman to employ parallel rulers for workaday plotting. These instruments are still popular in parts of the U.S., however, so it is important to teach their use, together with at least one type of plotter. This should be as simple as possible. The one sophistication which may not lead to confusion is an effective system for allowing the plotter to read in degrees Magnetic, should that be the user's wish.

Chapter 3 -- Pilot Information, Chart Types and Corrections

The positioning of this lesson within a course is not critical, so long as the material is covered before you come onto Inshore Pilotage and Passage Planning.

The first session may concentrate on the chart types indicated in the textbook, plus any others you feel are relevant. Produce examples if you are able, and discuss the benefits of one against another in a variety of circumstances.

The way in which pilot books and cruising guides expand the information on the chart should be explained, leading up to the light list, which can be used as a link into chart correction.

Chart Correction

This must be taken seriously. Possibly the best way of bringing students to grips with the subject is to have them correct their own charts by producing a copy of your local Notices if this proves appropriate. If not, you'll have to invent a correction or two.

Chart corrections make first-class plotting exercises.

Whilst stressing the importance of using up to the minute data, an instructor must also teach how to handle the all too common reality of charts which are past their "sell-by date." You should know from your own experience how to deal with this, using recent light lists, almanacs, etc., where you are in doubt about a light or mark that really matters, but the message must be *to exercise absolute caution at all times.*

Chapter 4 -- Aids to Navigation

It is sometimes hard to know where to start when tackling this large subject. Bearing in mind that your students know nothing to speak of, you can sometimes begin by explaining the need for navigational aids, why they have come about, etc. You can then go on to discuss each type of aid in turn, but search always for visual presentation methods to stop your lesson degenerating into a boring list.

Major Lights

Although the textbook discusses most of the common light characteristics it is worth running through them orally. Occulting lights in particular can give rise to misconceptions. An OHP of a sectored light, showing the dangers it picks out, is a good way of breaking up the lesson, and you should make use of a copy of the Light List to start a talk about what lighthouses and their associated structures really look like.

Range -- Take care to point out that the heights given for lights are above high water ("more on that later...") and that the figure on the chart refers to the height of the lantern, not the tower. The Light List should give both heights.

The question of nominal range is readily handled, but the business of whether or not a light will be geographically visible gives plenty of scope for creative teaching. At worst, use an OHP or something else similar to the illustration depicting the effect of the earth's curvature on visibility (textbook pg. 17).

Note that the textbook does not go into detail at this stage of exactly how far off you can expect to see a particular light. You might explain that this will be dealt with later, but be sure to mention the appearance of the loom of a light.

Sound Signals

If you can manage it, try to prepare a recording of a variety of fog signals. The song of a real Nautophone echoing round your classroom brings the smell of saltwater a lot closer. If this proves impossible, you'll be left with your own imitation of a dying cow. Remember the remarks about comedy earlier in this book, and the best of luck to you!

Buoyage

The illustration of a boat entering a channel (textbook pg. 20) is the first one in the buoyage section of the textbook to remind everyone that we are teaching practical piloting. That is what our person actually sees on a harbor approach, rather than a map covered in little symbols representing buoys. Having made that point, you can now go on to work through the basic buoyage system employed in U.S. waters.

Slides or video can be a great help here, and if your pictures can be of buoys or light structures which exist on the class' practice charts, you are in very good shape indeed. It does not do to forget that buoys in reality are often quite different from the schematic examples given in textbooks, so any pictures of real ones are a great assistance. If you are going to use video, keep it simple and resist any temptation to dethrone the kings of Hollywood with your production techniques.

The "Preferred Channel" illustration (textbook pg. 21) shows a system of channels involving preferred channel markers. Try drawing a blank chart of your own, then run off a few copies and ask your students to fill in the sort of buoys they might expect to see. This is a classic example of an *indirect question*. There is no absolutely right answer, though there should be plenty of details which can be wrong or right. There is, however, space for everybody to have their say. The solutions you are offered will provide you with one prompt after another from which to talk interestingly about buoyage.

Make certain that your class understands that while buoys are there to guide the mariner, they do not necessarily have to be slavishly obeyed. Try to photograph a chart which is well stocked with buoys, some of which a yacht would leave on the designated side, some of which would be unimportant, and others which, for reasons of avoiding shipping, the yacht might actively decide to pass on the "wrong" side.

Charts are easy to photograph. They make great 35mm transparencies, and plots drawn with a soft pencil stand out clearly. Use diffuse daylight and a tripod, but if you haven't one, you'll manage OK by holding your camera exactly parallel to the chart. Stagger the exposures one stop either side of the "auto" setting.

It is a good idea to tell your students about those marks which conventionally flash a predetermined light characteristic, but do not be disheartened if they cannot or do not choose to commit them all to memory. Remember that for the most part the marks will be described on the chart. Encourage the class to learn the lights by pointing out that if they see an unexpected one while operating with an old chart they will at least know what sort of buoy it is.

If a student who is proceeding well seems to be having trouble over the rote learning, do not penalize him or her. At all costs, the student must not be put off at this stage by being made to think that navigation is all about academic cramming. Perhaps he or she will begin to see how the system works during "spot checks" on buoyage in later sessions, and even if he or she doesn't, there has been many a first-class intuitive navigator whose talents lay more in the direction of deciding what represented a safe clearance on the day than how many times a safe-water mark flashes in a minute.

Beacons, Daymarks and Specialized Situations such as the Intracoastal Waterway

If you are not careful, you will have lost most of your people by the time you reach this part of the business. They may not have actually gone home, but unless you are delivering an inspired lecture, they will have snoozed off to a happier land. Watch them carefully, therefore. You must be near the end of the "learning span" by now. Flexibility must be your watchword. So far as attention periods are concerned you must go with the flow. At the first sign of glazed eyes, take a break, then move on to something else. You can always pick up the pieces next week or tomorrow.

Having run your initial session on buoyage, keep plugging away at the subject by introducing five-minute Question and Answer "bites" throughout the next few lessons as a way of punctuating your course.

Chapter 5 -- Navigational Inputs

If you are looking for a way of introducing this subject, the "eyeball" paragraph in the textbook supplies one.

The basic proposition is that if you can see where you are -- alongside an identified buoy, perhaps -- and are able discern where you are going to, it is OK to sail there, providing the chart confirms that there is absolutely no possibility of hitting anything hard on the way. The clever part of piloting comes when any one or more of these three criteria is not fulfilled. Then you must begin to navigate formally in order to be sure of success, drawing in data on your yacht's progress so as to be confident about where you are and the direction you have been traveling, or will travel. Such data can be described as navigational inputs.

It will do no harm to conclude this preamble with a statement that experienced navigators constantly use their eyes. As a result, when operating in unchallenging circumstances, it is not unusual to see no plotting appear on their charts at all. There is little worse than a chart covered in superfluous lines. Given the three requirements described above, a student under at-sea examination who plotted more than was needed would actually lose "points."

The message must be, *if in doubt, plot, but do not spend so much time over it that you neglect to skipper the yacht properly.*

The Compass

This section can usefully be opened by reminding the students that thus far all direction has been considered in degrees True. For the record, remind them also of what that means. This gives you a lead in to your lesson on variation.

The "Compass Rose" caption (textbook pg. 23) supplies a statement of variation in practice. Give a few examples of variation decreasing or increasing to make sure that they've got it so far.

The sketch diagrams on whether to add or subtract variation (textbook pg. 24) should be self-explanatory to the instructor. They may not be to all the class, however, so you must take some time to work through this primary concept. If you have a better way than the one in the textbook, by all means use it. The important thing is that everybody finds the right answer every time. Once people have understood the proposition, the "Error West, Compass Best" mnemonic often proves the neatest route to the correct answers.

