personally presented to the King and Queen, who conversed most graciously with each of them. On the 22nd the Minister of Agriculture entertained the Congress at a State dinner. On the 20th the Syndic of Rome had given a reception in the Capitoline Museum, which was illuminated for the occasion. For their own part the foreign delegates invited their Italian hosts to a dinner at the Hotel de Russie on the 19th.

The proceedings were closed by a very graceful and munificent act of hospitality. The entire Congress, with the ladies who had accompanied some of the members, received free tickets for Naples and became the guests of the Italian Government for two days and a half. An expedition to Vesuvius, which was arranged for them, proved a complete success. The courtesy and forethought of the Italian officials extended to every detail which could contribute to the comfort of their visitors. The day was one of unclouded enjoyment; the weather was a perfect specimen of an Italian spring, and Vesuvius was tranquil enough to allow the more adventurous members of the party to explore every part of the crater, only deigning to eject a few stones as Parthian arrows at the descending meteorologists.

The Congress at Rome will remain in the memory of all who took part in it as one of the pleasantest and most successful opportunities of international scientific intercourse which has ever been organised.

OUR ASTRONOMICAL COLUMN

TEMPEL'S COMET (1867 II).—The following ephemeris of this comet is deduced from M. Gautier's elements, but with the perihelion passage corrected to May 6·9537 G.M.T. to accord with the approximate position observed by Dr. Tempel on April 24:—

At Greenwich Midnight

1879.	Right Ascension.	Declination.	Log. distance from Earth.	Log. distance from Sun.
	h. m. s.	° ′		
May 15	16 50 3	−16 17·6	9·8959	0·2487
17	— 49 15	16 36·6		
19	— 48 20	16 55·9	9·8911	0·2492
21	— 47 20	17 15·6		
23	— 46 16	17 35·8	9·8880	0·2498
25	— 45 8	17 56·3		
27	— 43 58	18 17·1	9·8866	0·2506
29	— 42 45	18 38·1		
31	— 41 31	18 59·3	9·8871	0·2515
June 2	— 40 16	19 20·6		
4	— 39 2	19 42·0	9·8895	0·2527
6	— 37 49	20 3·4		
8	— 36 38	20 24·8	9·8937	0·2539
10	— 35 29	20 46·1		
12	16 34 23	−21 7·2	9·8996	0·2554

The intensity of light is at a maximum about May 26, but is not then very materially greater than on April 24, when the comet was described by Dr. Tempel as a faint object. In 1867 it was observed at Athens until the theoretical intensity of light had diminished to 0·21, so that with the larger telescopes in the southern hemisphere observations may be possible in August. The position for August 13·5 is in R.A. 16h. 58·8m., Decl. − 29° 11′. When brightest in 1867, the nucleus was star-like and of 9·7 m., the value of I. at the time being 1·23.

During the ensuing revolution considerable perturbation may again result from the action of the planet Jupiter, though not to so great an extent as in the revolution 1867-73. Using the above time for perihelion passage in the present year and taking the mean daily motion, 593″·184, it appears that the least distance of the comet from the planet will be about 0·58 of the earth's mean distance from the sun, in the middle of October 1881, and that from the beginning of July, 1881, to the middle of January, 1882, the comet will always be within 0·65; this will again necessitate a rigorous calculation of the perturbations to insure a near prediction of the comet's track in the heavens in 1885.

It was at one time suggested that the object detected by M. Goldschmidt on May 16, 1855, while searching for De Vico's comet of short period, might have been the comet of which we are writing; but the late Dr. von Asten undertook the calculation of the perturbations backward for two revolutions from 1867, and found that the comet being in perihelion on February 1, 1856, with elements not very different from those of 1867, could not have been identical with Goldschmidt's nebulosity. So far, therefore, as is known at present, there is no recorded observation of Tempel's comet previous to April 3, 1867, notwithstanding it may have performed many earlier revolutions in the restricted orbit it now describes; but the case is similar with other comets of short period.

