consentaneous in the equatorial belt, and of opposite meanings outside the critical latitudes. We here conceive the function always to be written ⅜-sin2λ, so that outside the critical latitudes high-tide is low-water. We may in continuinç the development, write the X-¾-Z functions in the form appropriate to the equilibrium theory with water covering the whole earth, for the actual case it is only then necessary to. multiply by the reducing factor, and to subtract the phase alteration *κ.* As these are unknown constants for each place, they would only occur in the development as symbols of quantities to be. deduced from observation. It will be understood, therefore, that in the following schedules the “ argument” is that part of the argument which is derived from theory, the true complete argument being the “ argument ” —κ, where *κ* is derived from observation.

Up to this.point we have supposed the moon’s longitude and the earth's position to be measured from the “ intersection but in order to pass to the ordinary astronomical formulae we must measure the longitude and the earth’s position from the. vernal equinox. Hence we determine the longitude and right ascension of the i\* inter­section ” in terms of the longitude of the moon’s node and the in­clination of the lunar orbit, and introduce them into our formulae for the functions. The expressions for the functions corre­

sponding to solar tides may be written down by symmetry, and in this case the intersection is actually the vernal equinox.

The final result, of the process sketched is to obtain a series of terms each of which is. a function of. the elements of the moon’s or sun's orbit, and a function of the terrestrial latitude of the place of. observation, multiplied by the cosine of an angle which increases uniformly with the time. We shall now write down the result in the form of a schedule; but we must first state the notation employed: *e, el-* eccentricities of lunar and solar orbits; *Itω* =obliquities of equator to lunar orbit and ecliptic; *p, pf ≈* longitudes of lunar and solar perigees, σ, Ciz== hourly increments of *p, pt∖* s, *h≈*moon’s and sun’s mean longitudes; *σ,* 17=hourly increments of s, *h;* i=local mean solar time reduced to. angle; 7—17 = 15° per hour; λ = latitude of place of observation; £, *v =* longitude in lunar orbit, and R.A. of the intersection; A=longitude of moon’s node; t = inclination of lunar orbit. The “ speed ” of any tide is defined as the rate of increase of its argument, and is expressible, therefore, as a linear function of 7, 77, σ, ST; for we may neglect *GSi* as being very small.

The following schedules, then, give h the height of tide. The arrangement is as follows. First, there is a universal coefficient

8α, which multiplies every term of all the schedules. Secondly, there are general coefficients, one for each schedule, viz. cos2λ for the semi-diurnal terms, sin 2λ for the diurnal, and ⅛-f sin2 λ for the terms of long period. In each schedule the third column, headed “ coefficient,” gives the functions of *I* and *e.* In the fourth column is given the mean semi-range of the corresponding term in numbers, which is approximately the value of the coefficient in the first column when Ζ=ω; but we pass over the explanation of the mode of computing the values. The fifth column contains arguments, linear functions of *ti ht st p, v, £.* In [A, i.] 2i-f-2(A-*v)* and in [A, ii.] *t-∖-(h-v)* are common to all the arguments. The argu­ments are grouped in a manner convenient for subsequent computa­tion. Lastly, the sixth is a column of speeds, being the hourly increases of the arguments in the preceding column, estimated in degrees per hour. It has been found practically convenient to denote each of these partial tides by an initial letter, arbitrarily chosen. In the first column we give a descriptive name for the tide, and in the second the arbitrarily chosen initial.

The schedule for the solar tides is drawn up in precisely the same manner, the only difference being that the coefficients are absolute constants. In order that the comparison of the importance of the solar tides with the lunar may be complete, the same universal coefficient *a* is retained, and the special coefficient for each

term is made to involve the factor ⅛. Here τz=J¾ *mi* being the *• ^r* sun’s mass. With

M o T. z∙ I

m=81∙5√=∙46035=5^5g.

To write down any term, take, the universal coefficient, the general coefficient for the class of tides, the special coefficient, and multiply by the cosine of the argument. The result, taken with the positive sign, is a term in the equilibrium tide, with water covering the whole earth. The transi­tion to the actual case by the introduction of a factor and a delay of phase (to be derived from observation) has been already explained. The sum of all the terms is the complete expression for the height of tide h.