Now chalk up a number of examples on your chalkboard to make sure everybody has thoroughly understood. Be ready to help those who are still struggling. Remember that a student may have to perform these calculations at 0300 in a heaving boat while feeling terminally seasick, so you simply must make sure the lesson is well learned.

Deviation

If deviation has never figured in your life, by all means tell your students in order to reassure any who are beginning to look punch-drunk. To be fair to them, however, you must also make clear that deviation is far less uncommon than many yacht navigators choose to believe. Even if the boats they propose to sail are deviation-free, they must be able to handle it if they ever intend to call themselves pilots, because there are any number of vessels where applying deviation is a routine part of shaping a course.

The "Deviation" illustration (textbook pg. 25) should lead neatly into an explanation of deviation, but a dynamic visual aid will be far more successful. If, early on, you can show a model boat "turning under her compass needle" you will already have aided your class' comprehension, but show the needle being deviated by a large lump of iron as the boat turns and you will have them in the palm of your hand.

Converting True to Compass or Compass to True (textbook pg. 25) -- Never assume that because the movement from Compass to True and back again is second nature to you, it will be for your students. You will probably need to spend a few minutes spelling out the schematic that Magnetic lies in the middle between True and Compass, and that to move from one to the other is a linear thought process. Point out that deviation is applied to a Magnetic heading not a True one, just as variation converts a True to a Magnetic heading.

The "Conversion" example (textbook pg. 25) looks fearsome to students. You must defuse this by dissecting it. The OHP is the ideal method, especially if you can lay your hands on a set of colored pens to draw overlays. First produce an acetate which shows variation alone being applied, pushing the compass round 7° to the left. With this still in place, lay on a second acetate in a different color showing deviation pulling the heading 4° back towards the right. The resulting overall compass error of 3° west can now be readily accepted.

Examples like those in the test papers are easy to arrange. Write a number of them and try them on your class, not only at the beginning of the next session but at any time you need a "punctuation mark." Then you'll know they have learned about the steering compass.

Once the class have understood the compass they will not forget, because it is a delightful exercise in logic if well taught.

Heeling Error -- This must be placed firmly in perspective. Unlike deviation, it really is unusual, but it is still real and on a long leg aboard any unfamiliar boat it should be checked for by the means described. The job takes about 15 seconds and may make all the difference to the yacht's landfall. Once again, a model makes a great dynamic visual aid.

Working in Magnetic Only

The textbook says it all. You are running a formal course in practical yacht navigation, not an on board skipper training session. On the boat, an inexperienced student has multiple concepts to struggle with in addition to "True Virgins." If you can get rid of one of these in the early stages so that his mind is freed to concentrate on working the boat to weather in a nasty chop, there will be no harm done.

Coastal Navigation Instructors, however, have an opportunity to teach navigation to a realistically higher level, and if the US SAILING program is to have any general credibility, it is towards those strata we should be moving. Explain about working in magnetic. Reassure the students that the sea will not swallow them up as heretics if they choose to do it for the sake of simplicity early on, but point out the method's very real shortcomings.

Away from the stress of skippering, there are no real problems about learning to handle True plotting, so long as the instructor is a master of it. Remember too, that any of your people who were to sit a commercial U.S. Coast Guard exam would be required to know all about working in True.

Swinging Ship

A discussion about this will ensure that the concept of deviation has penetrated the minds of all your students, and working out a series of examples will box up the job completely. It is also important, particularly in the "on-board" situation, to inculcate in your students the habit of always checking the steering compass when running an established range. This way, the deviation card can be continuously checked, and any tendency of the compass to drift away from it noted.

Speed and Distance

If you can manage it, try to bring an old-fashioned trailing log into the classroom. It will provide a useful natural break in the proceedings while you pass it round, and its reassuring "heft" will remind people that there was a different type of life before electronics.

Set a few Speed and Distance questions. For instance,

1) *A boat is traveling at 6 knots. How far will she travel through the water in 35 minutes?*
2) *You have logged 7½ miles in one-and-a-quarter hours. What is your boat speed?*

Checking the Log -- The textbook makes no mention of checking the log against the GPS, or any other electronic device. This would of course be perfectly in order, so long as the distance run were sufficient to render any GPS error insignificant. Current must be accounted for, of course, just as with the conventional methods.

It is also worth recommending that a boat owner build up a picture of his/her log's accuracy over a period of years by comparing distances run with known mileages. This is perhaps the best log check of all, but like many of the finer things in life, it is not instant.

Depth

Depth gives a good opportunity to put the charts back on the desks. Try teaching what chart datum means at this stage. Although it is not strictly a navigational input, when you come on to tidal heights there will be a number of levels to define and learn, so if this primary one is already under your belt, you will find life easier.

Standard Mistakes

- Belief that the tide will never drop below chart datum. All you need say at this stage is that this is not always true.
- A lack of understanding of what a drying height is.

If you are struggling with diagrams and need something different to wake everyone up, bring in a plastic bowl containing a few inches of water with some object resting on the bottom which stands an inch or so above the water. The water level represents Chart Datum. The object "dries one inch." Now make the tide rise by tipping in a jug full of water. When the waves have died down, the object will be submerged and has depth, not height. If your class is composed mainly of physics professors, leave this one out!

The Fathometer -- The main item to clarify here is the question of what the instrument is actually reading. "Depth below transducer" is best illustrated with a simple diagram as per the text.

If possible, bring in a lead and line so that the class can feel its weight. It should be around 7 lb. You can draw attention to the depression in its base which, years ago, was often "armed" with tallow to pick up a sample of the sea bed. Fishing skippers found their way around the seas under sail by checking this and referring to their compass, which, together with the lead, represented their sole navigational equipment. Sometimes they would sniff the bottom sample and more than one is on record as tasting it when the fog was particularly thick. And we call ourselves pilots....

Chapter 6 -- Tidal Heights

The Tide Cycle

Before coming to grips with the straight-up learning of tidal definitions, it is worth sweetening the pill by having a session on the lunar tide cycle. You have a choice here as to whether you tell your class about the phases of the Moon and how they effect tidal heights, or save it for your discussion on Spring and Neap ranges in the "Tidal Current" chapter. There is much to be said for dealing with it at the outset. It is an interesting sub-topic, a natural for the constructive visual aid, and since it relates "boring old tide tables" to the exciting reality of the movements of the universe, it can bring the subject alive unexpectedly.

OHP overlays are adequate for illustrating global tide effects, but instructors have been known to perform wonders of communication using a beach ball for the Sun, a grapefruit to represent the Earth, and a golf ball as the Moon. Place a spotlight alongside the distant beach ball and dim the lights to show the phases of the Moon as seen from the surface of the grapefruit. Afterwards, you can eat the grapefruit, so at least that part of your lesson will not be wasted.

A question often asked and almost as frequently fudged is why there is a tidal "bump" on the side of the Earth *away* from the Moon as well as on the proximate side. The easiest explanation is that the Earth is not an immovable object around which the Moon spins. The Moon has substantial mass, which affects the movement of the Earth so that both bodies oscillate around one another. The Moon does most of the running and the Earth the oscillating. This motion of the Earth creates a centrifugal force which pushes a surge of water to the outside of its wobble opposite the Moon's position, so you have two tides per day in the normal semi-diurnal cycle. The geography of some areas smoothes out these effects, producing diurnal or mixed tides.

Tidal Definitions

There is no soft option with this subject. After an easy start describing the lunar tide cycle you must face up to tidal definitions. Make sure that you fully understand them all and their inter-relation, because it is by failing to comprehend these definitions properly that most student problems arise.

OHPs with overlays are handy as you build up the tidal picture. So are Question-and-Answers.

While you are discussing Spring and Neap tides, issue the class with copies of the local tide tables or some other typical publication, find a suitable month and run through the days, showing how the range changes.