BRORSEN'S COMET.—Dr. Krueger has kindly sent us two meridian observations, made at Helsingfors, of the star over which Major Tupman witnessed a nearly central transit of this comet on May 3 (NATURE, vol. xx. p. 27). The star was rated 8·7 mag., and its mean position for 1875·0 was R.A. 6h. 9m. 14·84s., Decl. + 61° 28′ 8″·5. Whence the apparent position of the comet by Major Tupman's observation was on May 3, at 10h. 11m. 14s. G.M.T. in R.A., 6h. 9m. 39·15s., Decl. + 61° 28′ 30″·9, showing corrections to the ephemeris, published in this column, of + 13s. in R.A., and + 2′ in declination.

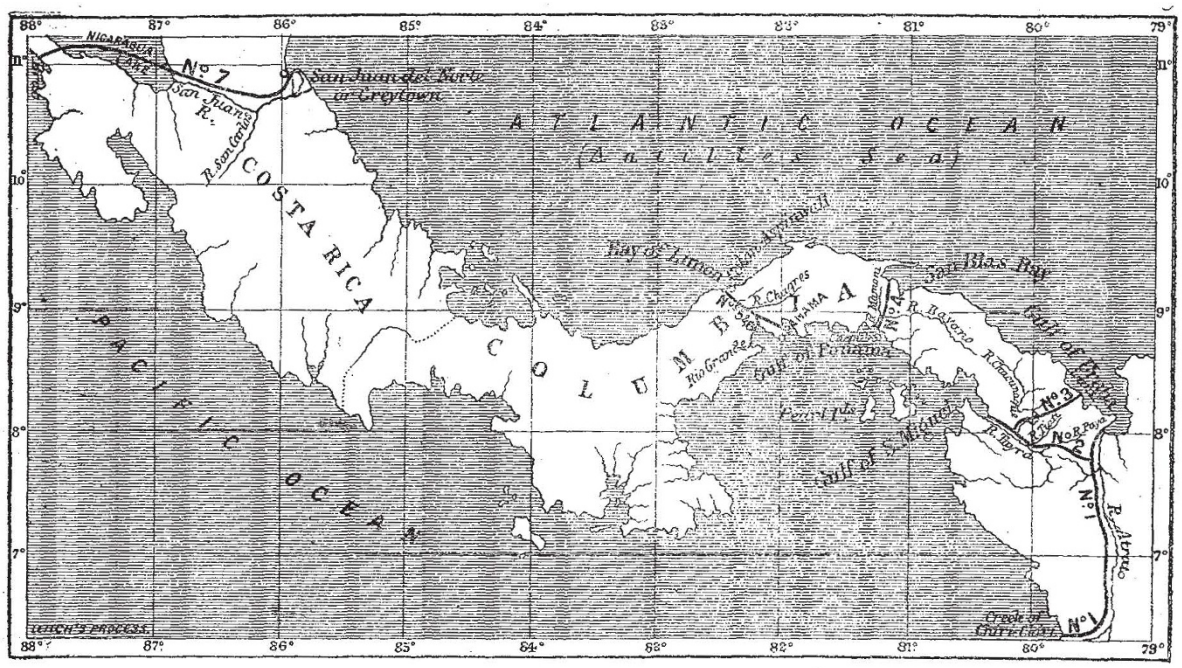
ANNUAIRE POUR L'AN 1879, PUBLIÉ PAR LE BUREAU DES LONGITUDES.—It has not been from want of appreciation of the astronomical contents of this small volume, so ably edited by M. Lœwy, that earlier allusion to it has not been found in this column. It provides information of a kind which is not to be met with in so collective a form elsewhere, and must be a valuable adjunct to the astronomical amateur, who needs reference to a really reliable authority on such details as the maxima and minima of variable stars and the general elements of the solar system, including periodical comets. M. Lœwy presents in one list the positions and limiting magnitudes of the variable stars of which the periods are known, and in a second list similar particulars of a large number of stars known to be variable, but of which the periods have not yet been determined; these lists are followed by an ephemeris of maxima and minima, arranged in order of date, with the minima of the more rapid variables, Algol, λ Tauri, S Cancri, δ Libræ, and U Coronæ. There is also a carefully-prepared list of the elements of the minor planets to No. 191 inclusive, such a catalogue, in fact, as has often been inquired for by those who do not see the *Berliner Astronomisches Jahrbuch*. The general contents of the *Annuaire* are as full and varied as usual, but for the reasons named it has now an especial value for amateurs of astronomy, and its almost nominal price places it within reach of all. M. Janssen makes an important addition in his "Notice sur les Progrès récent de la Physique solaire," which is accompanied by a photograph of a portion of the sun's disc, taken at the observatory at Meudon, June 1, 1878, illustrating the rapid transformations occurring in the photospheric network and granulations within less than an hour.

