

DATUM FOR SOUNDING REDUCTION

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IHB Note. — *This article has been written to comply with the recommendation of the Eighth International Hydrographic Conference that "the Bureau collect and publish in such form as the Directing Committee may consider most appropriate the various proposals submitted to date concerning the datum for sounding reduction". (Report of the Proceedings of the 8th International Hydrographic Conference, Resolution K.35.1., page 411).*

1. — HISTORY

Even before the IHB's foundation, that is at the International Hydrographic Conference of London in 1919, the technicians were all absorbed in seeking a mathematical but also universally applicable definition of the datum for sounding reduction. During this meeting the following resolution was adopted :

" Tidal datum should be the same as chart datum, and should be a plane so low that the tide will not frequently fall below it.

It is greatly to be desired that a uniform datum plane should be adopted by all nations, and the following rule is suggested for the further consideration of hydrographers for a universal datum plane, which should be called " international low water ".

That the plane of reference below mean sea level shall be determined as follows : — Take $1/2$ the range between mean lower low water and mean higher high water and multiply this $1/2$ range by 1.5. "

As soon as the IHB was founded on 21 June 1921, it started to study the advantages and drawbacks of this resolution; with the result that in 1925 the new organization published S.P. No. 5 (*), whose authors were Rear Admiral PHAFF, then Director of the Bureau, and Commander H. D. WARBURG, R.N., Superintendent of Tidal Work of the Hydrographic Department of the British Admiralty. Both these technicians expressed independently their respective points of view but they arrived at the same conclusions. As Admiral PHAFF states it at the end of his study : " Inter-

(*) See also *Hydrographic Review*, Vol. II, No. 2, 1925.

national low water is an erroneous conception; it is impossible to establish a general hard and fast rule for a level of reduction of soundings which is applicable to every system of tides ". It is obvious from this conclusion that the system of tides should be known beforehand, and this leads us to classify tides into various types. This author then recommends expressions based on harmonic constants to give the distance of the datum for sounding reduction below mean sea level. The types of tides considered by Admiral PHAFF are : pure or very preponderant diurnal, pure or very preponderant semi-diurnal, and finally mixed tides with two subdivisions : preponderant diurnal and preponderant semi-diurnal.

The part of S.P. No. 5 written by Commander WARBURG is completely practical and ends with a very modern opinion : " The level of average lowest low water could be computed from the harmonic constants but the formula would necessarily include all constituents with periods of a month or less and it would further be necessary to multiply the H of each constituent by a factor depending, according to the type of tide, on the difference at new or full moon or at some other definite astronomical circumstance, between the time of low water of the greatest constituent and each other constituent. A formula would therefore be extremely complicated and datum is best ascertained directly from the observations. "

After S.P. No. 5 appeared, the Bureau published S.P. 10 (*), the title of which is again " International Low Water ". This special publication is only a commentary on Admiral PHAFF's work, a few details of which are discussed. LUYMES' article ends with the same conclusion as PHAFF's : " International low water is an erroneous conception; it is impossible to establish a general hard and fast rule for a level of reduction of soundings which is applicable to every system of tides. The level of reduction should be such that the negative corrections to be applied to the soundings on the chart and which are larger than the unavoidable inaccuracy of tidal prediction on board ship, are neither numerous nor important ".

It seems that from that time opinion was sufficiently formed for the discussion which would take place at the second International Hydrographic Conference.

2. — THE SECOND INTERNATIONAL HYDROGRAPHIC CONFERENCE (1926)

It is noteworthy that during this Conference the subject was discussed by the authors already mentioned, with the exception of Admiral PHAFF, and also by two universally known experts, the Ingénieur Hydrographe Général E. FICHOT and Dr. RAUSCHELBACH. The topic of International Low Water was thoroughly discussed and the arguments exchanged are still of such vivid interest that we recommend reading the minutes of this discus-

(*) See also *Hydrographic Review*, Vol. III, No. 2, 1926.

sion (*Report of the Proceedings of the Second International Hydrographic Conference*, pages 493-495).

