

shipwreck and loss of life, and felt relief when they found that there was no mention of the Indiaman.

"Hope springs eternal in the human breast."

They began to gather courage. The *Andromache* was a staunch ship—Captain Talbot a skilful seaman, with experienced officers and men under his command. They persuaded themselves that, foreseeing the approach of the gale, he had not ventured near the land, or that, perhaps, he had put into some port on the coast of France. That would account for his long delay after the arrival of the *Swallow*.

The next day's "Shipping Gazette" encouraged this hope. An editorial paragraph ran thus:—

"Great anxiety has been felt respecting the *Andromache*, Indiaman, Captain Talbot, which vessel was looked for at Southampton for some days before the late terrific gale commenced. This anxiety has been in some degree allayed by the report of Captain Somers, of the *Lapwing*, West India mail-packet, which came into port last night in a disabled condition; in fact, almost a wreck. Captain Somers reports that, on the first day of the gale, he saw a large vessel, which he believes to have been the *Andromache*, lying to, about fifty miles west of Cape Ushant. The ship had lost her mizen and fore and main top-gallant masts; but she appeared to be making tolerable weather. The captain says that, in all his long experience, he has never witnessed so severe a gale, nor such a tremendous sea."

The anxious wife and daughter comforted themselves with the hope thus afforded them, for two days longer, refusing to acknowledge, whatever may have been their secret fears, that any serious accident had happened to the *Andromache*, and still looking every hour, every minute in the day, for Captain Talbot's arrival; but the delusive hope upon which they had fed was soon succeeded by blank, crushing despair. A few brief lines in the newspaper sufficed to tell the terrible story, how more than a hundred human beings, crew and passengers included, met their death, and passed in one short hour from time into eternity.

"It is our painful duty," again wrote the editor, "to state on the too sure authority of the keepers of the Lizard Lighthouse, that shortly after daybreak on the morning of the 4th inst., when the gale had reached its height—a large frigate-built ship was seen to go on shore on a reef a few miles from the Lizard Point.

"The keepers watched the fearful sight from the gallery of the lighthouse; but so terrific was the force of the gale, and so tremendous the sea, that it was utterly impossible to render any assistance to the unhappy crew, who battled manfully with their terrible fate to the last moment. Again and again the ship was veered round, and held off from the fatal reef. At length, however, the vessel's masts went by the board. She became utterly unmanageable, and was swept with furious force right on to the pointed rocks. She fell over on her beam-ends, and in a moment every soul was swept from her decks. The sea made a clean breach over her, and in less than a quarter of an hour she parted midships and became a mass of broken timbers; but, long before this, all on board had met a watery grave.

"The tide was turning when the ship struck, and all the bodies were washed out to sea; but from several pieces of wreck and cargo that subsequently floated on shore, and have since been picked up, there remains not the slightest doubt that the hapless vessel was the *Andromache*, East Indiaman, commanded by Captain Henry Talbot, formerly of the Royal Navy, which vessel has been for some days past expected at Portsmouth from Calcutta.

"The *Andromache* had on board a crew, officers and men, all told, numbering sixty souls, and forty-five passengers, none of whose names have yet been ascertained; but there can exist no doubt that all have perished. The general cargo, we are informed, was very valuable, and was, together with the ship, fully insured; but we learn from the underwriters at Lloyds that, by some oversight, a large amount of specie, and several tons of private cargo which belonged to Captain Talbot himself, were—as per advices from Calcutta—uninsured."

This was all that was ever known respecting the loss of the ill-fated *Andromache*. Not one of her crew or passengers escaped to tell the fearful story of the shipwreck, though, of course, the names and conditions of the lost passengers became known in process of time.

The same newspaper which conveyed to the lately hopeful and happy wife and daughter the dread intelligence that their sole earthly hope and stay was lost to them for ever in this world, likewise conveyed to them the sad news that with the husband and father they had lost all their worldly wealth.

As it was afterwards learnt, Captain Talbot had been engaged in very heavy speculations in India, in which he had embarked the whole of his means. These speculations had proved successful, even beyond his most sanguine expectations. All his worldly wealth was on board his ship, and the one act of negligence which, as though he had foreboded evil, he had spoken of with regret in the last lines he had ever penned to his wife and children, had reduced them from independence to poverty.

Henry Talbot returned home on hearing of his father's death, to find his mother on her dying bed. The terrible shock she sustained proved too much for her already enfeebled frame, and she died only a few weeks after the loss of the *Andromache*, leaving her son and daughter, comparatively speaking, almost penniless; and, so far as she knew, without a friend able and willing to aid them—without a relative, at the same time, able and willing to acknowledge the claims of kinship, in all the wide world.