Early on in your lesson, you can deal with the straightforward high and low water situation on a given day. Find a sounding on a practice chart and ask the class to work out how this will be affected by the tide at high water. If that goes well, try them on a low water figure and you will know that at least the simple situation is understood.

As you work through the tidal definitions, keep the examples coming thick and fast, so that everything is referred to a practical problem. Drying heights, for example, can be a brute to comprehend in a vacuum, but after the class has been reminded of the bowl of water (see page 2-13 in this section) and then dealt with half a dozen examples of the type given in the textbook, they will be full of confidence and wondering what all the fuss was about. The same applies to secondary tidal stations, where you must make sure your students are working in a logical format such as the one illustrated.

Tidal Heights between High and Low Water

The student book expands this subject in detail and unless you have a working system of your own, you will be well advised to follow its progression. There are one or two points which in either case you should be sure to stress:

- When working with the Rule of Twelfths, take pains to explain that it does not hold good everywhere, but that in the absence of better information it can be used with caution. Where there is a significant tide that does not conform to the sine wave principle embodied by the Rule, you can be reasonably confident that further data will be available. An example is San Francisco Bay, where excellent tidal height curves can be picked up from most chandlers' counters (see example in Chapter 6 of the textbook).
- Note that tidal height curves normally follow the *height of the tide*, rather than the *rise of tide* given by the Rule of Twelfths. The Rule always shows the rise *above low water* for that particular tide. You can help students here by saying, "With the Rule of Twelfths, low water is here all day. You have that for free. What you need to calculate is how much *more* there will be at 0335. We find that out by seeing how much of the range will have come up," or some such wording ("Rule of Twelfths" illustration on textbook pg.36).

Having taught this subject so far in theory, you must bite the bullet and hand out a series of examples. Walk round and help the class answer them, because there will be some problems, most of which will stem from failure to understand the definitions.

You may find it useful to produce a few memory aids, such as

Mid-way Tidal Height by Rule of Twelfths = Low Water + A Proportion of the Range, determined by the 1,2,3,3,2,1 system

Practical Tidal Height Calculations

This is where the whole subject suddenly makes sense. Success depends upon your working through a number of examples on the blackboard to make certain everyone understands the rules, then set one or two questions to see how well you have taught your class.

Typical examples would be as follows. Tidal data is supplied by a suitable set of tide tables issued to the class.

1) *What is the earliest time I can enter Gasworks Creek on the afternoon of April 4? (The creek dries to a height of 1 foot. Your draft is 3ft 6in.)*
   Teaching Tip: You may have to discuss the question of a safe clearance.
2) *After some serious celebrating, I have run aground on a falling tide at 2335 on July 4. How much water is left to fall. I am on a weather shore and the bottom is mud. Do I need rescuing, or should I put the kettle on?*
3) *It is 1800 on September 5. You can save 5 miles by passing over the mile-wide, well-charted shoal of Grumbling Sands with a charted depth of 5 feet. Conditions are calm and the barometer has been steady at around 1032 for a couple of days. Your draft is 6 feet. Is it safe to do so?*
   Teaching Tip: In a question like this, you should give students either a rising tide and a couple of feet clearance -- obviously safe, or a falling tide and the same clearance -- only cross in desperation.
4) *Make sure that you give an "anchoring depth" question, because this apparently simple problem causes more trouble than all the rest put together. It is a good idea to teach it first.*

Out on the water, always ask students about depth as they approach a tidal anchorage. If their first action is to grapple for the chart and look at soundings (given that they know there will be enough water to enter and that there are no specific dangers to avoid), they have missed the point completely. All they need to know is the depth required at low water, then calculate how far the tide will fall between now and then, and add the two figures together.

Chapter 7 -- Tidal Currents

The significance of current to the navigator varies extremely with the area of operation. All US SAILING navigation graduates are, however, required to be competent current pilots. It is a sound plan to point out to the class that a sailor who cannot handle current will be in trouble in many areas, not only globally, but also in the U.S.

The textbook "Current" chapter has been organized as it is for good reason. The first three illustrations in this chapter are up front, not because they make interesting reading, but because the effects described, together with using or avoiding them, are very much part of everyday navigation. Beginning your lesson with this material is painless because it introduces the class to the subject gently, requiring little of them but their interest for the first quarter-hour or so.

Non-tidal Currents

One can talk in general terms about these. An ocean current map for your particular ocean can be useful, showing the great order of things and how this sometimes adds up to water drift along the coasts.

If you have a current of local significance, describe its effects in some detail, then show students how to obtain empirical information about its movements.

Tidal Currents

(These are called streams in Great Britain and some other countries.) You can introduce this topic by having a short revision session on the lunar tide cycle, which you probably covered in the tidal heights lessons, but the recap will ensure that everyone now remembers about springs and neaps.

Tidal Current Charts and Tables -- These are straightforward to teach, but note the lesson of the "Current Rates" diagram (textbook pg. 42), which is a popular source of error.

The only successful way to teach rates of a lesser velocity than the spring rate is to give a series of examples. Work out a couple yourself on the chalkboard, then set questions for your students. Don't use multiple-choice answers. Set real-life questions and see whether or not the class has fully understood the various propositions.

You can build up the examples from simple to comparatively complex. For tables, issue the class with copies of the local rip, or if you haven't one, acquire photocopies of the ones for Hell Gate, or some such joyous spot. Begin by asking the rate and direction for a spring tide at a full hour. Then introduce a tide of lesser range than the spring. Next, try a secondary station at full spring and finally, a secondary station at a time of lesser range.

Now produce a set of tidal current charts for each student and repeat the operation. By the time you have this lot behind you, your class will be as adept at predicting tidal streams as a group of Breton fishermen.

Set a few more examples for homework and you'll be there. Take solace from the fact that although you have to prepare a considerable number of questions for this section, at least they are easy to work on. If you imagine you are having a hard time, go and talk to your colleague who is running the celestial navigation class next door. Trying to work a 7-star fix backwards with only two or three sample pages of almanac and sight reduction tables is the stuff of which nightmares are made.

Personal Observation

The on-board instructor should make it a priority to indicate the turn of the tide by observation. Point out ships swinging to their anchors, current running past buoys and beacons, yachts inshore or offshore apparently sailing much faster or slower than the training boat, etc. On a windy day you can often detect a tidal eddy near the turn by noting the state of the water. This leads you straight into a tutorial about waves in wind against current situations.

Shorebased teachers must remind students that all printed tidal information consists of *predictions* and that predictions may prove inaccurate by increment in both time, rate, and tidal height.

Afloat, you can have great fun stemming the tide alongside a buoy, noting your course and speed, then comparing these with the local tidal current prediction. This is a multi-facet exercise because not only does it teach accurate reading of the compass and log (remember that predicted sets are always given in degrees True), it makes students think about the tide and builds up their boathandling skills at the same time.

On-board instructors will have no difficulty remembering to make any relevant points about local tidal knowledge because they will need to advise students preparing passage plans. In the classroom you will have to draw on your own experience, whether it be from a vacation in San Francisco Bay where you noted that major rainfall upstate prolonged and intensified the ebb at the Golden Gate, or something you once read on tidal surges in the North Sea following northeasterly gales 500 miles away.

Chapter 8 -- Planning a Course to Steer

This lesson can start with a fanfare because for the first time the class will be producing real-life plotting that could actually hold good in practical situations.

Plotting Conventions

The simple course to steer ("Course to Steer" illustration on textbook pg. 45) should be no problem to put across. It is important, however, that right from the outset you encourage your students to employ conventional plotting symbols. US SAILING has decided to break with American tradition in this respect. For many years, European navigators operating in generally stronger tides than North Americans have used the convention of arrowheads described in the textbook. This system is totally unambiguous, even to the casual glance of an exhausted, seasick mariner. It also involves less writing on the chart itself and more use of a ship's log, all of which encourages accuracy both of plotting and of performance.

