the sieve is shoved under it, and the contents of the former are released. In case no washing is necessary, the specimens are rapidly transferred to their proper receptacles; but if, as usually happens, the load consists mainly of mud or sand, a stream of water from a hose is turned upon it, and it is thoroughly washed down. A nest of three or four small circular sieves, each having a different mesh, is generally employed for washing the contents of the dredges.

To describe the various appliances of research belonging to the outfit of the Albatross would carry us beyond the proper limits of this article: suffice it to say, that every method of obtaining results known to the fishermen and marine zoölogist will be tried. The scientific apparatus is mainly such as has already been thoroughly tested by American expeditions, and much of it has been described in published reports. There are many additional features, however, which have been lately added. The fisherman's outfit is complete, and comprises all kinds of seines and gill-nets, line-trawls, and hooks and line. The principal appliances for deep-sea research will be the dredges and beam-trawls, both in their original and modified forms; and, in connection with the latter, two large towing-nets will always be used. They are fastened, one at either side of the trawl, in the shape of wings, which name they now bear in the dredger's vocabulary. They were introduced as an experiment two years ago by the fish-commission; and, proving an invaluable adjunct to the trawl, they soon became a permanent fixture. The simple open towing-nets are to skim the surface of the sea at all times, when the speed of the vessel will permit; and occasional trials will be made with the Sigsbee trap for ascertaining the amount of animal life within any prescribed area below the surface.

The chemical department has not yet been completely furnished, but all the more important apparatus for making the principal tests, and glassware for saving water-samples, have been supplied. The photographic section has, however, been placed in perfect running-order, and affords the means of illustrating all sorts of objects, whether large or microscopic. It also contains improved appliances for registering the intensity of light at different depths.

Among the small boats with which the Albatross is liberally provided are two steam launches of the Herreschoff pattern for use in setting and hauling nets, and in spearing porpoises and large fish which cannot be reached from the high deck of the steamer.

From the above brief account, it may be rightly assumed that this new addition to our coast-marine is the most perfect floating workshop and laboratory for scientific purposes ever constructed. Its first cruise, during which it encountered severe winds, gave proof of its superior sailing qualities; and, judging of its outfit from past experiences, we are justified in predicting for it a long life of usefulness to science and the fishing interests. RICHARD RATHBUN.

SUN-SPOT OBSERVATIONS.

THE U. S. signal-service has published month by month since June, 1877, observations of sun-spots, made by Prof. D. P. Todd (now of Amherst college) with a telescope less than three inches aperture.

As a maximum of solar spottedness seems to have passed, it has been thought wise to collate these observations in the accompanying table, and present them for comparison and study.

In this table the Roman figures are the actual observed values, and interpolated values in Italic type are added for the sake of completeness.

The observations for August, 1878, were made by the Signal-service at Fort Whipple, Va. The mean monthly results combine both actual and interpolated values, and show that the last minimum epoch was at 1878.9, and the last maximum was at 1882.4.

Professor Fritz of Zurich gives the following table of maxima and minima of sun-spots for the present century to 1878. These agree in the main with the results of other researches.

Epochs of maximum and minimum sun-spots of the nineteenth century.

Maximum.	Period.	Minimum.	Period.
1804.2		1810.6	
	12.2		12.7
1816.4		1823.3	
	13.5		10.6
1829.9		1833.9	
	7.3		9.6
1837.2		1843.5	
	10.9		12.5
1848.1		1856.0	
	12.0		11.2
1860.1		1867.2	
	10.5		11.7
1870.6		1878.9	
	11.8		
1882.4			
Mean	11.2	Mean	11.4

Taking the mean of each twelve months, we have mean yearly numbers, in 1878, 2.2; 1879, 2.0; 1880, 14.3; 1881, 26.7; and, in 1882, 28.3. The last two agree with the observations of Tacchini in Rome.

Prof. D. P. Todd's sun-spot observations.