THE NAUTICAL ALMANACK.

BY EDWIN DUNKIN, F.R.A.S., ROYAL OBSERVATORY.

Of the numerous almanacks that are published in England by far the first in scientific and national importance is the "Nautical Almanack," published by the Board of Admiralty for the use both of astronomers and of seamen. As this almanack is less popularly known than many others in common use, some account of its origin and history, its contents and uses, may be acceptable to the readers of the "Leisure Hour."

Before astronomical observations were made with the precision of modern days, and when the art of navigation consisted mainly in a knowledge of the coast line, much scientific attention was given to that great national problem, the discovery of a method for determining the longitude at sea. The subject was considered of such importance that the Government of the day, in 1714, offered a reward of twenty thousand pounds for an easy, practical method available for nautical purposes. Since that time hundreds of impracticable schemes have been forwarded to the Commissioners of the old Boards of Longitude, each author apparently appearing satisfied with his solution of the problem, and of course claiming the reward. The investigations were not confined to one class of scientific men. We have lately had occasion to look over a huge manuscript volume of these

documents, and have been considerably astonished at the great ingenuity displayed by men of all ranks of intellect, some exhibiting great mathematical power, others plainly showing the results of the minds of illiterate, but original thinking men. Some, however, contain only wild fancies of the writers. Still the question was not even partially solved to the satisfaction of the authorities till the remarkable improvements made in the construction of clocks and chronometers by John Harrison. In 1758 this celebrated mechanic produced a chronometer which was sent on a trial voyage to the West Indies. After an absence of little more than five months, the error of the chronometer was found, on its return, to be only sixty-five seconds. For this remarkable success, which was the first practical step in the accurate determination of the longitude at sea, Harrison received a reward of five thousand pounds. This grant was afterwards increased by an additional sum of ten thousand pounds, other chronometers having been constructed for the Board of Longitude with equal accuracy. On one occasion Stukely, the antiquarian, paid a visit to the workshop of Graham,* then a celebrated clock and instrument maker, to view a wonderful time-piece by Harrison, which is probably one of those still preserved at the Royal Observatory. Stukely relates: "I saw Harrison's famous clock last winter at Mr. George Graham's; the sweetness of its motion, the contrivances to take off friction, to defeat the lengthening and shortening of the pendulum through heat and cold, and to prevent the disturbance of motion by that of the ship, cannot be sufficiently admired."

To make Harrison's invention a complete success it was necessary that predicted places of the sun and moon should be published some time beforehand, so that when observations were made at sea they might be compared directly with the computed lunar distances from the sun and principal stars, determined from the best tables extant. Hence the origin of the "Nautical Almanack." It owes its actual existence to a memorial presented to the Commissioners of the Board of Longitude by Dr. Nevil Maskelyne, Astronomer Royal, on February 9th, 1765. This memorial was supported by several officers of East India ships, who had lately made use of a work compiled by Dr. Maskelyne, entitled "The British Mariner's Guide to the Discovery of the Longitude at Sea and Land, within a degree, by Observations of the Distance of the Moon from the Sun and Stars, taken with Hadley's Quadrant." These officers all agreed in testifying that they had made observations according to the rules laid down in this book at various opportunities, and that "they had found the said observations easily and exactly to be made; so that the longitude resulting always agreed with the making of land, near the time of making the observations, to one degree; and that they could make the calculations in a few hours, not exceeding four; and they are of opinion that, if a nautical ephemeris were published, this method might be easily and generally practised by seamen." This memorial of Dr. Maskelyne had the desired effect, for a nautical ephemeris was at once ordered to be compiled and printed.

Shortly before this time M. Mayer, a German mathematician, had constructed lunar tables by means of which the place of the moon in the heavens could be computed for any stated time. Owing to the decease of Mayer,

* It is worthy of remark, that there are several clocks constructed by Graham still in use at the Royal Observatory. Some slight modifications have, however, been made in some of them. He also made the mural arc and the zenith sector with which Dr. Bradley made important astronomical discoveries. These instruments are also preserved at Greenwich.

these tables remained in manuscript. In order that they might be made more useful in the calculation of the new almanack, they were printed at the expense of the British Government, and an application was also made to Parliament for a grant of money to Mayer's widow. She afterwards received a reward of three thousand pounds. The celebrated mathematician Euler assisted Mayer in the theoretical portions of his work, for which the Government gave him three hundred pounds. Dr. Maskelyne was appointed superintendent of the new ephemeris, an office which he retained till his death in 1811.