This decision has not been reached lightly. It is the result of long, hard discussions. The arrangement preferred in the textbook is what US SAILING would like you to teach, but you will have noted that because this diverges from the conventions used by some U.S. training bodies, the book explains the other system as well. One objection you may hear to the US SAILING method of plotting is that it requires a ship's log, or logbook. As you will be well aware, many American navigators do not use one. The main reason for this seems to be a deep-rooted misconception about the form of a ship's log for realistic small yacht navigation. Chapter 9 sets the record straight. The ships' logs which have alarmed generations of yachtsmen are just what they say they are -- logs for ships. We are in a far less formal situation, and our logbooks can reflect this. Consider these remarks and the considerable value of running a simple ship's log whenever formal navigation is required, and you should be left in no doubt as to the reason for US SAILING's decision.

True or Magnetic?

As we have noted in the section on the steering compass, at the Basic Cruising level, US SAILING is teaching that it is simpler to operate entirely from the magnetic rose, choosing to ignore the True "grid." The reason for this is to ensure that a trainee skipper with much to think about is not confused by a navigational concept that might get in the way of boathandling. This does not mean that to navigate entirely in magnetic is what we should ultimately be promoting. The subject can now be recapped, expanding as follows.

Some of the drawbacks in "total magnetic navigation" are pointed out by the textbook as follows:

If your compass has been proved by swinging ship to have no significant deviation, there is nothing to stop you doing most of your plotting in Magnetic. You can use the magnetic compass rose together with parallel rulers, and stick with that denomination. ***Be careful if you opt for this policy. Remember to label all plotted bearings and headings "M", to remind you, because any bearing or range spelled out on the chart or in a Coast Pilot will normally be given in degrees True. So will current vectors.*** *Deviation apart, this is another reason why the Navy and the Merchant fleet always plot in True, so if you decide to opt for the apparently simpler Magnetic plotting, never forget that deep down, you know they are right.*

This highlighted section should make clear to you, the instructor, why serious navigators generally choose to work in degrees True. In addition to the examples noted in the highlighted box, azimuths for Astro Navigation are also given in True degrees, and so the list goes on. If you give your students plenty of worked examples of conversions from True to Magnetic and Compass, they will soon be dealing with them as second nature.

Leeway

The "Leeway Plot" illustration (textbook pg. 46) carries the following caption:

You can counteract leeway by steering to windward of the course you want to make good. To quantify this, place your plotter on the course line and rotate it to windward on the chart by the estimated leeway angle. Draw a short line as shown with an arrow on the end of it. That is the course you should steer, which you will note in the ship's log if you are navigating formally. If you are writing your courses on the chart, you should note the plotted course value rather than the course actually steered, because that is the course you hope to make good after leeway has been taken into account. If this sounds confusing to you, forget about writing courses on the chart and simply note them in the ship's log.

It is far less confusing to teach people to note the actual course steered in the ship's log than to write courses that have theoretically been made good through the water against a line on the chart. The textbook is worded in this way because there has been a sizable body of yacht navigators who have preferred to write against the course, then tell the helmsman to "steer up a few degrees for leeway." The net effect of this policy on the course made good through the water should be the same, but it does not relate so neatly to the theory and practice of working up an EP, and thus ultimately makes the instructor's task more difficult.

When you come to teach Estimated Position, you will be showing your students how to allow for leeway against the course steered. If circumstances have changed during a leg, leeway may have altered also. Because of this, if you have simply used the course you hoped to make good through the water, you will be grasping at "softer" data than you otherwise could have been. This is because the EP is plotted from a course made good

corrected for the actual leeway experienced. If you are working from a line you have already drawn and which is now history, your thought processes will be struggling to maintain a step-by-step progression and your plot will contain more potential for error.

When the boat is sailing closehauled, no course line can be plotted until it is time to work up an EP, so this question will not arise. Where the boat is close reaching or otherwise laying its course but experiencing leeway, the short line with single arrowhead noted in the illustration serves neatly to indicate what is going on.

Current Sailing -- The Simple One-hour Vector Diagram

The way the textbook explains this is a teaching system in itself. If you have not taught current sailing before, study the book carefully, then work on putting across the theory and practice as suggested. An OHP can be useful here for creating a dynamic presentation of what is really going on. Cut a small outline of a boat from piece of card and use it to "slide" along the track line of a pre-produced acetate of a one-hour vector.

Now set a number of worked examples. These are easy to write and can be plotted on any convenient chart. Try to come up with some which are awkward to fit onto the chart you are using, so that a scale other than miles must be utilized. Students can choose their own scale units and you can then have a discussion on whose ideas worked best. It is also perfectly acceptable to plot a diagram based on "half-time, half-speed," etc. The following paragraph on standard mistakes will give you guidelines on how far to allow this to go.

Standard Mistakes

- At all levels there will be one or two students who think that they must join the end of their tidal vector to the destination in order to deduce a proper course to steer. *Make sure you clarify this point.*
- Practical instructors may come across all manner of weird fantasy about how to plot a vector from students who have not had the benefit of a US SAILING shorebased course. Typical examples of this are plotting current at the end of the hour's run and working up some sort of parallelogram.
- Another is where the distance to run does not make an exact hour and students try to calculate what the tide would do to the boat in 37 minutes, for instance. This mistake is based on an essential flaw: students cannot know how long they will be running the course line until they have found how great the tidal offset will be. Since they cannot know this until they have drawn the vector diagram, their efforts are doomed. Measuring the length of the track between two points will not tell them how long they will take to traverse between them because of the unknown offset. Only a simple vector diagram can succeed in this.

Compound Vectors

Only when you are certain the class has fully understood the basic vector diagram should you move on to two-hour courses, courses in turning tides and longer range offsets involving net vectors. Happily, these are easy to teach once the vital groundwork has been accomplished.

Once again, plenty of examples are of prime necessity. As with the simple cases, these will cause no problems to produce.

Alternative Plotting Method

This, as described in the textbook, is the traditional U.S. big-ship system. You do not need to spend much time on it, risking demoralizing your students with "yet more theory." Simply draw their attention to it, explain why it is in the book, and point out in a few sentences why US SAILING has moved away from it.

Chapter 9 -- Estimating Your Position

Now is the time to start talking to your students about the fundamental philosophy that one must always draw navigational data from as many different sources as possible. DR and EP worked up from figures taken entirely from instruments inside the yacht serve to cross-check fixes collated from outside information such as compass bearings. When you come to fixing as a separate subject you will discuss further the benefits of mixing your sources of data. The importance of understanding this concept has been reinforced in recent years by the arrival of universally available electronic navigation aids. They provide yet another area of information -- a good one, it must be said -- but they are nonetheless to be considered as part of the overview rather than the complete answer.

Ship's Log

The ship's log features in this section because **its prime function is to furnish the navigator with all he or she may require to work up an EP at any time.** In other words, if everything goes down, the logbook must be able to tell you what you need to know in order to deduce your current position if you cannot otherwise fix it.

You should discuss and promote the simple ship's log recommended by the textbook, pointing out the benefits of being able to note down time and log reading for any incident of navigational significance.

If you pass an unconfirmed distance from a buoy, it is far easier and neater to make a log entry with a "guesstimate" of the distance off than it is to mark a guessed position, time and log reading on the chart. Encourage students to make entries such as,

"Blowing Hole Rock abeam to starboard. Distance approximately 1 mile."

when no fix is available but the sighting of the buoy at least confirms or rejects the distance run from the last known position.