AN INTER-OCEANIC CANAL

TO-DAY the long-talked-of International Congress on the subject of a canal across the Central American Isthmus meets in Paris under the presidency of M. De Lesseps. This question is a very old one, but the movement which has led up to the present Congress commenced only in 1875, at the instigation of Lieut. Lucien N. B. Wyse, of the French Navy. At the International Congress of Geography of that year the subject of the

piercing of the American isthmus was seriously discussed. Under the presidency of M. De Lesseps an international jury was appointed to decide upon the best track and to give its opinion on the financial and economical possibility of the execution of the scheme. It was resolved to postpone the meeting of the grand jury until after the exploration of the Paya-Caquirri line. In less than a year a society of exploration was constituted, the capital subscribed, the concession of a canal obtained from the Government of Columbia, and towards the end of 1876 an expedition set out from France for the Isthmus of Darien under the command of Lieut. Wyse. From that time till a few months ago, Lieut. Wyse, with the aid of Lieut. Reclus, M. Sosa, and a staff of engineers, surveyors, &c., has been carrying on his explorations in various parts of the isthmus, so that now a vast quantity of data has been collected, and will be brought before the Congress which meets to-day. Whatever decision the Congress may come to on the immediate subject under discussion, the value of these, as well as previous explorations in connection with an inter-oceanic canal, are very great so far as our knowledge of Central America is concerned. They have added much to the scanty information we had on the physical geography, hydrography, fauna and flora of the region explored.

Not to go farther back, the first serious work of the isthmus in recent years, with a view to the construction of a canal, seems to have been undertaken by the French engineer, Napoleon Garella, who in 1843 explored the isthmus of Panama, and proposed a canal with locks and a tunnel from Simon Bay, in the Atlantic, to the Bay of Vaca de Monte, in the Pacific. But it has been the United States which, until the French Expedition, has been most earnest in the task of endeavouring to find a practicable route for such a canal, as, on the face of it, to them, in spite of their trans-continental railway, it would be of immense commercial advantage. It would reduce by more than half the sailing distance between their east and west coasts. Therefore since 1850 numerous expeditions have been sent out by the U.S. Government to



Central American Isthmus. The Longitudes are reckoned from Paris.