Day of month.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Mean daily observation.	No. of days.
1877.																																	
June	0	0	0	0	0	1	1	2	4	7	13	5	0	0	0	0	0	0	0	0	0	0	2	2	5	6	0	0	2	2		1.7	13
July	4	3	3	3	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	1	2	3	5	.9	20
August	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	4	8	8	8	7	6	2	2	1	1.8	19
September	0	0	0	0	1	2	4	6	9	10	7	6	4	6	5	5	12	14	18	10	6	10	5	0	3	3	2	1	1	2		5.1	19
October	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	7	10	12	30	2.1	16
November	30	25	20	12	8	2	0	0	0	0	0	0	6	14	11	8	5	0	0	0	0	0	0	0	0	1	3	6	9	9		5.6	12
December	9	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3	3	2	0	0	0	1	2	3	4	1.2	15
1878.																																	
January	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	6	6	12	12	10	5	2	0	0	0	2.0	20
February	3	9	14	26	30	35	25	18	10	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				6.4	14
March	0	4	8	6	5	6	7	9	5	8	10	12	14	16	20	24	16	2	0	1	2	1	1	1	0	0	0	0	0	0	0	5.7	18
April	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		.7	19
May	1	2	0	0	0	0	0	0	1	2	1	1	0	0	0	1	1	0	0	1	1	0	1	2	3	7	13	18	18	20	22	3.7	11
June	24	26	28	12	5	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	2	0	8	8	6	4	2		4.4	15
July	1	0	0	0	0	0	0	0	1	2	3	2	1	0	0	0	0	0	0	0	0	1	2	1	0	0	0	0	0	0	0	.5	5
August	0	0	0	0	0	0	0	0	5	10	8	6	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.1	12
September	0	0	0	0	0	1	0	1	1	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		.2	13
October	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0		1	0	1	1	3	1	1	.4	19
November	1	2	2	1	1	1	1	1	0	0	0	0	0	0	0	0	1	0	1	2	1	0	0	0	0	0	1	0	0	0		.5	17
December	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	1	.3	10
1879.																																	
January	1	2	1	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	.3	13
February	0	0	0	0	0	1	0	0	0	0	0	1	0	2	2	1	0	0	0	0	0	0	1	0	0	0	0	0				.3	13
March	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	2	0	0	0	0	0	0	0	0	.2	17
April	0	0	0	0	0	1	0	0	0	2	3	3	4	8	14	10	8	6	4	2	1	1	1	0	0	0	0	0	0	0		2.3	17
May	0	0	0	0	0	1	3	4	4	3	2	0	0	2	4	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	1.1	20
June	0	0	2	5	8	4	0	0	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	5	4	8	9	10		2.1	20
July	4	4	3	2	1	0	0	0	0	5	4	4	3	1	2	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1.1	19
August	0	0	0	0	0	0	0	0	2	4	8	14	8	2	1	0	0	0	0	1	0	0	7	12	10	8	11	10	7	3	3	3.6	19
September	3	2	1	1	1	1	0	0	0	0	0	0	0	1	0	3	0	0	0	0	0	0	0	1	1	1	2	2	2	2		.8	24
October	1	9	1	3	0	0	4	10	16	13	15	17	14	7	3	0	5	10	17	11	6	2	0	0	0	0	0	0	0	0	0	5.3	22
November	0	0	1	1	0	10	25	20	11	11	14	16	18	4	3	3	3	2	1	1	0	0	0	0	0	0	3	4	6	3		5.3	21
December	3	3	3	2	1	0	0	0	3	2	0	0	0	0	0	2	2	4	3	0	0	0	1	2	3	1	0	0	0	0	0	1.1	15
1880.																																	
January	2	5	15	24	22	15	16	16	20	24	22	20	26	30	20	18	12	10	7	5	2	1	0	0	0	3	4	4	0	3	9	11.5	17
February	14	14	11	11	11	11	11	18	18	13	8	6	4	0	0	0	0	1	2	3	3	6	6	3	6	1	1	1	2			6.4	19
March	3	5	3	1	1	2	2	0	1	4	3	1	0	0	0	1	2	2	1	1	0	0	0	0	0	2	3	4	5	8	9	2.1	18
April	10	12	20	26	16	10	3	3	5	10	10	10	10	13	13	8	3	3	3	4	6	6	0	0	4	8	18	25	12	2		9.1	23
May	20	20	20	17	12	10	14	13	12	8	8	4	2	1	1	0	0	0	0	7	2	3	4	8	20	22	25	26	28	29	27	11.7	18