It is a good idea to talk about the significance of "heavyweight" logbooks such as the example given in the textbook. Let there be no mistake, these make sense in the world for which they are designed. As all instructors know, however, there are a number of blank logbooks available commercially to yachtsmen, whose relevance to the real world of smallboat piloting may not seem apparent. Some people like them, nevertheless, and there is certainly no harm in filling in columns for the time the mate cleaned his teeth if that is what turns you on, so do not risk upsetting any of your students who may already enjoy using one.

Dead Reckoning (DR)

The DR is the lowest form of life in the order of position finding. It is also probably the easiest thing in the syllabus to teach, bearing in mind that as soon as you introduce anything other than course steered and distance run you are moving into the realms of the EP.

The question arises, however, of how much you should actually plot for a DR on a day-to-day basis. In many textbooks on navigation one sees charts with lines drawn on them with neat DR marks showing where the boat has theoretically been. Since any application of leeway or current will render such a line redundant, it is rarely of much practical use to the sailing vessel. Plotting a DR position is better accomplished by laying the plotter or ruler along the course from the departure point, measuring the distance run along its face with the dividers, then penciling a very short line which passes through where the DR will be. Plot the dot and half-moon symbol onto this and there is a neat DR which does not obscure the chart.

The Estimated Position (EP)

Since the EP contains a factor for leeway if any is present, it makes sense to teach this first before discussing current sailing.

The main idea to get across is that whereas in plotting a course to steer, leeway was counteracted by steering *to windward* of the theoretical course, in EP plotting, leeway is applied by plotting the course made good through the water *to leeward* of the course actually steered.

This sounds very difficult to explain on paper, and indeed, it can be, but this is where the chalkboard or its equivalent comes into its own. First, recap the situation for course to steer, reminding the class of the fact that they logged the course actually steered. Now draw on the board the course steered and show the wind by means of a "mighty" arrow. Ask which way they expect the boat to be blown. They will answer correctly because put like that it is obvious, and the day is won.

Remind your students that if ever they are in doubt about which way to apply leeway, first to consider whether they are applying it to a course they want to make good, and thus counteracting it, or whether it is to be applied to a course already steered, and so plotted as an historical fact. Encourage them to draw a diagram every time on a piece of scrap paper, and there should be no mistakes.

EPs will be deduced only from course steered and leeway when there is no current to consider. They are plotted in the usual way.

Wind up the session with a few examples, have a nice cup of tea, then move on to current-sailing EPs.

Current-Sailing EPs -- Having made sure that everyone understands the business of leeway when applied to an EP, your best bet is now to forget about it for a while as you move on to the matter of current. Taken on its own, this presents no problems to most students. You can use your little boat models on the OHP as you did for course to steer, and here they are particularly useful because it is not conventional to actually draw the track, or course made good, when plotting an EP. This is only done if you really need to know where you have been.

Pay attention to plotting symbols, making sure that your class takes them seriously, then set a series of examples. Give the set and drift for the first few, then spice things up by writing the questions so that the current vector must be deduced by the students from a tidal current atlas or current table. You can use this session to revise current by setting times that do not coincide ideally with the tidal hour, and so on.

Finally, bring leeway into the total sum and move on to EPs for periods of more than one hour, as described in the Student Book.

When the class is properly on top of the subject, it is time to introduce the idea of always checking an EP with a sounding if at all possible. Make sure that everyone understands this crucial "extra source" of data with which you began your lesson. *Instructors out at sea with their students should make a continuous point of checking EPs and fixes against this third dimension of information.* Not only is it sound practice to do so, it also serves to train students into the "cross-checking mentality" which is one of those features which separates good navigators from the rest.

Chapter 10 -- Knowing Where You Are

The order of events in this chapter of the textbook is as good a structure as any for organizing a lesson on position fixing. Beginning with the "position by immediate observation" you can develop to the single Line of Position (LOP) and proceed from there.

The session on sources of LOP is important because it introduces the vital concept of the range in all its forms. The practical instructor should be using this from "Day 1" to develop the students' concept of sideways motion, but in the classroom, teaching it is less simple. Fortunately, visual aids can readily be brought into play by a creative teacher.

Find a practice chart with a variety of sources of LOP and set examples which relate to it.

If you are sited on an estuary or bay, you can take the students down to the water's edge with charts and compasses and invite them to fix their position. Considerable satisfaction will be achieved by those who find they are where they thought they were. Ideally, this exercise will be done without your giving a hint as to the best sources of LOP for the fix. See who finds the right ones and hold a discussion about it on the spot.

Don't forget to talk about hand bearing compasses being deviated unpredictably by proximate metal objects, like spectacle frames, marlinspikes, galvanized fittings, electricity and the rest.

Fixes by Distance Off

If you are going to teach distance off by vertical sextant angle, you absolutely must take a sextant into the class, tell the students about index error, describe how to use the instrument, then give everyone a try. If you don't do this, that part of the lesson will be a total waste of time because the students will write it off as mumbo jumbo. In a large class explaining the use of the sextant is difficult and can be time-wasting, so make sure that you have set a series of good exercises for the rest to attack while the instrument is being passed round. Choose any suitable angle to measure outside the window. A tree half a mile away is often higher than a lighthouse in real life, but a distant rooftop is fine for index error checks, so long as it really is distant. Ideally, of course, line up the two images of the horizon for the latter.

You should make the point that the sextant is an astonishingly accurate piece of gear and that extremely good results can be had by this method of fixing. The reality is that nobody on a yacht ever fixes their whereabouts by two or more circles of position. The "distance off and single bearing" method is, however, easy to execute and can be as accurate as the compass bearing allows.

The Single Bearing and Estimated Position

Considered by many navigators to be a form of EP, this can either be thought of as a *refined* EP or as a sort of "half-way house" to a fix. The important thing is not what you call it, but that the students understand the usefulness of a single LOP as a way of checking the soundness of an otherwise uncorroborated EP.

Use examples to show how intuition and commonsense will indicate how to assess the situation if the LOP and the EP do not coincide. A bad miss means the navigator must consider retaking the LOP or recalculating the EP from first principles, including checking the log reading -- or may consider doing both. A minor discrepancy will require judgment about the quality of the LOP and the likely accuracy of the EP. *The vital component of any such thinking is that the pilot does not subconsciously massage the data to make it fit in with what he or she would like to see.* This final point is a general one and you would be well advised to ensure that the class understands it as such. It will stand them in good stead throughout their careers and can even be helpful ashore....

The Running Fix

As we all know, the running fix is rarely used, but it must be taught because occasionally, it is all one has. Tell the class this, because they can easily be "psyched out" by the apparent complexity of the plotting, especially if you are tired and have lost your cutting edge by the time you come around to teaching it.

Take it stage by stage as per the text and you should not have too much difficulty. A good way to tackle the subject is like this:

1. Take a single compass bearing on the light and log it. Plot the LOP.
2. Sail on for a while until a second bearing on the light would give a good cut on the first one if they were from different objects.
3. Take a second bearing, log it and plot it.
4. You don't know where you were when you took the first bearing, though you were certainly somewhere along the LOP. You do, however, know how far you have come since then, and in what direction, by referring to your ship's log.
5. Choose any point on the first LOP as an assumed position, then plot a DR (or EP as appropriate) for the time of the second bearing using the assumed position as your starting point. Whether or not you guessed the correct position, if you use parallel rulers to transfer the first LOP so that it passes through this "DR", the transferred LOP is now in such a position as to represent an LOP drawn from a different source. It will be in the right place, since even if your assumed position was wrong (which it probably was), you know you were certainly somewhere on the LOP, and you know your course and distance since its bearing was taken. This is all you need to be sure of.
6. Where the transferred LOP crosses your second LOP is therefore a two-point fix.

