

position of the Cambridge Observatory, using a sextant and reflector [artificial horizon] — and Chambers' 7-figure logarithm tables. We produced the *Nautical Almanac – Abridged for the Use of Seamen*, but it gave no indication of the means of reduction of sights. Moreover, the Office, as such, did not — and had not since the time of Maskelyne — produced sight reduction tables. This was due to the Admiralty insistence on the cosine-haversine method, and, as I later found, to an arrangement with a commercial firm for the provision of the relevant tables. The *Abridged Nautical Almanac* (A.N.A.), as it is usually called, was completely standardized and its routine preparation (mainly copying) was handled by Scott.

The demands for the R.A.F. were urgent; a form of *Air Almanac* (A.A.) for 1937, and the first volume of the *Astronomical Navigation Tables* (A.N.T.s) by the end of 1938. This did not leave very much time for planning. After a general agreement on the contents and arrangement of the *Air Almanac* and on the A.N.T.s, it was arranged that the Air Ministry should formally request the Admiralty to allow the Office to undertake the projects — with an inter-departmental payment. The Admiralty (probably the Hydrographer, but I cannot remember) arranged two meetings to discuss the projects, *technically*. There was an open meeting at the Royal Geographical Society, and an internal one, at which the representation of the Royal and Merchant Navies was much in excess of the representation of the R.A.F. and the one representative of civil aviation. The Astronomer Royal was the principal speaker at the R.G.S. meeting, leaving me to describe our, then rather tentative, proposals. My recollection is that the discussion was not very informed nor helpful — the only points raised were: the relative merit of tabulating G.H.A. stars directly or G.H.A. Aries and, what later came to be called, S.H.A. Stars; A. R. Hinks (Director of the R.G.S.) strongly objected to our invented names (e.g. Avior) for the bright southern stars for which no recognised names existed. At the internal meeting, almost all the discussion centred on the extent to which the *Air Almanac* could be used at sea, and whether its availability would affect the use of the A.N.A.. The meeting recommended that the two projects be undertaken — and appropriate approval was given without delay.

Introduction of the *Air Almanac*

The first approach to the *Air Almanac* was in the form of a cover, with constant information such as interpolation, into which an 'ephemeris' could be inserted. This was an attempt to make the actual almanac as light as possible, but the experimental edition for the last quarter of 1937 (which was produced rather quickly) was far from ideal, particularly in respect of the need to transfer the daily pages to the separate cover. This attempt failed, and it was speedily changed to a 'tear-out' Almanac, in which unwanted sheets would be torn out. There were several changes of format before the present form was adopted — itself to be considerably modified when unified with the *American Air Almanac*. With hindsight I consider that we were by no means as far-seeing as we could have been expected to be, even though neither of the two technical meetings were adequately critical.

My recollection is vague regarding the details. I knew very little about surface navigation, and nothing at all about air navigation. The only publication for comparison was the French *Ephemerides Aeronautiques*, which was based on the concept of 'vers-R.A.'; its bulk rendered it quite unsuitable, and I doubted its value. [It was later dropped and replaced by the equivalent of the *Air Almanac*.] Many of the suggestions for revision, and improvements, came from the active and fertile brain of (then Squadron

Leader) “Kelly” Barnes, who wrote the admirable *Manual of Air Navigation* and, later, inaugurated the Specialist Navigation School at Cranage (near Byley, Cheshire). It was he {or was it Mackworth?} who, requiring notations and symbols for use in the manual, demanded more-or-less instant decisions from me. Firstly, for $360^\circ - \text{R.A.}$ (in arc), for which, admittedly without large-scale consultation, we introduced S.H.A. (sidereal hour angle), now generally accepted. Secondly and less controversially, for the correction to the observed altitude of Polaris to give latitude for which we adopted Q , also now in general use. As far as I can remember we had the copy ready before the R.A.F. had made up their minds. The S.H.A. was criticised in that it was *not* an hour angle, but the critics were not faced with an instant decision; moreover, the various alternatives [e.g. left ascension] were cumbersome and unsuitable. A minor point was that of star names; the R.A.F. insisted that the stars must be named, and there were two or three bright stars in the southern hemisphere that had no classical names. Scott made a hurried search of the literature, and we adopted the names Avior and Peacock for the two stars without names.

At a somewhat later date, Scott designed a series of ‘posters’ showing the 22 stars used in the *Astronomical Navigation Tables* in the field of view of neighbouring stars. These were printed by the R.A.F. and exhibited widely.

The responsibility for the preparation of the A.A. later came under Miss McBain, but the actual routine work of preparation of copy was done under Scott’s supervision. The division of responsibilities and duties varied from time to time, according to varying demands and to the staff available.

Astronomical Navigation Tables for use in the air

The design of the A.N.T.s was rather less hurried: it was a R.A.F. requirement that provision for both stars and Sun and planets be in the same volume in a similar format. The emphasis was on single sights and single position lines, rather than on position fixing; this largely determined the arrangement. Although the main details of the A.N.T.s were sound in principle, there is a major defect in the tabulation of the stars. Mackworth did, as I recall, at one time suggest using L.H.A. Aries as argument for the stars instead of L.H.A. Star, but (with the single-star arrangement) this would have doubled the amount of tabulation required. It affords, however, the user an automatic selection of stars and a much simpler form of calculation. The device had been used for certain stars in Weems’ Star Altitude Curves, and later in the astrograph, but was not introduced into formal sight reduction tables until after the war. We did not consider the ‘Hutchings’ arrangement of tabulating the altitudes and azimuths of the optimum selection of stars for each latitude and value of L.H.A. Aries — a great pity and a regrettable oversight. I have since regretted that I did not use this opportunity for introducing the argument L.H.A. Star in the A.N.T.s. Otherwise, the A.N.T.s were a ‘model’ tabulation, with printing of a high standard and impeccably proofread. I spent much effort on typographical design of the tables and, in retrospect, I am reasonably satisfied with the result — however inappropriate for its purpose it may have been!

[The ‘Hutchings’ arrangement was used in the first edition of *Sight Reduction Tables for Air Navigation* (H.O. 249) published in 1947; but the idea had been earlier used by Hoehne.]

I was required to give the Admiralty an estimate of the total cost of producing the tables, excluding printing and binding, but including proofreading, etc.. This depended