explore the isthmus with this view. In this way have surveying expeditions visited Nicaragua (1850), the passages between the Atrato and the Pacific, by the San Juan, the Baudo, and Cupica Bay (1850-51), the isthmus of San Blas, the narrowest part of Central America (1854), Humboldt Bay, and the Atrato, by the Truando Valley (1858-59), the Paya and the Atrato (1865). As none of these had satisfactory results, the United States Government resolved to send out a large and thoroughly equipped expedition, once for all to settle the question. For three years the expedition carried on its work, with excellent results so far as science is concerned. Tehuantepec was explored by Commodore Schufeldt, Nicaragua by Commodores Hatfield and Lull, Panama by Lull, Isthmus of San Blas, that of Darien, between the Sabana and the Bay of Caledonia, and between the Tuyra and the Atrato, by Commander Selfridge, the Atrato-Napipi by Selfridge and Collins. This expedition did not contemplate any other kind of canal than one with locks, and moreover did not examine the whole of the passage of the Paya, an affluent of the Tuyra, examined in part by M. de Lacharme in 1865. This was the state of matters when Lieut. Wyse's expedition entered upon the field, one of his chief objects being to examine thoroughly the passage from the Rio Paya to the Rio Caquirri, an affluent of the Atrato, and to discover if it were not possible to construct a canal on a level throughout, dispensing with locks, and constructing instead one or more tunnels. Lieut. Wyse and his colleague, Lieut. Reclus, point out the many advantages a level canal has over one with sluices, and by one or more of the routes they think such a canal could be constructed, and make light of the construction of a tunnel. The passages explored by Lieut. Wyse's expedition were those between the end of the Gulf of Uraba and the Gulf of San Miguel; from Acanti at the mouth of Uraba Gulf to San Miguel Gulf; from San Blas Bay to Chepillo Roads and the head of the Gulf of Panama; from Simon Bay to Panama Roads; and from Greytown to Brito Creek.

The following is a summary of the various schemes that are to be brought under the consideration of the

Congress, the numbers corresponding with those on the sketch-map which we give. The first six lie within the United States of Columbia, and the last in Nicaragua and Central America.

1. This line is in the state of Cauca, and extends from the head of the Gulf of Uraba on the Atlantic side to the bay of Chiri-Chiri. The total length between the two oceans is 290 kilometres, of which 50 are canal proper, and the rivers utilised would be the Atrato, Napipi, and Doguado. The volume of excavation would amount to 29,000,000 cubic metres, and of embankment 3,000,000. This canal would require twenty-two locks, and a tunnel six kilometres long. There are a good many objections to a canal along this line, which the American Commission placed only in the second class; besides the locks and tunnel, it would be difficult to make a good port at Chiri-Chiri. It would take nine years to make.

2. The second line is in the States of Cauca and Panama, and runs from the head of the Gulf of Uraba to Darien Harbour and the Gulf of San Miguel. It is 235 kilometres long, 128 being canal, the rivers utilised being the Atrato, Caquirri, Puquia, and Cué, or rather the Tibule, Paya, and Tuyra. It would require 22 locks and 1 kilometre of tunnel, or without a tunnel, extremely deep excavation. The material excavated would amount to 60,000,000 or 65,000,000 cubic metres, and the embankments, &c., to 6,000,000. The tertiary formation along this route presents comparatively soft rocks, and there are fine ports at the two extremities. It would take twelve years to make.

3. The third scheme is in the same State as the previous, but the line goes from Acanti at the entrance to the Gulf of Uraba, to the same Pacific terminus as No. 2, utilising the Tolo, Tiati, Tupisa, Chucunaqua, and the Tuyra. Its length would be 125 miles, of which only 74 would be canal. It would require 70,000,000 cubic metres of excavation; there would be no locks, but a tunnelling of 17 kilometres, which is a great objection, combined with the elevation of the point of departure and the difficulty of sinking shafts. It would take twelve years to make.

4. This route lies in the Chepo district of Panama State, going from the Bay of San Blas to opposite Chepillo Island, at the head of Panama Gulf. The length is fifty-three kilometres, forty-two being canal, the rivers utilised being the Nercalegua, Mamoni, and Bayano. The material excavated would amount to only 34,000,000 cubic metres, there would be no lock, but 16 kilometres of tunnel. This last point is, of course, an objection. The length of time would be ten years.