If you are drawing this out on a chalkboard or OHP as you make your presentation, it can help to draw in a "ghost" lighthouse where your transferred LOP crosses the coast. Where your students are not using parallel rulers, you must show them how to use their plotters to achieve the same result.

Set one or two examples of running fixes for homework. Start with easy "DR" types, then move on to a full "EP with leeway" job if you think the students are up to it. This will be an excellent way of revising EPs while they are thinking about something else altogether.

If one or two of your less academic people struggle with the more refined forms of running fix, reassure them and take a little more trouble over their electronic navigation. Never allow the importance of the running fix to expand out of proportion. As we all know, it is not something the navigator practices every day.

Plotting and Defining Positions

This is worth dealing with now, because it presents no difficulty and so may give some of the tardier members of your class the morale boost they sorely need after the running fix. It also means you have the subject "on board" before moving on to electronic fixing which, of course, depends on defined positions.

Chapter 11 -- Electronic Navigation Aids

The importance of this topic in the course stems less from the true position of electronics in the navigator's toolbox and more from the misconception which many students will have that this is the lynch-pin, the nitty-gritty of piloting. As years go by there will be an increasing number of untrained navigators who believe that the job begins and ends in the linked-function GPS receiver, with classical navigation continuing to exist merely as a Coast Guard required annoyance or, at best, a backup in case their systems go down.

Your lesson could therefore usefully begin with an explanation of the significance of electronics to a really good pilot. It would be fatuous to suggest that top navigators in the real world outside of sailing schools have little to do with electronics unless it is foggy, and that even then they approach the black box with the gravest suspicion. The position is rather that a person of your experience as an sailor sees electronic equipment as a useful part of the overall navigational strategy.

When it is appropriate to do so, a navigator might plan around the phenomenal capabilities of GPS for position fixing, but because of the primary need always to garner information from many sources, the navigator would not be unduly embarrassed if the system blew out at any stage of the trip. The plot will be run conventionally, with added information from the electronics, the ship's log will be entered in the usual way, always bearing in mind the basic requirement to be able to work up a non-electronic EP at any moment, and all electronic positions will be logged and cross-checked as a matter of course.

One could say without fear of contradiction that by sticking to this philosophy, electronics will make a good navigator into a better one, but the fool who believes that skill and safety can be bought off a chandlery shelf by the richest bidder is ultimately doomed to disappointment, with a space reserved for him on the list of accident statistics.

GPS/Loran C

Because there are so many different receivers in the market, it can be unwise for you to go too deeply into what the various buttons do on a particular example. The important thing, once you have explained briefly and in non-technical language how the two main fixing systems work, is to discuss what can realistically be expected in terms of accuracy from each system. Be sure to make the point about repeatable accuracy in Loran C.

The question of error in electronically derived positions is expounded briefly in the student textbook, but because the whole subject is so important and potentially complex, instructors should make it their business to read around it in more detail, to attend seminars when possible, and generally to ensure that they are more than one jump ahead of their students.

Experience in Europe with practical instructors indicates that while most have a basic working knowledge of how the receivers can be used, the response to a question from an examiner such as, *"Tell me about fixed and variable Decca errors."* (Decca being the local equivalent to Loran) results in a row of blank faces. Do not let yours be one of these. Your students expect great things from electronics. Make certain that you can answer *any* question that may arise. After all, you are a modern professional navigator.

Use of Electronic Fixing Aids on a Passage

The great mistake made by the untrained electronic navigator is to use the machine and ignore everything else. People who know what they are doing, on the other hand, always log their GPS positions at regular intervals. It is the work of a second or two to compare the latest fix with the current log reading and the course that has been steered. Any serious discrepancy will be immediately obvious and can be investigated. Similarly, a line of electronic fixes marching across the chart when a yacht is proceeding at a fairly even pace will show straight away if the latest one is failing to coincide with the previous pattern. Students who neither log nor plot their electronic fixes have none of these benefits and become a victim of any anomalies.

It is vital that this point is well made. Invent example scenarios whereby a foolish navigator loses his or her vessel because a thunderstorm puts out the Loran at a crucial moment. An EP worked up from the last Loran fix would have saved the day, but no fix had been plotted and there was no logbook.....etc.

Course and Speed Made Good

The textbook does not dwell on possible inaccuracies in these readouts. You will be aware from personal experience that GPS in particular is sometimes less than perfect, particularly in terms of speed. Make a point of reminding your students that they must not take these figures as gospel truth. On board, you can power up the electronics from time to time and check them against reality. This is probably the best of all ways to build student familiarity with electronic navigation, but you must be very careful. Any box of tricks like a GPS receiver is a fascinating toy for a particular type of student, usually a man, who will become mesmerized by it and forget what he is really there to learn. Therefore, treat the electronics with the greatest care during a hands-on course.

Waypoint Navigation

Waypoints may well be a part of your life, but the very word is only a name a student has heard up to now. You should explain how waypoints work, show how to select a point sensibly for the wind, sea and current conditions prevailing, explain how most receivers can be set up to notify you at a certain distance from the point, and make clear that we are talking about sailboat navigation, so that any waypoint may become redundant if the wind does not allow us to behave like powerboat commanders.

Talk through the "course and distance to waypoint" function, explaining that the course given is what it says, *not* a bearing *from* the waypoint. In other words, beware of reciprocals.

You can sometimes contrive to teach about the *overboard* function as a sort of instant waypoint, which is exactly what it is. Give out some exercises on how far away from the recorded "ground" position the casualty will have drifted after a given time in various conditions of current. This not only clarifies the issue, it is also a handy way of revising "speed, time and distance" without anyone realizing you have done it.

Cross-track and Human Errors

There are two sorts of error in GPS: cross-track and human.

Cross-track error is easily abused by the ignorant. Spend a little time expanding the textbook's remarks about this. The session is a golden opportunity to show how various parts of the syllabus integrate, because while cross-track error is a breakthrough in safe, medium-range rock-hopping (always provided that you have a contingency plan for when the machine runs out of volts), you cannot use the function properly on an extended passage in current-swept waters until you are a master of classical current sailing. As in the overboard discussion above, you will be recapping current sailing while you talk about cross-track error.

A good example would be to fabricate a five-hour cross-tide passage with a turn of tide in the middle. Anyone who has attended your talk on current sailing will understand that the boat should be allowed to be swept out to the side of the rhumb line so that the turning tide can carry her back once more. Show this happening, work out how far through the water the boat will sail, then indicate as a series of vector triangles how much farther she would travel through the water if she were to employ her cross-track error incorrectly by sticking to the straight line. You can now point out that the correct use of cross-track error in this case would be to monitor how far the boat has been set and compare this with the theoretical set and drift plotted into the EP. Sensible adjustments can then be made to the course so as to take full advantage of the GPS without losing the benefits of sound navigational practice.

Human Error -- Wind the session up with a "call to arms" about double-checking every input to the receiver's computer. Therein lies the "Human Error" part of the equation. It's all in the Student Book, but the matter cannot be over-stressed.

Radar

Like satellite and hyperbolic systems, you owe it to yourself and your students to be thoroughly informed about radar. If you cannot honestly say that you are, the very least you should do is buy, read and inwardly digest one of the excellent short radar books written specifically for smallcraft operators. You do not need every skill a full-time operator holds at fingertip readiness, but if you have no quick answer on beam width and rain clutter, it is time you did.

Don't be afraid to ask a more experienced person if you are in doubt. There is no shame in admitting your ignorance on this particular subject. After all, numerous fine sailors have circumnavigated the globe without ever looking into a radar tube and for whom VRM and EBL might be undiscovered subatomic particles for all their relevance to their survival battles with great gales.

The ideal answer to teaching radar is to be experienced in its use. If you are not, get away to sea and put the situation to rights. Try to borrow a radar-equipped yacht, go out into an area well stocked with likely radar targets, read the book of instructions, switch on and start playing with the controls as directed by the manual. Look at the chart, observe the visible world with your eyes, then see what the screen is telling you. Try different ranges, work the EBL and the VRM and let your wisdom grow.