Prof. D. P. Todd's sun-spot observations. — *Concluded.*

Day of month.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Mean daily observation.	No. of days.
1880.																																	
June	12	8	7	6	4	2	3	7	3	4	5	2	0	1	4	7	10	17	23	23	22	34	30	31	30	33	32	35	28	20		14.8	13
July	16	12	13	16	20	28	36	30	10	2	0	0	0	0	0	0	0	4	5	8	12	15	20	20	22	24	18	12	12	6	6	11.8	17
August	5	3	1	10	12	16	23	25	32	24	26	30	36	40	40	50	52	45	42	40	30	25	10	5	3	6	10	18	20	20	15	23.0	18
September	12	7	3	4	11	20	30	40	55	75	85	80	75	63	48	28	15	20	25	22	20	10	8	14	17	22	32	40	50	70		33.4	20
October	55	58	60	20	18	12	12	12	12	22	24	14	13	12	12	10	12	16	25	25	25	20	24	25	24	22	20	18	16	14	10	21.4	16
November	22	25	24	20	16	10	3	3	5	2	0	3	8	12	15	17	20	25	35	28	20	12	12	10	14	18	22	25	22	20		15.6	15
December	15	15	10	14	20	22	25	20	15	15	10	10	8	2	0	4	9	12	12	14	5	4	14	13	10	8	6	4	3	6	10	10.8	18
1881.																																	
January	10	11	12	13	14	12	11	10	8	6	4	3	2	4	6	10	15	20	18	16	10	3	8	20	28	35	50	55	56	55	50	18.5	13
February	45	35	25	25	25	40	40	35	25	15	15	10	10	12	17	20	25	20	13	22	18	16	12	11	10	8	4	3				19.9	19
March	6	8	5	1	1	3	4	12	22	35	45	47	50	85	85	85	80	70	55	40	45	60	60	40	15	9	2	3	4	5	7	31.9	21
April	8	10	20	20	20	18	14	12	10	8	7	11	15	20	40	47	55	65	75	90	115	100	85	60	58	55	35	10	7	5		36.5	16
May	6	8	12	14	15	14	13	18	18	18	17	20	22	13	8	8	6	4	2	1	4	9	16	26	30	37	44	56	48	60	65	20.4	22
June	60	55	50	45	35	20	9	15	22	30	40	45	47	48	50	40	33	25	15	12	10	5	10	17	25	40	50	57	65	60		34.5	14
July	45	40	35	25	35	25	27	30	35	35	30	25	22	20	19	20	15	13	15	15	15	20	25	40	65	60	62	65	65	62	60	34.4	24
August	50	40	35	25	19	25	25	26	20	20	15	10	8	3	0	0	8	4	8	5	6	10	35	50	60	70	80	110	120	120	110	36.0	22
September	100	85	70	55	40	30	25	20	20	15	20	25	30	30	25	20	25	25	20	15	12	10	8	5	3	4	7	9	9	9		25.7	16
October	9	20	35	30	20	25	25	20	20	20	18	17	16	15	14	12	13	14	15	25	45	40	40	35	30	25	18	16	14	12	10	21.5	16
November	8	6	4	2	2	3	6	9	15	20	20	20	18	20	20	35	35	34	35	35	36	35	33	30	22	21	20	18	15	17		19.8	12
December	25	30	32	34	35	30	28	25	30	35	30	35	30	27	26	25	20	17	12	10	9	8	6	12	9	9	10	12	12	12	15	21.0	16
1882.																																	
January	15	15	15	17	20	17	15	15	15	12	14	16	18	20	20	16	12	18	20	18	15	12	12	11	14	17	20	22	25	20	19	16.6	18
February	18	15	20	25	30	35	37	35	42	50	60	55	57	60	60	55	45	30	25	20	15	20	25	20	20	10	10	5				32.1	19
March	10	20	25	25	30	35	30	30	25	22	20	20	20	23	24	24	25	20	35	35	32	30	30	30	30	25	20	15	20	35	30	25.6	17
April	30	40	40	40	41	43	45	45	45	50	57	65	55	60	70	85	125	160	140	125	110	95	60	20	14	12	11	12	9	8		57.1	16
May	12	20	20	18	20	25	33	44	55	55	60	65	70	75	80	85	90	90	90	90	62	35	20	10	6	3	3	4	5	4	6	40.5	19
June	2	7	8	7	6	6	5	11	19	25	27	28	35	37	40	50	52	55	55	50	45	40	35	25	30	35	35	35	35	40		29.3	22
July	38	35	40	32	25	12	5	0	0	15	30	25	30	40	45	40	35	35	35	35	37	40	32	25	25	20	25	30	15	20	25	27.0	23
August	25	21	17	12	10	5	3	7	10	10	10	10	8	7	2	2	10	20	35	35	40	35	30	30	20	17	15	20	10	10		16.0	23
September	17	25	35	45	45	40	35	20	20	20	16	12	16	20	25	27	31	35	35	35	31	28	25	25	24	20	21	25	30	30		27.1	18
October	45	45	50	40	40	30	5	2	0	2	5	7	9	12	17	26	35	45	47	50	50	47	41	38	35	25	20	19	18	20	25	27.4	21
November	35	35	35	30	25	20	25	30	25	25	27	30	25	24	20	15	17	21	25	30	35	40	35	30	27	25	35	35	35	25		28.0	17
December	10	10	0	5	6	8	8	8	15	17	19	20	19	15	10	30	28	25	20	15	10	14	8	6	4	2	4	10	15	12	10	12.4	14
1883.																																	
January	8	6	2	4	6	7	8	7	5	6	6	12	16	20	30	28	27	25	23	20	18	20	15	10	8	8	7	4	2	6	14	12.2	11
February	20	20	20	17	15	22	30	25	25	25	31	45	55	45	35	25	20	20	15	10	6	3	0	2	3	4	7	7				19.7	20
March	6	5	3	2	0	2	4	6	10	15	10	6	4	8	12	17	20	20	20	15	20	25	30	30	25	30	27	25	24	22	21	15.0	17
April	20	22	25	30	35	32	30	30	25	20	25	35	40	60	67	70	67	65	65	55	55	45	40	30	20	20	15	12	10	8		35.8	21
May	10	7	10	9	8	7	9	9	11	14	12	9	7	12	11	10	11	11	12	11	10	8	4	2	0	0	0	0	1	1	4	7.4	23