Nos. 5 and 6 are both in the Colon and Panama departments of Panama State, and, as will be seen, are to a considerable extent coincident. The former is 72 kilometres long, all canal, the River Chagres being made use of. The amount of excavation would be 57,000,000 cubic metres, and of embankment 5,000,000; there would be 25 sluices and no tunnel, and it would take six years to make. No. 6, again, would have no sluices, but tunnelling 6 kilometres long, with 47,000,000 cubic metres of excavation. It would be 75 kilometres long, and the rivers Chagres and Rio Grande would be utilised. Each would take about six years to make, and would cost about the same sum. They are near the Panama Railway, pass through a well-peopled region, and there is no difficulty as to ports. Lieut. Wyse's commission, however, advocate warmly No. 6 scheme, as being preferable to any other. The time wasted in passing locks, the difficulty and expense of maintaining them, and other considerations, induce them to advise that all idea of a canal with locks should be abandoned; and of all possible level canals with tunnels, that numbered 6 seems to this commission altogether the one presenting the most favourable conditions.

The scheme numbered 7 is in the state of Nicaragua and Costa Rica, and passes from Greytown on the Atlantic side, to the Bay of Brito on the Pacific. This line would be 292 kilometres long, 195 being canal, the San Juan, Lake Nicaragua, and the Rio Grande being utilised along the route. The excavations would amount to 48,000,000 cubic metres, and embankments, &c., to 5,500,000, and there would be twenty-one locks and no tunnel. There are too many objections to this line to attract the favourable consideration of the Congress. There are, *e.g.*, the complete absence of ports, difficulty of constructing and maintaining them, insalubrity of nearly the whole of the Atlantic slope, length of the canal, and the political instability of the countries concerned. It would take ten years to make.

As to the cost of the various schemes, we may say that it varies from 475,000,000 to 650,000,000 francs, with a yearly sum for maintenance of from 4,000,000 to 15,000,000.

Some statistics as to the dimensions proposed to be adopted for the basin of the canal may be of interest. The breadth of the canal will be about 20 metres at the bottom, 26 metres at 3 metres high, and according to the nature of the ground, from 32 metres as a minimum at the surface in deep cuttings to 50 metres, when steep banks require 2 in 1 of fall. The increase in breadth which is proposed at 3 metres above the bottom is intended to give more play to ships of large bulk and to increase the water-section, which would thus never be less than 224 square metres. The depth of the canal would be 8½ metres. The curves proposed, with a minimum radius of 3,000 metres, are less pronounced than those in the Suez Canal. The crossing stations will have a breadth of 40 metres at the bottom on a length of 500 metres. The tunnelling will also have a depth of water of 8½ metres, a breadth of 20 metres at bottom, but only 24 at the surface. The smallest water-section will thus be 187 square metres. Above the mean level, on each side, there will be a straight space of 4 metres, then an arch of 30° in a radius of 63 metres; the summit will be semicircular, with a radius of only 2 metres. To satisfy all contingencies the height of the vault above the level of the water will reach 34 metres, which will allow the largest vessels to pass by a little adjustment of their most prominent masts and yards. The entire subterranean section will be 780 square metres, of which 563 will be above water. It is expected that throughout, very little embanking will be necessary.

Thus, so far as the International Commission is concerned, the information to be laid before the conference is full and exact. So far as we have studied the question there seems no serious physical or engineering difficulty in cutting a canal through the American isthmus between the Atlantic and Pacific; probably the great difficulty will be a monetary one, and even this need not, we suppose, be insuperable, if all other difficulties are removed.

ON THE EVOLUTION OF THE VERTEBRATA[1]

II.

AMPHIBIA (*continued*).—When the history of the development of these forms has been thoroughly made out, the terminology can be put into something like proper form. This will have to be done cautiously, for that which we see as one bone in the larva represents, and may become, two or three bones in the adult, and these may represent bones that start as distinct centres in the higher forms.

In the Urodeles there is one bone (the *pterygo-palatine*) in the larva which plays many parts during metamorphosis, and a different part in different species. At first it is related to no cartilage at all, only arising as a cement to a patch of palatine teeth, but after a time the ethmo-

[1] Abstract of Prof. Parker's Hunterian Lectures, delivered at the College of Surgeons, commencing on February 10. Continued from p. 32.