Come to think of it, can you imagine a better way of teaching radar to your students?

Chapter 12 -- Inshore Pilotage

There is no doubt that this subject is taught most effectively on board a boat while the real thing is in progress.

Up to a point, coastal navigation can be taught successfully in a classroom, while inshore pilotage can only really be talked about, because of its essentially dynamic nature. If you are afloat with your students, inshore pilotage is therefore a vital topic, because before you can be called an expert you need to feel the alarm as you fail to identify the mark that seemed so obvious on the chart, and to have lost yourself a couple of times. Nonetheless, the instructor in the classroom must not forget that far more rocks and shoals are avoided by inshore pilotage techniques than are ever circumvented by the coastal navigator plying his/her trade from a safe distance of five miles offshore. Yours may be the only pilotage lessons some students ever receive, so you must do your best.

The main message you can put across in the classroom is that pilotage generally takes place in straight hops down clearly defined safe lines. Once the student is established on one of these, it will probably be unimportant how far along it the boat is until the pre-defined moment arrives to leave it, either to proceed into broader waters or to resume the passage on a new line. Formal fixing thus becomes an irrelevant diversion. This is the essence of inshore pilotage. The rest is detail.

Stress the superiority of the range over the compass bearing for defining a line, then go on to describe the various techniques in the textbook. Try to come up with new examples from your local charts or the class's practice charts.

The student book makes no mention of the fact that in tidal waters it can be vital to work out the state of tide before entering a tight pilotage situation. It is up to you to remind them of this, because if things do not go according to plan, the navigator may have to perform some snappy chart reading as the action unfolds. If there is an extra 5 feet available above the charted depths, it may make all the difference, but there will probably not be enough time to work this out in the heat of the moment.

It can be stimulating to ask a class to find a safe route through a series of charted dangers where there is no cruising guide to help them. Teach them to lay a straight edge on the chart along the approximate line they wish to follow, then to try and find a range that will serve their purpose by looking along its edge. Remember that any pair of charted objects which can be visible will do. It is surprising how often two will show up.

Also ask for some lines to be defined where no range can be contrived. See whether the students come up with a bearing on a buoy or a beacon, or a near or a distant object. Discuss the relative merits of one and the other, then note whether there was a depth contour that they all missed, etc.

There is plenty of scope in this subject for a creative instructor to encourage students to read a chart in depth rather than just glance at it and imagine they have seen everything it has to offer.

Night Entries

Once again, these are essentially the province of the practical instructor, who simply must take every opportunity for improving this potentially daunting skill. The "pep-talk" in the student book states the principles, but ten minutes discussion in the classroom on the realities of spotting buoys and lights when they are half-lost in shore glare can be time well spent. After all, the shorebased instructor cannot be certain that all his graduates will march off and instantly book up for the practical skippering course from which most could probably benefit. This might be the first and last course some of them attend, so they should receive as much practical coaching as you can find time to give them.

With this in mind, you can usefully enlarge upon such hands-on tips as lining up the next buoy with its background (by day or night) from the previous mark so as to have an unofficial range and thus dispense with the compass.

You should talk about the real dangers of entering unknown harbors after dark and discuss the sort of place you should and should not try. It may also prove helpful to advise your people concerning the amount of ambient light that may be present in a residential or semi-industrial situation.

Chapter 13 -- Navigational Strategy

This is a subject which lends itself to classroom teaching. Like pilotage it is often ignored, yet a sound knowledge of strategy can make the difference between a successful passage and a resort to a long and uncomfortable stint under power. Some would say that strategy isn't strictly a part of navigation, but your students won't learn it anywhere else, so if you have the time, it is well worth including in your course.

The student book covers strategy comprehensively enough for the needs of the cruising sailor, so your main requirement is to work through this, expressing its points in your own words and making full use of visual aids to clarify the various propositions. With a small class, you can have great fun by setting up a passage on the classroom floor or on a large table, using two small model boats and a chalked rhumb line to show the losses or gains resulting from good or bad tactical decisions.

Try starting the session by showing a boat that has allowed itself to be set down-current or to sag to leeward (*"Feckless* and *Complacent"* illustrations on textbook pg. 85).

There is wide scope for Question-and-Answer here. A typical example would be where the boats are beating to windward and a veer is expected. The question would be,

> *"OK folks; which tack will put you on the favored side of the rhumb line after the wind shift?"*

The answer will of course be that the boat now on port tack standing to the right of the rhumb line will be clear ahead if she tacks after the wind has veered (shifted clockwise). ("Anticipated Wind Shifts" illustration on textbook pg. 87)

The same setup can be used to show the real advantages to be gained by using the "tacking cone" ("Tacking Cone" illustration on textbook pg. 87). This is a hard one for students to grasp unless they have seen it with their own eyes with two boats on a model. You should show this to any class which is seriously interested in sailing. Powerboat navigators don't know about it, so only you can enlighten them. In reality, the situation is just like a racing dinghy tacking on the wind shifts up a one-mile beat. The only difference lies in the scale.

While you have the model in front of the class, demonstrate in measurable terms about how you can tack downwind to ease the pain of a dead run ("Downwind" illustration on textbook pg. 88).

Chapter 14 -- Navigation in Poor Visibility

Fog

Any lesson about navigation in restricted visibility is usually best started with a general talk about what it feels like to be out in fog. Tell your people about the signs that fog is imminent -- dew drops in your eyebrows, halos around your own navigation lights, etc. Discuss the way sound is distorted by fog so that sound signals must be treated with circumspection, and talk about the gut-wrenching alarm that comes with total disorientation.

Having gained your students' attention, you can lead into the ways of ensuring that disorientation never happens to them: the firm, sure things they can hold onto; compass, log and fathometer. Or, as the ancient mariner would have put it, *"The four L's: Leadline, Log, Lookout, and trust in the Lord."*

You will have to mention the natural desire of the modern navigator to hang onto his electronics in fog as a baby holds its mother's apron. Point out that there is no harm in this, so long as **correct navigation practice** is being observed. *In the context of fog, this means that at all times there must be proper logging of courses, distances, fixes and events, as well as a safe escape route to deploy in the event of electronic failure.*

It is also vital that you hammer home the need for a fix before the world disappears. This, of course, is an ideal scenario and there will be times when taking a visual fix proves impossible. An EP from the last known position will then have to serve, or an unconfirmed electronic fix, though you can take the opportunity to point out once more that so long as the navigator has been logging electronic fixes as a proper series, there should be no reason to doubt the latest one.

Now work through the textbook sequence, talking about the illustrations on pages 89-91 ("Fog Tactics," "Running the Contour" and "Steering within Visibility Circles"). There is not a great deal that can be done here in the way of worked examples, though a chartwork exercise on buoy hopping can be beneficial, if only because it breaks up the lesson and gets the class actively involved.

The on-board instructor is more advantageously placed to teach about fog than the shore-based instructor. For a start, he or she may be lucky enough to get some of the real stuff. Nothing could be better! Fog should make a cruising instructor rub his/her hands in glee almost as much as a gale of wind. As a true professional, of course, you will have been following the weather prognosis and will have organized the boat's movements so that it is in a position to take full advantage of either "undesirable" circumstance. You don't tie up in a rockbound harbor for the night when fog is forecast for the morning.

Now choose a passage that can safely be made by skillful handling, talk your students through it, then have one of them skipper the boat with you "riding shotgun." In awkward areas, such a trip may be no more than an outing to a bay two or three miles away, anchoring for coffee, then returning, but at least your students will have smelt the fog and will know from firsthand experience that a boat can be brought safely home in the right circumstances. You must, of course, be totally confident of a successful outcome, but if you have anticipated the situation correctly, you have a good chance of being in the right place at the right time.