Following these discussions it was concluded that, at the current stage of tidal analysis and study, too strict a computation formula was not possible, and that a datum for sounding reduction should be adopted such as is defined in the *Repertory of Technical Resolutions* under item A 5 III.

We consider that the text of Resolution A 5 III makes very good sense and is therefore acceptable to all. We shall return to this point later.

3. — PROPOSALS MADE AFTER THE SECOND INTERNATIONAL HYDROGRAPHIC CONFERENCE

After the resolutions adopted at the second International Hydrographic Conference, no new attempts to standardize the *method* of determining the datum for sounding reduction were made for 26 years. It was only at the sixth Conference that the question was discussed again, when a proposal of one of the States Members suggested that the datum for sounding reduction should be defined as the "lower limit of the average of the lowest ordinary low water".

We consider it useful to quote two of the comments on this definition :

"Seksjonssjef SUNDBY (Norway) said that they would like to adopt the datum line if a mathematical solution using harmonic constituents could be arrived at, as in that case it would be a datum which everybody could understand".

"Dr. DOBSON (Liverpool Observatory and Tidal Institute) said he had come to the conclusion that it was not possible to get a mathematical formula which would be suitable for all the tides; a formula for a 40 ft tide would be too complex for a tide of only 2 ft. The right idea had been sounded by the remark 'It did not matter how often the tide fell below datum so long as it never exceeded the margin allowed by the seamen'."

And he further pointed out that "the proposal formulated a certain rule which was evidently not acceptable; they were not dealing with a general proposition".

We finally arrive at the 8th Conference during which Argentina presented a proposal, resulting from a very interesting study by M. BALAY which was published as an article in the *International Hydrographic Review* (1952, XXIX-2, pp. 105-122). In this article, M. BALAY uses the statistical method in his search for the datum for sounding reduction so as to give mathematical meaning to the words "not frequently" of Resolution A 5 III. This proposal was vigorously discussed during the 8th Conference and was rejected. It should be observed, indeed, that despite the mathematical character of the method proposed, the reference LW does not supply an absolute indication because it is not possible to predetermine mathematically the percentage of Low Waters which would be lower than this reference level or the negative heights by which they would deviate from it.

After the Conference, Argentina's proposal was also discussed in the *International Hydrographic Bulletin*. The Director of their hydrographic office considered it interesting to give additional explanations beyond those attached to their 8th Conference proposal. These explanations are to be found in the Bulletin of January 1963. Comments by the Hydrographic Department of Great Britain on Argentina's article will be found in the June Bulletin of the same year. These comments raise sound objections, particularly with regard to the duration of observations which would be necessary to permit the application of the statistical method to the search for the datum for sounding reduction.

Also, a long article by Commander D. L. GORDON of the Hydrographic Department of Great Britain will be found in the *Bulletin* of September 1962 in which he recommends a completely different method of determining the datum for sounding reduction. In commenting on this article Canada asked what the author meant by the words "lowest predictable tide". The answer to this question may be found in the *Bulletin* of February 1963.

4. — CONCLUSION

It is our opinion that very useful conclusions may be drawn from the discussions summarized above. One fact at least is clear : in order to have any chance of being adopted a proposal must be :

- a) completely general in character, and
- b) apparently the only solution to the problem.

The proposals presented, however, were never of a general character and there were always other possible solutions for finding the datum for sounding reduction. Moreover the determination of the datum for sounding reduction cannot depend only on long periods of observation, because we need frequently to establish the datum from short period observations, in which case the statistical method fails.

To conclude, we think it useless to give a definition of the astronomically predictable lowest low water unless it follows from an absolutely general mathematical solution. We believe it is not worth while to submit proposals which will be discussed indefinitely before technicians come to an agreement.