Plotting the monthly numbers, it will be seen that there are plain indications that the maximum has passed, though it is thought by some that it is still to come. H. A. H.

FIFTEENTH ANNUAL CONVENTION OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS. — I.

THE members of the society began to assemble in Chicago as early as Thursday, June 14, to visit the exposition of railway appliances, and to take part in the excursions planned for their benefit by the Engineers' club of the north-west.

By Monday morning, June 18, the number of those intending to take the special train for St. Paul, generously tendered by the officers of the Chicago, Milwaukee, and St. Paul railway, had swelled to three hundred. The train of eight cars, well filled, left Chicago at 7.30 A.M., arriving at St. Paul at 10 P.M. But few stops were made on the way, the principal one being at the crossing of the Wisconsin River, for the object of inspecting the railway bridge, and taking a better view of the fine scenery at that point. Quite an accession to the party came on board at Milwaukee.

Upon reaching St. Paul, an engine of the St. Paul, Minneapolis, and Manitoba railroad was attached; and the train was drawn over that line, through Minneapolis, to Lake Minnetonka, — a beautiful sheet of water some thirty miles long, where, at Hotel Lafayette, thirty-three miles from St. Paul, the members of the society and their invited guests were to be quartered during the convention.

The two cities of Minneapolis and St. Paul, only a few miles apart, and each containing over eighty thousand inhabitants, were rivals for the opportunity of entertaining the society; and to prevent any ill-feeling, as well as to avoid crowding any of the city hotels, already taxed to accommodate their own patrons, this summer hotel, just opened for the season, only built one year, newly enlarged and furnished, and capable of providing for the comfort of five hundred or six hundred guests, was chosen for headquarters. With the exception that some valuable time was lost in going to and returning from the place of holding the daily sessions, this selection is to be commended; for the location was extremely pleasant, and the air fresh and cool. Those who did not desire to go to the meetings each day could find rest and enjoyment at this agreeable summer resort. A special train was at the service of the convention each day throughout the entire week. A large accession to the number of members present was made as the week progressed, so that the attendance was larger than at any previous convention.

On Tuesday morning the engineers took the special train for St. Paul, and thence went to the state capitol, where the first meeting was called to order in Representatives' hall. After formal announcements of programme and arrangements, the usual addresses of welcome were made.

The first paper read was by the late Major F. U. Farquhar, U.S. eng., on the building of the dike for the preservation of the Falls of St. Anthony.

The falls, which furnish the water-power for the mills of Minneapolis, were first described. A stratum of upper magnesian limestone, eleven feet thick at the lower edge, is underlaid by an extremely soft sandrock, which is rapidly worn away; and the limestone is thus undermined and broken off. The recession of the falls was rapid; and, as the limestone outcrops with a thin edge twelve hundred feet above the present brink of the falls, their final reduction to rapids would occur, if not prevented. Citizens dug a tunnel for a tail-race in the sandrock, and the river broke in at the upper end. The immediate destruction of the falls was imminent; and attempts to check the rush of water, which rapidly enlarged the tunnel and repeatedly broke through in different places, proved ineffectual. The citizens, after building cofferdams at various weak points, discouraged by failures at times of high water, obtained an appropriation from the U. S. government, on the ground that the wearing-away of the falls would injure navigation above. A plan was finally proposed by Major Farquhar, of excavating a tunnel across the entire river, through the sandrock, from the limestone overhead to the sound rock below, some forty feet, and filling it solidly with concrete. This work was carried out under his direction, and was fully explained in the paper, and illustrated by drawings. The dike is eighteen hundred and seventy-five feet long, and has successfully shut off the water which worked its way through the soft sandstone. The detailed statement and cost can be found in the Report of chief of engineers, U.S.A., for 1879. The action of the water has been injudiciously concentrated upon a limited space of some three hundred feet by the erection of wing-dams by the mill-owners.

In the discussion on this paper at the time of its reading, and in remarks made the next morning by the engineer officer now in charge