If you are challenged -- *"It's unseamanlike to go out in fog,"* etc. -- your retort must be that you know your job. Any of your students could find themselves caught out next week on their own. Far better to have had the experience under expert guidance than to meet it for the first time "cold." After all, you are a professional seaman running a working boat. You are emphatically not operating a "happy holidays yachting jolly," so to turn tail at the first sniff of difficulty is to shortchange your class.

If you are not lucky enough to have a foggy day, it often pays to work a **"blind navigation" exercise.** Choose your strategic position well so that there can be a satisfactory outcome, give the student navigator time to take a fix, then send him or her below, turn off the GPS and metaphorically draw the curtains. The student navigator should then order up courses to bring the boat to a safe anchorage or harbor entrance. The watch on deck will feed sightings of everything within the designated range of vision (50 yards is often a good distance). They can also fabricate sound signals that would be heard in fog, which in itself is useful because it asks them questions about the signals that would be given by whatever is passing.

One criticism of blind navigation exercises is that they can fall into the category of role-playing which is not generally a good idea on a cruising boat at sea. However, since they are normally executed in calm conditions when the instructor is looking for a useful way to spend the third windless afternoon in succession, they may be considered to be the exception which proves the rule.

Chapter 15 -- Planning a Passage

Passage Planning

Notice the introduction to the Student book chapter on passage planning and be ready to talk along those lines for a while. Students on a boat who are being asked to actually skipper a passage will realize only too well the need for a plan of action. Ashore, however, this may be less obvious. You may therefore need to make a case for the subject before you begin to work through the various headings.

Throughout this session you can utilize the Question-and-Answer technique to reassure yourself that all the lessons that precede it have been well learned. It is now that the whole picture falls into shape, so any holes in the information retention will be a major drawback.

A passage planning lesson can be tackled successfully by starting out with the headings list in the textbook and expanding the various items as you see fit. You will find plenty to say here. For example, the section about **distance and time** looks obvious on the face of things, but when you begin to think about it you will realize students may not understand that a 35 mile beat can be pretty unpleasant. Nor may they comprehend that while a 40-foot cruiser is capable of running 60 miles in a daylight period, this may be more than the average family crew out for a good time would choose. Place all this in perspective and encourage the class to *define their objectives* carefully before planning to make any passage.

The **Waypoints** heading gives you an opportunity to make sure that all hands understand how these work, while the section on weather could, if you have time, enable you to give a "lecturette" on the anatomy of a low pressure system, clockwise circulation around highs, etc.

Tidal gates and tidal height windows are an essential part of planning, and the fact that they turn up again here will serve to reaffirm that the slowest student understands the difference between a drying height and clothes-line prop. If that is not the case, you must at least be sure that this student appreciates his or her shortfall in knowledge and can take a "safe option" bearing this in mind.

The section on **Traffic Separation Schemes** is the only mention these receive on the course, but they are important nonetheless. Heavy fines have been levied on yachts which have ignored them. Tell that to the class and you will win their attention for sure.

Students, especially those on a boat, have a natural tendency to over-plan their **courses to steer,** and you must help them to avoid this. As an experienced navigator, you will be aware that pre-plotted courses seldom work out perfectly in real life. You cannot lay the course, perhaps, or maybe it turns out to be too close to a dead run. Even if it shapes up into an ideal reach, the helmsman may wander, or an unexpected set could carry the yacht off the neat line you have drawn. For these, and many other reasons, a line on a chart pre-drawn for any purpose other than to work out a tidal vector diagram could well become redundant almost as soon as it has been plotted. It then clutters the chart and may cause confusion when plotting the first EP, which is founded on a course line that has actually been steered.

Pre-plotted courses are therefore not recommended. It takes little time to lay a ruler on the chart, check for dangers, read off the course, log it, and sail on. And it is far more realistic.

Chapter 16 -- Navigating in Heavy Weather

Heavy Weather

This subject is not well suited to classroom presentation. You are therefore left with the material in the student book and perhaps twenty minutes or so to discuss it. Talk through the illustrations in this chapter, and stress the Human Error factor in electronic navigation.

On board, it is a different matter altogether. As with fog, an instructor should make it his or her business for the boat to be in the right place at the right time. This is not a matter of coincidence. If hard weather is on the way, ensure that you are in sheltered waters where full advantage can be taken.

Unless it is blowing a hurricane, there should be no day on a cruising course where the boat is not moved on account of press of weather. If conditions really are so desperate that it is genuinely dangerous outside, you can always shift berths to give the students an impression of how different things become when it's windy. At all costs, however, you must try to get them to sea, probably with you in sole charge, even if it is only for a short time.

The parallel with fog is clear. Better by far that the class should experience forty knots of wind with you at the backstay reassuring them and showing the way, than that they find themselves caught out with their family, never having reefed in anger.

One of your crew, or several in turn, should have charge of the navigation when it comes on to blow. Watch for signs of seasickness and help them cope with it. Don't put them through hell, but try to show that this is real, and that the next time it happens you will not be there to bail them out. You probably won't feel much like navigating yourself, so there should be no difficulty about putting across the genuine need to *do as little as possible, but as much as is absolutely necessary.*

Chapter 17 -- Passage Navigation

This is the crunch for students. Everything so far leads up to their being able to navigate on passage. By this stage, their heads are filled with details about the general subject of piloting a boat around the seas, but in practice they will be anxious with good reason, because **lack of experience leaves them short of know-how about "which piece of information to deploy when."**

Practical instructors see the results of this at first hand, and in its more extreme forms it can cause a sort of paralysis by over-navigation. In the student's mind, the yacht becomes a chart table with a keel, a rig and a sharp end, with the paperwork department by far the most important. The student skipper simply cannot wait to fix the yacht's position, whether it needs it or not. Having fixed it, the student then hunkers down to plot an exact course to steer which takes so long that by the time it is ordered up, the fix is a mile away and the yacht has been sailing in a different direction altogether. His or her efforts are therefore doomed.

Serious misconceptions often occur, not about what to do, but about when to do it and to what degree of accuracy, because shorebased instructors have not realized they were going to arise. A good passage navigation lecture followed by a set example to be worked on together in class can defuse this common and frustrating problem before it ever takes hold.

What the students need to know on this last day of the course, is *"What do I really do when I am running a yacht between two ports?"* The way to answer this unspoken question is to talk it through in general terms, then issue all hands with a chart and work through a couple of sample passages.

Insofar as you are able within four walls, navigate for real. Tell a story about the boat's progress.

> *"It's 1030 and we are taking our departure from the fairway buoy. Log it. Our course, allowing for 0.6 knots current at 045° will be 130°T. There is no appreciable leeway. Off we go. Let's enjoy the yachting and see how things are after half an hour or so...."*

Write in the ship's log, take a fix when you would really want one, and leave it alone when you don't. Work up an EP when you cannot see the shore; be set away from your ideal heading and re-plan as you go. Decide when to come off watch and brief your crew as to what their duties are; make a landfall and identify it, with difficulty at first, then with increasing firmness as you manage a decent fix at last. Finally, shape a course from your fix to bring you to the harbor mouth where you will produce your pilotage plan prior to working up to a berth.

It is a kindness to finish with a few words about entering a strange harbor. Remember, you have found yourself a berth a thousand times. Your students may never have done it at all. They won't like to ask, so help them.

Working all this out will take you an hour or two, but you should find it fun. Even if you hate it, however, you simply must make this a good session. It is the one from which your class will ultimately venture forth onto the sea, freed from the anxieties and dangers of ignorance by the benevolent discipline of thoughtfully taught navigation.

Good Luck to you all!