The first "Nautical Almanack" was published in 1766; it was available for the following year. About twelve months only were occupied in its calculation and preparation for the press—a marvellously short time when it is considered how difficult the arrangement of a novel work of this kind must have been. The first number will ever remain as a great memorial of the skill and industry of the originator. It was announced to the public as follows:—"The Commissioners of Longitude, in pursuance of the powers vested in them by a late Act of Parliament, present the public with the Nautical Almanack and Astronomical Ephemeris for the year 1767, to be continued annually; a work which must greatly contribute to the improvement of astronomy, geography, and navigation. This ephemeris contains everything essential to general use that is to be found in any ephemeris hitherto published, with many other useful and interesting particulars never yet offered to the public in any work of this kind."

By the publication of the "Nautical Almanack" for 1767 and subsequent years, and by the continual improvements in the construction of chronometers, the longitude at sea was practically determined with moderate accuracy at the close of the last century. At the present time, astronomical observations have been the means of so far improving the lunar and planetary tables that they may be said to have, in conjunction with the use of the beautifully-made modern nautical instruments, conclusively disposed of this great problem, for the solution of which so large a reward had been offered.

During Dr. Maskelyne's superintendence of the "Nautical Almanack," its success was complete. It was annually received with eagerness by seamen, and it gained not only the approbation of the naval service, but also of all lovers of the science of astronomy, in England and on the Continent. The French *savant*, M. Lalande, remarked that "there are almanacks published at Bologna, Vienna, Berlin, and Milan; but the 'Nautical Almanack' of London is the most perfect ephemeris I have ever seen."

On the death of Dr. Maskelyne, the superintendence remained in abeyance for some years, being in the hands of no responsible person. No wonder that the reputation which the almanack had attained in his lifetime was soon lost. It became inaccurate and incomplete, and could no longer bear a favourable comparison with the productions of other countries. Astronomical knowledge had been remarkably progressing; but the "Nautical Almanack" remained not only stationary, but retrograded. The attention of Government having been drawn to this state of its affairs, the question was referred to a new Board of Longitude appointed in 1818, of which Dr. Wollaston, Captain Kater, and Dr. Thomas Young were a resident sub-committee. Towards the end of that year, Dr. Young was made secretary to the Board, and superintendent of the "Nautical Almanack." The first volumes published under his direction did much to retrieve its character; but the irregular system

employed in making the calculations left no hope of any permanent improvement being effected without some radical change in its personal organisation. It is a remarkable fact that the computations were made in different parts of the country. It seems almost incredible that, in a time of slow travelling and expensive postage, a system in which all the calculations had to be transmitted several hundred miles to be verified, should have continued so many years without any attempt at centralisation. The father of the writer of this article, resident at Truro, Cornwall, was one of these scattered computers from 1800 till his removal to London, in 1832, being responsible for five months' computations of each year.* We can well remember, in our early days, the extra labour borne by him in preparing duplicate copies of his work, to be transmitted to the examiner in Derbyshire, and the length of time which necessarily elapsed before any answer could be expected. His subsequent experience in the "Nautical Almanack" office in London formed a great contrast to this irregular manner of producing the national ephemeris. As an illustration of the scattered residences of the computers in 1828, we may state that one lived at Arbroath, Scotland; another at Truro; a third at St. Hilary, near Marazion; a fourth at St. Mabyn, Cornwall; a fifth (a lady) at Ludlow, Shropshire; and a sixth at Tideswell, Derbyshire. Dr. Young, the superintendent, resided in London.

After the death of Dr. Young, which took place in 1829, a proposition was laid before the Council of the Royal Astronomical Society by the Lords Commissioners of the Admiralty, with a request that they would take into consideration the advisability of forming some plan by which the "Nautical Almanack" might be prepared more in accordance with the advanced state of astronomical science. In conformity with this request, a committee consisting of the principal members of the Society was appointed. They recommended that an office should be established in London, in which all the calculations should be made; also, that there ought to be a complete change in the form and contents of the almanack, making it at least double in size, and adding valuable matter useful to the astronomer. The proposed alterations were adopted by the Council of the Astronomical Society, November 19th, 1830, and subsequently ordered by the Government to be carried into effect.