It must be remarked that the schedule of tides is here largely abridged, and that the reader who desires fuller information must refer to the BnX *Assoc. Report* for 1883, or vol. i. of G. H. Darwin’s *Scientific Papers,* or to Harris’s *Manual of Tides.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *A.—Schedule of Lunar Tides.*  Universal Coefficient = ∣ *a.* | | | | | |
| i.- | -Semi-diurnal Tides; General Coefficient = cos@@1 λ. | | | | |
| Descriptive Name. | Initial. | Coefficient. | Mean  Value of Coefficient. | Argument  2∕4-2(A-F.) | Speed in Degrees per m. s.  Hour. |
| Principal ) lunar ) | m2 | ⅜(x-ξe\*)cos4 V | •45426 | -2(4-f) | 28-9841042\* |
| Luní-solar Ί (lunar > portion) J | κ2 | ⅜(ι+^s)l sin1/ | •03929 | — | 30-0821372\* |
| Larger )  elliptic J | N | *⅜ · le* cos4 i∕ | ∙087<)6 | -2(ι-f)- | 28-4307296· |
| ii.—Diurnal Tides; General Coefficient = sin 2λ. | | | | | |
| Descriptive Name. | Initial. | Coefficient. | Mean  Value of Coefficient. | Argument <+(\*-f). | Speed in Degrees per m^. Hour. |
| Lunar di- ) urnal ý | O | (x — ξe\*)⅜ sin *I* cos’ÿZ | •18856 | -2d-f)+⅛ιr | r30430356∙ |
| Luni-solar \*í (lunar > portion) J Larger )  elliptic ) | κ1  Q | (ι-Hel)l sin ∕ cos *I le* · ⅜ sin *I* cos’ ⅜Z | •181x5  •03651 |  | 15-0410686\*  x3∙3986609∙ |
| iii.- | -Long Period Tides; General Coefficient ⅜- *f* sin2λ. | | | | |
| Descriptive Name. | 1 Initial. | Coefficient. | Mean  Value of Coefficient. | Argument. | Speed in Degrees per m.s.  Hour. |
| Change of Ί mean >  level. J |  | (ι+2eυ⅛(r-JsinV) | ∙252241 | ΓOf variable parti -< is *N,* the long. > L of node J | J9∙34β per annum |
| Fort- )  nightly. ) | Mf | (x— gej)i sin’ Z | •07827 | 2(5-f) | x 0980330\* |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| B.—*Schedule of Solar Tides.* Universal Coefficient = “ (-) *a.*  2 *m ∖cj* | | | | | |
| Descriptive Name. | Initial. | Coefficient. | Value of Coefficient. | Argument. | Speed in Degrees per m.s.  Hour. |
| i.—Semi-diurnal Tides; General Coefficient = cos2λ. | | | | | |
| Principal ) solar )  Luni-solar Ί (solar ?  portion) J Larger )  elliptic ) | s2  Kî  τ | ∙^(χ~ ξe,1)⅛ cos4⅜ω  Visin’" φ ⅜ ¼ cos\* ⅜ω | ∙2jι37  •0x823  •01243 | 2/  2H-2A  2i-(⅛-A) | 30Oo0000oβ  30∙0821372o  29∙95893Ma |
| ii.—Diurnal Tides; General Coefficient = sin 2λ. | | | | | |
| Solar di- ) urnal )  Luni-solar Ί (solar >  portion) J | P  Ki | ⅞(χ *— ξe,i)* ⅛ sin ω cos’ ⅜ω τ  fi(x-|-|e,’)i sin ω cos ω | •08775  •08407 | /—Λ⅛⅜jγ  /4-Ä-⅜1Γ | 149589314·  15∙04x0686∙ |
| iii.—Long Period Tides; General Coefficient≡=⅜-g sin2λ | | | | | |
| Semi-an- ) nual ) | Ssa | L(x—Jβ,s)⅜ sin’ ω | •03643 | 2Ä | 1 0∙0821372∙ |

From the fourth columns we see that the coefficients in de­scending order of magnitude are M2, Ki (both combined), Ss, O, Ki (lunar), N, P, Ki (solar) K2 (both combined), K2 (lunar), Mf, Q, K2 (solar), Ssa.

The tides which we omit from the schedules are relatively unimportant, but nevertheless commonly evaluated in accurate tidal work, are all lunar tides, viz. the follow­ing semi-diurnal tides: the smaller elliptic tide L, the larger and smaller evectional tides vl λ, the variational tide *μ.* Also the fol­lowing diurnal tides, viz. the smaller elliptic tide Mi, a tide of speed γ¼-*cS* called J. Also amongst the tides of long period, the luni-solar fortnightly called MSf.

The tides depending on the fourth power of the moon’s parallax

@@@1 The mean value of this coefficient is ∣(ι +Je2)(ι — Jsin⅞')(ι — gsin2ω) = ∙25, and the variable part is approximately — (1 +jte2) sin *i* cos *i* sinω cos *ω* cos A = — ∙0328 cos *N.*