

studies, whereas six such courses are offered by polytechnics² and the first of these was approved ten years ago.

More recent developments have included a B.Sc. in Fishery Science; a number of degree courses in Environmental Studies and Geography, which contain substantial elements of meteorology, oceanography, cartography and marine surveying; and post-graduate courses in Shipping Management and in Hydrographic Surveying. These courses gain awards of a first degree or the diploma of the Council for National Academic Awards—a body which deserves much credit for encouraging experimentation in many 'new' areas of study.

The polytechnics have grown from the larger (regional) Colleges of Technology and the work of these colleges, in the professional field, has underpinned the present developments in higher education in maritime studies. The staffs of these establishments are to be commended for many of the advances in nautical education made over the last two decades; the 'bread and butter' courses for M.N. officers, leading to certificates of Mate and Master, have proved useful starting points from which to expand.

No longer is entry to the courses that are offered restricted to students who actively serve at sea. An inspection of the prospectuses shows that 'A' level school leavers may be accepted on many of them, either as 'sandwich' students undertaking industrial experience in a branch of shipping, or in some cases as full-time students, who may or may not subsequently obtain employment in the maritime world.

To suggest as he does that 'the interest in marine subjects in the polytechnics and colleges of technology is no better than in the universities' is rather unkind to the former and perhaps flattering to the latter. The polytechnics in a relatively short life (less than a dozen years) have opened up a number of areas which are now included under maritime studies and have been foremost in introducing degree and diploma courses in nautical and fishery science—albeit that the universities have had something of a head start.

REFERENCES

- 1 M'Pherson, P. K. (1975). Education and the sea. *This Journal*, 28, 232.
- 2 Council for National Academic Awards, *Annual Report*, 1972-73, 24.

Automatic Radar Plotting Systems

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If I may continue Mr. Harrison's analogistic extravaganza¹ for only a moment, I would like to say that whatever smoke, haze or fog there may have been in his vicinity it has prevented him from identifying the target at which I and my colleagues have been firing. I must also say that his bland assumption of the superiority of his own gunnery is hardly complimentary to the highly qualified and experienced support without which, as he well knows, no simple sailor would venture into such a technical action.

None of my comments made upon this subject thus far have denied the exis-

tence of errors, cyclic or otherwise, in the sources from which the radar data is drawn; nor have I disagreed with the evidence and the theories about the size and character of such errors, and the resulting prediction errors they might cause, which have been adduced by the various experts (in electronics), under the conditions and within the limits which they postulate.

What I have questioned from the beginning of these exchanges is the *belief* that the magnitude of the errors which will be present *in realistic conditions when offered to an automatic plotter of current* (although, of course, sophisticated) *design* will lead to the serious deception of an averagely intelligent and instructed operator. Admittedly, the foregoing sentence contains as many imprecisions and imponderables as those of the experts mentioned but, although I have expressed the same sentiment several times, no one has yet produced operational evidence from seagoing ships which does other than support my contention and disprove those of which I complained originally. Evidence based on a 'computer without data filtering' does nothing to alter my question.

A great deal of what Mr. Harrison advocates for the future is already the present as far as seagoing automatic equipment is concerned. The wiggling trail of the K-H display becomes an even more evocative wiggling vector in Digiplot and is shown in wiggling figures on the digital readout, which provides hard evidence for the anxious operator. The data is processed over more than five minutes and 'present' data is weighted more heavily in the computation, thus achieving response to actual target manoeuvres, as opposed to error wiggles.

This sophistication has been achieved the hard way; based on deep knowledge and experience of the computer field, prolonged study of the sensor error probabilities and hundreds of trials at sea. It is in use, not only in Digiplot, but in hundreds of ships and being proved by Masters and officers of many nationalities.

REFERENCE

- ¹ Harrison, A. (1975). *This Journal*, 28, 363.

Multiple Sun Sights with One Reduction

John P. Budlong

THE small-craft navigator is beset by a number of problems in taking sextant observations; of these wave motion is foremost for the constantly changing height of eye makes the dip correction uncertain. One alternative is to take a number of sights and average the times and altitudes; but averaging angles, and especially times, is an error-prone occupation and if one of the sights is badly in error it will probably not be noticed, and will bias the resulting average. This would be avoided if all the sights were individually reduced and plotted, but the work involved is prohibitive. The method here described permits several sights to be taken and the individual position lines plotted, but requires practically no increase in work over a single sight. Inspection of the position lines will give a