In the first series of the "Nautical Almanack," up to 1833, the information was intended principally for maritime purposes, but not wholly so. That portion, however, inserted for the benefit of astronomers, was not sufficiently accurate for comparison with the observations, and consequently was practically useless for all delicate researches. One great object of the committee was to recommend that in the new series the positions of the sun, moon, and planets should be calculated with the precision which the best modern tables would allow. Then, with regard to the improvement of nautical astronomical observations, it was considered that the determination of the position of a ship at sea ought not to

* It may not be amiss to state here that Mr. William Dunkin was an early boy-friend and school companion of Sir Humphrey Davy, both natives of Penzance, Davy being the senior by three years. The attention of Mr. Davies Gilbert, M.P., afterwards President of the Royal Society, was drawn to both of these youths on account of their scientific tendencies; one for chemistry, the other for mathematics and astronomy. He gave them the use of his valuable library at Tredrea, his seat near Penzance. The brilliant career resulting from the introduction of young Davy to the Pneumatic Institution at Bristol, in 1798, is well known to all. Mr. Gilbert afterwards placed young Dunkin under the care of the Rev. Malachy Hitchens, at St. Hilary, Cornwall, then computer of the "Nautical Almanack" under Dr. Maskelyne. Mr. Dunkin soon became one of the principal computers of that work, in which employment he remained till his death in 1838.

be the only object of a seaman's solicitude, because that might be attained by a much smaller work than the "Nautical Almanack," and by the use of very inferior observing instruments. But the committee also considered that an equally important branch of nautical astronomy, consisting in the exact determination of the position of well-known points on the earth's surface, should also be provided for. These observations cannot be effectually and properly executed by methods available only on board a ship, but by delicate instruments placed firmly on solid ground. Observers in this position require all the astronomical aid which can be given them from the best tables, arranged in a form most convenient for practical and immediate use. In the new series of the "Nautical Almanack," the first volume of which was for 1834, this two-fold object has always been kept in view. Thus the seaman can still find everything he requires, and the astronomer at the same time has at his fingers' ends the tabular positions of the principal stars and planets for every day in the year. This enables the latter to point his telescope at any hour of the day or night to the celestial object selected for observation, and then to compare the results of his labours with the numbers previously computed. He is thus continually keeping a check on the lunar and planetary tables used in the construction of the "Nautical Almanack," and providing fresh data for their correction.

The result of the deliberations of the committee of the Astronomical Society having been adopted by the Government, an office was established in London in 1831, since which time the whole of the calculations have been made there. The superintendence after Dr. Young's death was temporarily undertaken by Mr. Pond, at that time Astronomer Royal. On the formation of the new office, Lieutenant Stratford, R.N., was appointed superintendent, assisted by a staff of skilled computers. The office is at present in Verulam Buildings, Gray's Inn, the director being the well-known astronomer, Mr. John Russell Hind, who succeeded Mr. Stratford in 1853.

Now that we have given a brief history of this truly national book, we propose to take a rapid glance through its contents—not, however, with a critical eye, but with a desire to explain in a few popular words what would probably appear unintelligible to most readers on the first inspection of its pages. Let us commence by turning the leaves over rapidly from the beginning to the end of the volume. Nothing is visible but an immense assemblage of figures. To those, however, who understand their use, every one of these figures has its peculiar significance. Every line we see before us is the result of a long and laborious calculation, nothing being printed but what is absolutely necessary. The tables from which nearly all the work is now computed have been originally constructed from the labours of the astronomical observer, principally, however, from the observations of the sun, moon, and planets made at the Royal Observatory, Greenwich. Hence the solar tables by M. Le Verrier, the lunar tables by M. Hansen, the tables of Mercury, Venus, and Mars, by M. Le Verrier, and others, depend almost entirely on the Greenwich astronomical observations of the last hundred years. It is from this cause that a popular error exists in the minds of many persons that the home of the "Nautical Almanack" is at the Royal Observatory.

The almanack may be divided into two divisions, one to be used by seamen and astronomers, the other by astronomers almost exclusively. The first division may be termed the monthly section, because here the matter for the different months is arranged according to one plan,

the whole being divided into twelve sub-sections under the names of the months. We will now briefly go through one of these sub-sections. Let us take as an example that for January, 1868. First, we have no calendar containing the ordinary information of popular almanacks, nothing more indeed than the days of the week and month. On the first opening we have the exact position of the sun in the heavens at Greenwich noon of each day, with some other information useful to seamen as well as astronomers. On pages 4 and 5 of each month the longitude and latitude of the moon is given for each day at noon and midnight, and of the sun for noon. The time of the moon's southing, and the angular value of the moon's semi-diameter and parallax, are also given. Pages 6 to 13 are occupied with the right ascension and declination of the moon for every hour throughout the month. Pages 14 to 19 contain the distances of the sun, planets, and principal stars from the moon for every three hours. These lunar distances are inserted solely for the benefit of mariners; and it is by the comparison of the observed lunar distances with those corresponding in the almanack that the longitude at sea is generally determined. Travellers also, when in unknown lands, have availed themselves freely of this portion of the volume. M. du Chaillu made an extensive series of observations of lunar distances during his late journey into Ashango Land. The geographical positions of some of the stations visited by him have therefore been determined with considerable accuracy. The late Captain Speke also used this method for determining longitudes in his explorations from Zanzibar to Lake Victoria Nyanza. The writer is able to form an opinion on the value of such observations, from a careful examination of the astronomical labours of these and other African travellers, and from the valuable geographical results he has obtained from the discussion of their observations. Pages 20 and 21 of the sub-sections contain the data for accurately computing the position of the fixed stars, useful only to the astronomer. These occupy the last pages of each month's information. This first division of the "Nautical Almanack" absorbs one half of the volume.

The second division of the work is intended purely for the use of the astronomer, and is prepared for the meridian of the Royal Observatory. It is, however, easily adapted for use at other observatories, by applying small corrections depending on the difference of longitude. We will endeavour to exhibit the contents of this division in as few words as possible. 1. We have the positions, as viewed from the sun and earth, of the planets Mercury, Venus, Mars, Jupiter, and Saturn, given for Greenwich noon of each day, and of Uranus and Neptune each fourth day. By means of the daily positions of these planets, particularly of Venus and Jupiter, the latitude, time, and variation of the compass, may be found with nearly as much facility and accuracy as by the sun. 2. The same information for the large planets, and a few of the minor planets, at the moment of transit across the meridian of Greenwich. 3. Standard places of 147 of the principal fixed stars given for every ten days throughout the year. Several of these stars, with some others, are used at Greenwich as clock-stars, from the observation of whose transits true Greenwich time is found daily. It is scarcely necessary to draw attention to the national importance of these observations, as it is now generally understood that the time of all the clocks in the country is indirectly kept in order by this daily reference at Greenwich to the great star-clock of the heavens. The mechanical and electrical arrangement made for the dissemination of true time

from the Royal Observatory to all parts of the country, now forms a most important part of the daily duties of that establishment. 4. Forty pages of the second division are occupied with the apparent positions of the moon, and of certain selected stars near her, at their respective times of Greenwich transit. By the corresponding observation of these objects on different parts of the earth's surface, a very accurate method for the determination of the difference of longitude between any two places is obtained. 5. The remaining portion of the book contains principally full details of all miscellaneous phenomena. First we have eclipses visible in 1868, with the elements of calculation. Then a list of stars occulted or obscured by the moon passing over them. These are succeeded by an extensive list of the phenomena of the moons of the Jovian system, consisting of eclipses in the shadow of Jupiter, transits over its disc, disappearances behind the body of the planet, together with the dark shadows of the satellites on the planet. Accurately computed times of the principal phenomena are given, and approximate times for the remainder. The concluding portion of the almanack contains a list of the principal planetary phenomena; elements of Saturn's ring; the libration of the moon; time of high water at London Bridge daily, and at various ports and places at the full and change of the moon; a few tables used by nautical men principally; a list of public and private observatories; and finally, an explanation of the different sections of the work.

In addition to the preceding valuable matter, the almanack contains rough ephemerides of the minor planets. In the volume for 1870, and in future volumes, these are intended to be omitted, as they are published in the Berlin Astronomical Almanack in fuller detail, and consequently more useful to the astronomer.

The United States of America also publishes a "Nautical Almanack," prepared by order of Congress. It is almost a fac-simile of our own with regard to the contents, the arrangement of the tables being copied as nearly as possible from the British "Nautical Almanack." France has also its national ephemeris, known by the name of the "Connaissance des Temps." It cannot bear comparison with ours. The "Berliner Astronomische Jahrbuch" is a valuable work, especially for the great attention given to the minor planets. Several other countries have their astronomical ephemeris; for example, the Milan ephemeris, and those of San Fernando, in Spain, and Coimbra, in Portugal, are well known to astronomers.

When the new series of the "Nautical Almanack" was first published, it was established as a rule that the work should eventually appear yearly four years in advance. Although since 1834 the establishment of ocean steamers has so practically shortened the distance between opposite portions of the globe that there is no longer the same object for such early publication, yet it has been thought advisable to continue the system as originally designed. In 1867, therefore, the volume for 1871 appeared, while the computers are engaged on years still farther in advance. The annual circulation amounts to more than 20,000 copies.

HER MAJESTY'S MAIL IN THE FAR-WEST.

BY J. K. LORD, F.R.S.

"Our English post-office is a splendid triumph of civilisation." In this memorable saying of Lord Macaulay, reference is made not merely to the postal organisation of the United Kingdom. The chief office in London, the railway mail-vans, the travelling post-offices, and